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UMUMIY KIMYO

*Umumiy kimyo
*Anorganik kimyo
*Organik kimyo
*Ma'lumotnomalar

O‘ZBEKISTON RESPUBLIKASI OLIY VA O‘RTA MAXSUS TA‘LIM VAZIRLIGI
SAMARQAND DAVLAT UNIVERSITETI
TABIIY FANLAR FAKULTETI KIMYO BO‘LIMI

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Umumiy kimyo

(*Qayta ishlangan 4 nashr*)

Samarqand davlat universiteti
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Umumiy kimyo (Uslubiy qo‘llanma)

Ushbu qo‘llanmada umumiy, anorganik va organik kimyo kursi qisqacha yoritishga harakat qilingan. Mavzularni yoritishda iloji boricha ixchamqor ko‘rinishga keltirishgan. Shuningdek, mavzular so‘ngida ilovalar berilib, kimyodan test topshiriqlarini yechishda foydali deb hisoblangan ma’lumotlar berilgan.

Qo‘llanmadan kimyo yo‘nalishi talabalari, litsey va kollejlarning o‘qituvchi va talabalari, kimyo fanidan kirish imtihonlarini topshiruvchi abituriyentlar va kimyoga qiziquvchilar foydalanishlari mumkin.

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KIRISH

“Kadrlar tayyorlash milliy dasturi” tizimida ta’limda uzluksizlikni ta’minlash bo‘g‘ini yoshlarni qiziqishi va iqtidorini e’tiborga olib, kasbga yo‘naltirish hisoblanadi. Shundan kelib chiqib tabiiy va tibbiyot yo‘nalishida Akademik litseylar o‘quvchilari uchun ko‘plab qo‘llanma va darsliklar chop etilgan. Ularda asosan oliy oq’uv yurtlariga kirish uchun nazariy ma’lumotlar va amaliy mashg‘ulotlar berilgan.

Qo‘lingizdagi qo‘llanma esa Akademik litseylarning tabiiy yo‘nalishi 3 yillik o‘quv rejasi asosida tuzilgan bo‘lib, unda umumiy, anorganik va organik kimyodan nazariy ma’lumotlar, masalalarning yechimlari keltirilgan. Uni tayyorlashda mavzuni yoritish uchun iloji boricha qisqa va to‘liqroq ma’lumot berishga harakat qilindi.

Hozirda kirish imtihonlarida test topshiriqlarini yechish usullari bo‘yicha juda ko‘p qo‘llanmalar mavjudligiga qaramasdan, ularning ko‘pchiligida masalalar yechish turli xil proportsiyalar tuzishga asoslanadi. Bu esa o‘quvchida bir tomonlama, ya’ni faqat masalani yechimini topishdan boshqa maqsad qoldirmasligiga olib kelishi mumkin. Shuning uchun biz qo‘llanmada iloji boricha test topshiriqlarini yechishda kimyoviy formulalardan foydalanishga, kattaliklarni to‘g‘ri keltirishga harakat qildik. Qo‘llanmada barcha kattaliklar Xalqaro birliklar sistemasi (SI) va belgilashlariga mos tushadi.

Shuningdek, qo‘llanmaning dastlabki nashridan farqli ravishda ushbu nashrda organik kimyo bo‘yicha Akademik litsey va kasb-hunar kollejlari uchun tasdiqlangan darsliklardagi reaksiyalar ham kiritildi.

Ushbu qo‘llanmani Kimyodan mavzulashtirilgan testlar to‘plami bilan birgalikda foydalanish maqsadga muvofiq. Chunki unda mustaqil yechish uchun masalalar keltirilmagan.

Qo‘llanmadan oliy o‘quv yurti talabalari, Akademik litsey o‘quvchilari, kirish imtihonlariga tayyorlanuvchi abituriyentlar va repetitorlar foydalanishlari mumkin.

Qo‘lanmani ko‘rib chiqib o‘z fikrlarini bildirganligi uchun mualliflar kimyo fanlari nomzodi, dotsent Lutfullayev E.L., SamQXI qoshidagi 1 son Akademik litseyi kimyo fani o‘qituvchisi G‘ofurov A. larga chuqur minnatdorlik bildiradi.

Mualliflar ushbu qo‘llanma bo‘yicha barcha fikr va mulohazlarni quyidagi manzilda mamnuniyat bilan qabul qiladi. Samarqand shahri, 140104, Universitet xiyoboni ko‘chasi 15, Samarqand davlat universiteti, Kimyo bo‘limi.

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1-Qism

UMUMIY KIMYO

* Nazariy ma'lumot

*Testlarning yechimlari

*Ma'lumotlar

I BOB. ASOSIY KIMYOVIY TUSHUNCHA VA QONUNLAR

Mavzu: Atom-molekulyar ta'limot

Ta'rif: *Kimyo moddalar, ularning tarkibi, xossalari, tuzilishi va ularda bo'ladigan o'zgarishlar haqidagi fan.*

Kimyoviy toza modda ayni sharoitda o'zgarmas fizik xossalarga ega bo'ladi.

Ta'rif: *Jism nimadan tashkil topgan bo'lsa, modda deyiladi.*

Modda haqidagi dastlabki ilmiy ta'limotni 1741 yil M.V Lomonosov yaratdi va u "atom molekulyar ta'limot" deb ataladi.

Uning asosiy hollari quyidagilar:

1. Barcha moddalar molekulalardan tuzilgan.
2. Molekulalar atomlardan tuzilgan.
3. Molekula va atomlar to'xtovsiz harakatda bo'ladi.
4. Oddiy moddalar bir xil element atomlaridan, murakkab moddalar turli xil element atomlaridan tuzilgan.

Lomonosovdan farq qilib ingliz olimi J.Dalton atomistik nazariyani yaratdi. Lekin u murakkab moddalar molekulalardan, oddiy moddalar faqat atomlardan tuzilgan deyiladi: (1803)

Oddiy moddalar: Fe, Al, Cl_2, S_8, P_4

Murakkab moddalar: H_2O, KCl, $Al_2(SO_4)_3$

7 ta oddiy modda molekulyar ko'rinishda yozilishi lozim: H_2, N_2, O_2, F_2, Cl_2, Br_2, J_2.

Lekin, Dalton 4 ta elementning nisbiy atom massasini vodorod massasiga nisbatan aniqlaydi.

Oddiy modda va element orasida farq mavjud. Atomar holda tuzilgan moddalarda ikkisi ham bir xil ma'noga ega bo'lsa, molekulyar tuzilishli moddalarda farq qiladi. Masalan: havoda kislorod mavjud (oddiy modda) va sulfat kislotada kislorod mavjud (element).

Mavzu: Nisbiy atom va nisbiy molekulyar massa. Absolyut massa

Atomlarning o'lchamlari va massalari juda kichik bo'lganligi uchun ular bilan olib boriladigan hisoblashlarni yengillashtirish uchun ularning nisbiy massasidan foydalaniladi.

1961 yil IUPAC bo'yicha uglerod shkalasi qabul qilingan .

Ta'rif: *Element atomining uglerod ^{12}C atomi massasining 1/12 qismiga nisbatan olingan massasiga nisbiy atom massa deyiladi va A_r bilan belgilanadi.*

A_r (H) =1,008 m.a.b

A_r (Cl) =35,5 m.a.b

Ta'rif: *Atom – oddiy va murakkab moddalar tarkibiga kiruvchi, elementning kimyoviy xossasini saqlovchi bo'linmaydigan eng kichik zarracha hisoblanadi.*

Ta'rif: *Molekula- ayni moddaning kimyoviy xossalarini o'zida saqlovchi eng kichik zarrachadir.*

Ta'rif: *Yadro zaryadi bir xil bo'lgan atomlar turiga element deyiladi.*

Ta'rif: *Modda molekulasi massasining uglerod ^{12}C atomi massasining 1/12 qismiga nisbatan olingan massasiga nisbiy molekulyar massa deyiladi va M_r harfi bilan belgilanadi.*

$M_r(O_2)=2\cdot Ar(O)=32$ m. a. b

$M_r(H_2SO_4)=2\cdot Ar(H)+Ar(S)+4Ar(O)=98$ m.a.b

Atom va molekulaning haqiqiy (absolyut) massasi g yoki kg da o'lchanadi.

$m_a(atom)=A_r\cdot 1{,}66\cdot 10^{-24}g=A_r\cdot 1{,}66\cdot 10^{-27}kg$

$m_a(molekula)=M_r\cdot 1{,}66\cdot 10^{-24}g=M_r\cdot 1{,}66\cdot 10^{-27}kg$

Masalan,

$m_a(Cu)=64\cdot 1{,}66\cdot 10^{-24}g=106{,}24\cdot 10^{-24}g=1{,}06\cdot 10^{-22}g$

$m_a(H_2SO_4)=98\cdot 1{,}66\cdot 10^{-24}g=162{,}68\cdot 10^{-24}g=1{,}63\cdot 10^{-22}g$

Agar atom yoki molekulaning absolyut massasi berilgan bo‘lsa, uning nisbiy massasi quyidagicha topiladi:

$$A_r = \frac{m_a(atom)}{1{,}66\cdot10^{-24}} \quad M_r = \frac{m_a(atom)}{1{,}66\cdot10^{-24}}$$

$1{,}66\cdot10^{-24}$g=$1{,}66\cdot10^{-27}$kg uglerod birligi deyiladi.

Mavzu: Kimyoda qo‘laniladigan asosiy birliklar

Ma’nosi	Belgisi	Birligi
Massa	m	[g;kg,mg,t]
Hajm	V	[m^3;l;ml=sm^3]
Zichlik	ρ	[g/ml=g/sm^3;kg/m^3]
Vaqt	τ	[s; soat; daqiqa]
Uzunlik	l	[m; dm; cm; mm; μm; nm; Å]

1kg=1000g=10^3g 1g=0,001kg=10^{-3}kg 1t=1000kg=10^3kg

1m^3=1000 l=10^3 l 1 l=0,001m^3=$10^{-3}$$m^3$ 1 l=1000ml=10^3ml

ml=sm^3 dm^3=l

1m=10dm=100cm=1000mm=10^6μm=10^9nm=10^{10}Å

1μm=10^{-6}m 1nm=10^{-9}m 1Å=10^{-10}m

Mavzu: Mol. Molyar massa.

Ta’rif: *Modda atomi yoki molekulasi massasining grammlarda ifodalanishiga molyar massa deyiladi va M bilan belgilanadi.*

M [g/mol]

M(Fe)=56g/mol M(H_2O)=18g/mol M(H_2SO_4)=98g/mol

Ta’rif: *Mol-12g ^{12}C izotopida qancha struktura birlik (atom, molekula, ion) tutsa, moddaning shuncha miqdoriga aytiladi va n bilan belgilanadi.*

$$n = \frac{m}{M} \quad [mol]$$

Har qanday moddaning 1 molida mavjud struktura birliklar soni o‘zgarmas va $6{,}02\cdot10^{23}$ ga teng. Unga Avogadro soni deyiladi va N_A bilan belgilanadi.

$N_A=6{,}02\cdot10^{23}$ mol^{-1}

Masalan, 1 mol Al da $6{,}02\cdot10^{23}$ ta Al atomi;

1 mol H_2O da $6{,}02\cdot10^{23}$ ta suv molekulasi;

1 mol NaCl da $6{,}02\cdot10^{23}$ ta Na^+ va $6{,}02\cdot10^{23}$ ta Cl^- ionlari bo‘ladi.

Agar zarracha soni berilsa, modda miqdori quyidagicha hisoblanadi:

$$n = \frac{N}{N_A}$$

Murakkab moddadagi atom soni quyidagicha hisoblanadi:

N(atom)=n·element soni·N_A

Eski adabiyotlarda mol atamasi o‘rniga gramm-atom yoki gramm-molekula so‘zi ishlatilgan.

Masalan, 1 g-atom O 16g kelsa

1 g-molekula O_2 32g keladi.

M1. 9g suvning miqdorini toping.

m(H_2O)=8g

n-? $n = \frac{m}{M} = \frac{9}{18} = 0{,}5mol$

M2. 3,5mol CO_2 necha gramm keladi?

n(CO_2)=3,5mol

m-? m=n·M=3,5·44=154g

M3. 49g sulfat kislotadagi kisorod atomlari sonini toping.

m(H_2SO_4)=49g

N(O)-? $n = \frac{49}{98} = 0{,}5mol$

N(O)=n·lement soni·N_A=0,5·4·6,02·10^{23}=12,04·10^{23}

M4. 2mol suvdagi kislorodga teng bo‘lgan kislorod tutgan sulfat kislota massasi nechaga teng?

98g H_2SO_4da 4mol O

x 2mol O *x*=49g

Mavzu: Kimyoning asosiy qonunlari

Asosiy stexiometrik qonunlar quyidagilar:

1. Modda massasining saqlanish qonuni (1748 y Lomonosov).
2. Tarkibning doimiylik qonuni (1809 y J.Lui Prust).
3. Karrali nisbatlar qonuni (1804 y J.Dalton).
4. Hajmiy nisbatlar qonuni (1808 y Gey-Lyussak).
5. Ekvivalentlar qonuni (1814 y Vollaston).

Modda massasining saqlanish qonuni.

Ta’rif: *Kimyoviy reaksiyaga kirishadigan moddalar massasi reaksiya natijasida hosil bo‘ladigan moddalar massasiga teng. Ya’ni dastlabki moddalar massasi reaksiya mahsulotlari massasiga teng.*

$2H_2+O_2=2H_2O$

4 + 32 36

Bu qonunni 1748 yil Lomonosov, 1785 yil Lavuaze ochgan.

Tarkibning doimiylik qonuni.

Ta’rif: *Har qanday kimyoviy toza modda olinishi usulidan va joyidan qat’iy nazar bir xil o‘zgarmas sifat va miqdor tarkibga ega bo‘ladi.*

Bu qonunga 1803 yil Bertolle qarshi chiqadi. O‘z navbatida Prust Bertollening xulosalariga qarshi chiqadi. Bertollening farazlarini N.S.Kurnakov rivojlantiradi va moddalarni o‘zgarmas va o‘zgaruvchan tarkibli birikmalarga bo‘lishni taklif qiladi.

Tarkibning doimiylik qonuniga faqat gazsimon va suyuq molekulyar tuzilishli moddalar bo‘ysunadi va Daltonidlar deyiladi. Daltonidlar qattiq moddalarning 5% tashkil qiladi. Masalan, CO_2, N_2O_5, H_2SO_4, SO_3.

Atom tuzilishli qattiq kristall moddalar bu qonunga bo‘ysunmaydi va ular Bertolidlar deyiladi. Ular barcha qattiq moddalarning 95% ni tashkil qiladi. Bertolidlarga o‘tish metallarining oksidlari, sulfidlari, fosfidlari va nitridlari kiradi. Masalan, TiO da $Ti_{1,2}O$ dan $TiO_{1,2}$, Fe O da $Fe_{0,89}O$ dan $Fe_{0,98}O$ gacha bo‘lishi mumkin.

Karrali nisbatlar qonuni.

Ta’rif: *Agar ikki element o‘zaro birikib bir necha kimyoviy birikma hosil qilsa, elementlardan birining shu birikmalardagi ikkinchi elementning bir xil massa miqdoriga to‘g‘ri keladigan massa miqdorlari o‘zaro kichik butun sonlar nisbatida bo‘ladi.*

Masalan, SO_2 va SO_3 ni olaylik.

SO_2	SO_3
32:32	32:48
32	48
2	3

yoki, azot oksidlarida

N_2O	NO	N_2O_3	NO_2	N_2O_5
28:16	14:16	28:48	14:32	28:80
14:8	14:16	14:24	14:32	14:40
8	16	24	32	40
1	2	3	4	5

Hajmiy nisbatlar qonuni.

Ta'rif: *Kimyoviy reaksiyaga kirishuvchi gazlarning hajmlari o'zaro va reaksiyada hosil bo'ladigan gazlarning hajmlari bilan oddiy butun sonlar nisbati kabi bo'ladi.*

$H_2+Cl_2=2HCl$	$N_2+3H_2=2NH_3$
1 + 1 : 2	1 + 3 : 2
2 : 2	4 : 2
1 : 1	2 : 1

Mavzu: Kimyoviy formulalar bilan ishlash

Ta'rif: *Modda tarkibidagi biror element yoki moddaning massa ulushini topish uchun uning massasi umumiy modda molyar massasiga bo'linadi. Massa ulush ω bilan belgilanadi.*

$$\omega(X) = \frac{m(X)}{M}$$

M1. Suvdagi elementlarning massa ulushlarini hisoblang.

$M(H_2O)=18$g/mol

$$\omega(H) = \frac{2}{18} \cdot 100\% = 11{,}11\%$$

$$\omega(O) = \frac{16}{18} \cdot 100\% = 88{,}89\%$$

M2. Mis kuporosidagi kristallizatsiya suvining massa ulushini hisoblang.

$M(CuSO_4 \cdot 5H_2O)=250$g/mol

$$\omega(H_2O) = \frac{90}{250} \cdot 100\% = 36\%$$

M3. Noma'lum metallning oksidini Me_2O_3 ko'rinishida tasvirlash mumkin. 76,5g shunday oksid tarkibida 40,5g metall bo'lsa, metallni aniqlang.

$m(O)=76{,}5-40{,}5=36$g

Me_2O_3	3O
76,5g	36g
x	48g

x=102g $M(Me_2O_3)$ $M(Me) = \frac{102-48}{2} = 27$g/mol Al_2O_3

Agar modda tarkibidagi elementlar massa ulushlari berilib, uning eng oddiy formulasi so'ralsa, har bir elementning massa ulushi uning atom massasiga bo'linadi. Hosil qilingan sonlar ularning eng kichigiga bo'linadi.

M4. Modda tarkibida kaliy, marganes va kislorodning massa ulushlari tegishlicha 24,7, 34,8 va 40,5% tashkil qilsa, uning eng oddiy formulasini toping.

ω(K)=24,7%

ω(Mn)=34,8%

ω(O)=40,5% $K:Mn:O = \frac{\omega(K)}{A_r(K)} : \frac{\omega(Mn)}{A_r(Mn)} : \frac{\omega(O)}{A_r(O)} = \frac{24{,}7}{39} : \frac{34{,}8}{55} : \frac{40{,}5}{16} = \frac{0{,}633:0{,}633:2{,}531}{0{,}633} = 1:1:4$

$KMnO_4$

II BOB. ATOM TUZILISHI

Mavzu: Atom tuzilishi nazariyasi

Atom tuzilishi haqidagi dastlabki tushunchalar er.avv. 400 yillarda Demokrit asarlarida uchraydi.

Faqat XVIII asrga kelibgina ingliz olimi J.Dalton *atomistik* nazariyani yaratadi. Unga ko‘ra barcha narsalar atomlardan tuzilgan. Daltonga ko‘ra har bir element atomi o‘ziga xos o‘lcham va massaga ega bo‘ladi.

Atomning o‘lchami juda kichkina – 10^{-10}m(1Å) atrofida. Uning absolyut massasi ham juda ham kichik $m_{u.b.}=1,66\cdot10^{-27}$kg.

1895 yil ingliz olimi Kruks manfiy zaryadlangan nurlarni ochadi va unga katod nurlari deb nom beradi. Yana bir ingliz olimi J.Tomson katod nurlarini magnit maydonidagi harakatini o‘rganib, bunday nurlar har qanday moddada mavjudligini asosladi va unga *elektron* deb nom beradi.

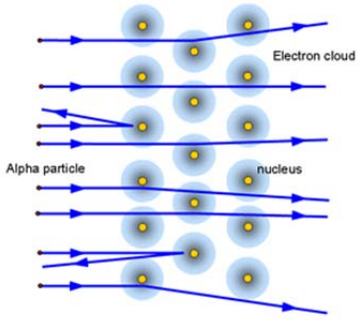
Amerikalik olim Milliken elektronning massasi va zaryadini aniqlaydi.

$q_e=1,6\cdot10^{-19}$Kl

$m_e=9,11\cdot10^{-31}$kg ya’ni atomning 1/1840 qismiga teng.

1911 yil ingliz olimi Ernest Rezerford atom tuzilishing *planetar modelini* kashf etadi. Ya’ni u yupqa Au folga olib unga α nurlar oqimini yuboradi. Shunda bu nurlardan barchasi ham to‘g‘ri o‘tib ketavermasdan baz’ilari burilishini, hatto orqaga ham qaytishini kuzatadi.

Planetar modelga ko‘ra:



1) Atom markazida musbat zaryadlangan yadro yotadi.
2) Yadro atrofida manfiy zaryadli elektron harakat qiladi.
3) Atom yadrosi o‘lchami atomning o‘lchamidan ancha kichik. Ya’ni atom o‘lchami 10^{-10}m bo‘lsa, yadroning o‘lchami 10^{-15}m ga teng.

Atom elektroneytral bo‘lib, yadro atrofidagi elektronlarning umumiy soni yadroning musbat zaryadiga tengdir. Yadroning musbat zaryadi esa o‘z navbatida elementning davriy jadvaldagi tartib raqamiga teng. Buni 1913 yil ingliz fizigi Mozli aniqlagan.

Elektronning massasi juda kichik bo‘lganligi uchun atomning asosiy massasi yadroda yig‘ilgan. Atom yadrosining musbat zaryadini *protonlar* tashkil qiladi. Lekin yadroda protonlardan tashqari massaga ega zarrachalar ham bo‘lib, ular *neytronlar* deyiladi. Neytronlarning mavjudligini 1932 yil Chedvik ochgan.

Ta’rif: *Atom musbat zaryadli yadro va uning atrofida harakatlanuvchi manfiy zaryadli elektronlardan tuzilgan. Yadro o‘z navbatida proton va netronlardan tuzilgan.*

Proton va neytronlar soni ayni atomning massasini beradi va *nuklonlar* deyiladi. Proton, neytron va elektron *fundamental* zarrachalardir.

	Zarracha	Zaryadi, Kl	Nisbiy zaryadi	Nisbiy massasi
p	Proton	$+1,6\cdot10^{-19}$	+1	1
n	Neytron	0	0	1
ē	Elektron	$-1,6\cdot10^{-19}$	-1	1/1840

Mavzu: Izotoplar, izobarlar va izotonlar

Atom massasini A bilan belgilasak, undagi protonlar soni Z va netronlar soni N o‘rtasida quyidagi bog‘liklik bor:

$A=Z+N$ $N=A-Z$

$^{A}_{Z}E\rightarrow N$ $^{35}_{17}Cl\rightarrow 18$

Ta’rif: *Bir elementning yadro zaryadi bir xil, atom massasi har xil bo‘lgan atomlar shu elementning izotoplari deyiladi.*

Masalan: $^{35}_{17}\mathrm{Cl}$ $^{37}_{17}\mathrm{Cl}$

Izotoplar bir-birlari bilan faqat neytronlar soni bilan farq qiladi.

$^{A}_{Z}$	$^{1}_{1}\mathrm{H}$	$^{2}_{1}\mathrm{H}$	$^{3}_{1}\mathrm{H}$
N	0	1	2

Izotoplar aralashmasidan elementning o‘rtacha atom massasi kelib chiqadi.

Masala: Cl ikkita 75% $^{35}\mathrm{Cl}$ va 25% $^{37}\mathrm{Cl}$ izotoplaridan tashkil topgan. Uning o‘rtacha atom massasini hisoblang.

$\bar{A}_r(\mathrm{Cl})=A_{r1}\cdot\omega_1+A_{r2}\cdot\omega_2=35\cdot0{,}75+37\cdot0{,}25=35{,}5\text{m.a.b.}$

Shuningdek, elementning o‘rtacha atom massasiga qarab undagu har bir izotopning massa ulushlari quyidagicha hisoblanadi:

$$\bar{A}_r=\frac{A_{r1}\cdot x+A_{r2}(100-x)}{100}$$

$$35{,}5=\frac{35x+37(100-x)}{100}$$

x=75% $^{35}\mathrm{Cl}$ 25% $^{37}\mathrm{Cl}$

Ta’rif: *Atom massalari bir xil, yadro zaryadlari bilan farq qiluvchi atomlar turiga izobarlar deyiladi.*

Masalan, $^{65}_{29}\mathrm{Cu}$ $^{65}_{30}\mathrm{Zn}$; $^{40}_{18}\mathrm{Ar}$ $^{40}_{19}\mathrm{K}$ $^{40}_{20}\mathrm{Ca}$

Ta’rif: *Neytronlar soni bir xil bo‘lgan atomlar turiga izotonlar deyiladi*.

Masalan, $^{39}_{19}\mathrm{K}$ $^{40}_{20}\mathrm{Ca}$

N=20 20

Mavzu: Yadro reaksiyalari

Ta’rif: *Elementlar yadrosi tarkibi o‘zgarishi bilan sodir bo‘ladigan reaksiyalar yadro reaksiyalari deyiladi.*

Ba’zi element atomlari o‘z-o‘zidan yengilroq atomlarga parchalanadi va bu hodisaga *tabiiy radioaktivlik* deyiladi.

Radioaktivlikni 1896 yil fransuz fizigi Anri Bekkerel ochgan. U uran rudasini tekshirib ko‘rganda o‘z-o‘zidan nurlanishini kuzatadi va buni tasvirga tushiradi.

O‘z-o‘zidan parchalanadigan atomlarga *radioaktiv atomlar* deyiladi.

Shundan keyin 1898 yil Mariya va Pyer Kyurilar 2 ta yangi radioaktiv element – Ra va Po ni ochishadi.

Tabiiy radioaktiv elementlarning 3 ta qatori bor:

1) Uran qatori: $^{238}_{92}\mathrm{U}\rightarrow{}^{206}_{82}\mathrm{Pb}$
2) Aktiniy qatori: $^{235}_{92}\mathrm{U}\rightarrow{}^{207}_{82}\mathrm{Pb}$
3) Toriy qatori: $^{232}_{90}\mathrm{Th}\rightarrow{}^{208}_{82}\mathrm{Pb}$

1919 yil Rezerford elementlarni sun’iy bir-biridan sintez qildi. U α nurlar bilan azot atomini bombardimon qilib, kislorod atomini oladi:

$$^{14}_{7}\mathrm{N}+{}^{4}_{2}\mathrm{He}\rightarrow{}^{17}_{8}\mathrm{O}+{}^{1}_{1}\mathrm{p}$$

Mavzu: Yadro reaksiyalarining tenglamalarini tuzish

Yadro reaksiyalarida element atomlari, quyidagi zarracha va yengil element atomlari ishtirok etadi:

1) $^{4}_{2}\alpha$ – alfa zarracha yoki $^{4}_{2}He$
2) $_{-1}\beta=_{-1}e$ beta zarracha yoki elektron
3) $_{+1}\beta=_{+1}e$ pozitron
4) $^{1}_{1}p$ – proton
5) $^{1}_{0}n$ – neytron

6) ${}_1^1\mathrm{H} = \mathrm{H}$, ${}_1^2\mathrm{H} = \mathrm{D}$, ${}_1^3\mathrm{H}=\mathrm{T}$
7) γ – gamma zarracha
8) hν – foton, nur

yadro reaksiyalarning tenglamalarini tuzishda quyidagilarga e'tibor berish kerak:

1) Massa sonlari elementning yuqori qismiga yoziladi va reaksiya tenglamasinig har ikkala tomonidagi massa sonlari yig'indisi o'zaro teng bo'lishi kerak.
2) Zaryadlar pastki qismga yoziladi va ularning qiymatlari ham o'zaro teng bo'lishi kerak.

$$^{14}_{7}N + {}^{4}_{2}He \rightarrow {}^{17}_{8}O + {}^{1}_{1}p$$

3) α, $_{-}\beta$, $_{+}\beta$, ^{1}n va p yemirilish va birikishlarda yadro tarkibi tegishlicha o'zgaradi.
4) Yadro reaksiyalarining tenglamalari qisqartirilgan va qisqartirilmagan ko'rinishda tuziladi:

$$^{14}_{7}N(\alpha; p)^{17}_{8}O$$

5) Agar tenglamaning biror tomonida elektron $_{-}\beta$ ishtirok etsa, uning qiymati tenglamaning qarama-qarshi tomoniga qo'shiladi.
6) $_{-}\beta$ yemirilishda neytron protonga aylanadi va yadrodan elektron ajralib chiqadi:

$$^{1}_{0}n \rightarrow {}^{0}_{-1}e + {}^{1}_{1}p$$

$_{+}\beta$ yemirilishda proton neytronga aylanadi va yadrodan positron ajralib chiqadi:

$$^{1}_{1}p \rightarrow {}^{1}_{0}n + {}^{0}_{+1}e$$

Elektronning yadroga qulashida elektron yadrodagi proton bilan birikib neytronga aylanadi:

$$^{1}_{1}p + {}^{0}_{-1}e \rightarrow {}^{1}_{0}n$$

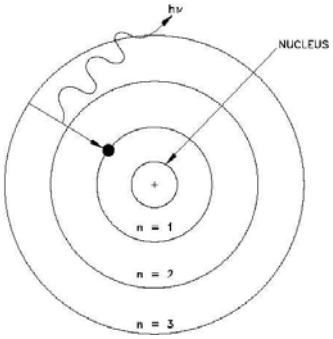
Yadro reaksiyalari keng qo'llaniladi. Eng ko'p qo'llaniladigan soha bu atom energiyasi sifatida. Chunki bunda juda katta energiya ajralib chiqadi. Meditsinada ^{60}Co izotopi rak kasalligini davolashda ishlatiladi. ^{14}C izotopi qadimgi o'simlik va hayvonlarning yoshini aniqlashda foydalaniladi. Reaksiyalarning borish yo'nalishi nishonlangan atomlar yordamida amalga oshiriladi. Masalan, eterifikatsiya reaksiyasida.

Shuningdek, quyosh va yulduzlarda quyidagi reaksiya amalga oshadi:

$$4\,{}^{1}_{1}H \rightarrow {}^{4}_{2}He + 2\,{}_{+1}e \qquad \mathrm{T}=10^{7}\mathrm{K}$$

Mavzu: Atom elektron qobiqlarining tuzilishi

Rezerford atom tuzilishining planetar modelini yaratgandan so'ng, 1913 yili daniyalik olim Nills Bor vodorod atomining tuzilish nazariyasini yaratadi.



1-postulat. *Elektron yadro atrofida faqat kvantlangan, ya'ni ma'lum energiya darajasiga muvofiq keladigan orbitalar bo'ylab harakat qiladi.*

2-postulat. *Elektron kvantlangan orbitalar bo'ylab harakatlanganda energiya chiqarmaydi va yutmaydi. Faqat bir orbitadan ikkinchisiga o'tganda energiya chiqaradi yoki yutadi.*

1927 yil elektron 2 xil: zarracha va to'lqin tabiatga ega ekanligi tasdiqlandi. Lekin elektronning fazodagi harakatini ma'lum bir traektoriya bilan ifodalash mumkin emas. Elektron fazoning ma'lum bir qismida ko'proq harakat qiladi. Masalan, vodorod atomida bu masofa 0,53Å ni tashkil qiladi.

Ta'rif: *Yadro atrofida elektronning bo'lish ehtimoli eng ko'p bo'lgan joyga orbital deyiladi.*

Mavzu: Kvant sonlar

Atomdagi elektronning harakati 4 ta kvant sonlari bilan xarakterlanadi. Bular

1) Bosh kvant soni –n;
2) Orbital (yonaki) kvant soni – l
3) Magnit kvant soni - m_l
4) Spin kvant soni - m_s

1. *Bosh kvant soni* elektronning energiyasini bildiradi va n bilan belgilanadi. Bu son Bor tomonidan fanga kiritilgan. n ning qiymati 1,2,3,4,5,6,7… ∞ bo‘lishi mumkin.
   Bosh kvant sonlari o‘zaro teng bo‘lgan elektronlar bitta *elektron qavatda* joylashadi. Energetik pog‘onalar K,L,M,N,O,P,Q harflari bilan belgilanadi.

n	1	2	3	4	5	6	7
⊕	)	)	)	)	)	)	)
	K	L	M	N	O	P	Q

2. *Orbital (yonaki) kvant soni* elektron harakatining shaklini belgilaydi va bu shaklga elektron bulut deyiladi. Bu kvant soni Zommerfeld tomonidan kiritilgan va l harfi bilan belgilanadi. Uning qiymati 0 dan n-1 gacha bo‘ladi.

l	0	1	2	3
	s	p	d	f

   l=0 bo‘lgan holda, sharsimon shaklga ega s-orbital to‘g‘ri keladi:

   l=0 s

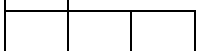
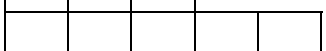
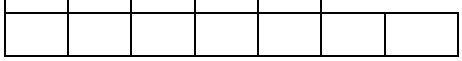
   l=1 bo‘lgan holga gantelsimon holdagi p-orbital mos keladi:

   l=1 p

   l=2 bo‘lgan holga qo‘sh gantelsimon shaklli d-orbital mos keladi:

   l=2 d

   l=3 bo‘lgan holga f-orbital muvofiq keladi.
   Orbital kvant soni o‘zaro teng elektronlar bitta *qavatchada* joylashadi.
3. Elektronning fazodagi yo‘nalishini va vaziyatini belgilash uchun *magnit kvant soni* kiritilgan va m_l bilan belgilanadi. Uning qiymati $-l$ dan $+l$ gacha bo‘ladi.

$l = 0 \rightarrow$	$m_l = 0$		s
$l = 1 \rightarrow$	$m_l = -1,0,+1$		p
$l = 2 \rightarrow$	$m_l = -2,-1,0,+1.+2$		d
$l = 3 \rightarrow$	$m_l = -3,-2,-1,0,+1,+2,+3$		f

4. *Spin kvant soni* elektronning o‘z o‘qi atrofida aylanish yo‘nalishini ko‘rsatadi va m_s harfi bilan belgilanadi. U +1/2 va -1/2 qiymatlarni qabul qiladi.

+1/2 -1/2

Mavzu: Elementlarning elektron konfiguratsiyasi

Atom orbitallarining to‘lish tartibi quyidagicha: avval kam energiyali orbital, so‘ngra energiyasi ko‘proq orbital to‘ladi va bu *Klechkovskiy qoidasiga* bo‘ysunadi.

Ta’rif: *Avval $n + l$ yig‘indisi kichik bo‘lgan orbital to‘ladi. Agar ikkita orbitalning energiyasi o‘zaro teng bo‘lsa, avval bosh kvant soni kichik orbital to‘ladi.*

Shuningdek, elektronlarning joylashishi *Pauli prinsipiga* zid bo‘lmasligi kerak.

Ta’rif: *Ayni elementda 4 ta kvant soni bir xil bo‘lgan ikkita elektron bo‘lishi mumkin emas.*

Elektronlarning pog‘onachalarda joylashishi *Xund qoidasiga* bo‘ysunadi.

Ta’rif: *Ayni pog‘onachada turgan elektronlar mumkin qadar orbitallarda juftlashmaslikka intiladi.*

Elektronlarning energetik pog‘ona va orbitallar bo‘ylab joylashishi ayni elementning *elektron konfigutarsiyasi* deyiladi.

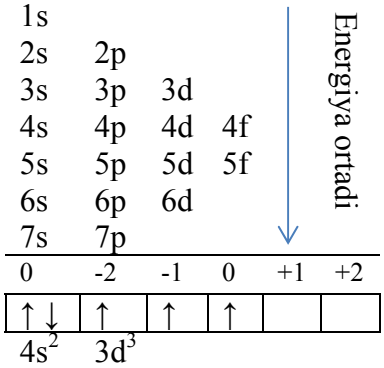
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 5f^{14}\ 6d^{10}\ 7p^6$

Har qaysi qavatda joylashishi mumkin bo‘lgan elektronlar soni $2n^2$ ga teng.

$N=2n^2$ n- qavat nomeri.

Qavatlar soni ayni element uchun davr raqamiga tengdir.

Element atomlarining elektron konfiguratsiyasini tuzishni quyidagicha sxematik tasvirlash mumkin:



Masala. $4s^23d^3$ ning kvant sonlarini tasvirlang.

	n	l	m_l	m_s
1	4	0	0	+1/2
2	4	0	0	-1/2
3	3	2	-2	+1/2
4	3	2	-1	+1/2
5	3	2	0	+1/2

$_{+88}Ra\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2$

+88	2	8	18	32	18	8	2
$_{+88}Ra$	$1s^2$	$2s^2\ 2p^6$	$3s^2\ 3p^6\ 3d^{10}$	$4s^24s^2\ 4p^6\ 4d^{10}\ 4f^{14}$	$5s^2\ 5p^6\ 5d^{10}$	$6s^2\ 6p^6$	$7s^2$
	K	L	M	N	O	P	Q

Davriy jadvalda 10 ta o‘tish elementi (d-element) da elektron ns qavatdan n-1d qavatga ko‘chgan. Bular:

Cu, Ag, Au, Nb, Cr, Mo, Ru, Rh, Pd, Pt

Pd da ns^2 elektronlar n-1d qavatga umuman ko‘chgan. Qolgan 9 ta elementda faqat 1 elektron ko‘chgan.

$_{+44}Ru\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1\ 4d^3$

$_{+46}Pd\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^0\ 4d^{10}$

III BOB. DAVRIY QONUN VA DAVRIY SISTEMA

Mavzu: Davriy qonun va davriy jadval.
D.I.Mendeleyevning davriy qonuni va elementlar davriy sistemasi

Davriy qonunning ochilishi juda qadimga borib taqaladi. Chunonchi atom haqidagi dastlabki tushunchalarning vujudga kelishi M.V.Lomonosovning “Atom – moekulyar ta’limoti”, 1808 yil Daltonning “atomistik nazariya”si va h.k lar.

Davriy qonun ochilishigacha bo‘lgan urinishlarning eng asosiysi quyidagilar:

1. 1829 yili Dobereynerning *triadalar* jadvalini tuzishi.

Li	Ca	P	S	Cl
Na	Sr	As	Se	Br
K	Ba	Sb	Te	J

2. 1862 yili fransuz olimi Shankurtua elementlarni *vint* yo‘nalishida joylashtirdi.
3. 1865 yil igliz olimi Nyulends elementlarni *oktet* qatoriga joylashtiradi va “elementlarning xossasi sakkizinchi elementdan so‘ng qaytariladi” deydi.
4. Eng yaqin natijaga nemis olimi Lotar Meyer erishadi. Lekin u atom og‘irligi bilan element xossasi orasidagi bog‘liqlikni ko‘ra bilmadi.

1869 yil 1 mart kuni Mendeleyev davriy qonunni quyidagicha ta’riflaydi.

Ta’rif: *Oddiy jismlarning xossalari, shuningdek elementlar birikmalarining shakl va xossalari elementlar atom og‘irliklarining qiymatlariga davriy ravishda bog‘liqdir.*

Davriy qonunning grafik tasviri – bu davriy sistema hisoblanadi. Davriy qonun tabiatning muhim qonuni hisoblanadi. Mendeleyev elementlar xossalari bilan ularning atom og‘irliklari orasidagi bog‘liqlikni ko‘ra bildi.

Davriy qonun muhim kashfiyotlar qila oladi:

1. Hali ochilmagan elementlar haqida aniq bashorat qilish. U davriy jadvalda 29 ta bo‘sh joy qoldirdi. Mendeleyev 10 ta elementning xossalarini oldindan aytdi va ularning 3 tasiga ekabor, ekaalyuminiy va ekasilitsiy deb nom berdi va Mendeleyev hayotligida ochildi. Ular Ga, Ge va Sc bo‘lib chiqdi. 1875 yil Lekok de–Buabodran Ga ni, Nilson va Kleva Sc ni va 1886 yil Vinkler Ge ni ochdi. Vinkler davriy qonunning haqiqiy tabiat qonuni ekanligini tan oldi.
2. Atom massalarining to‘g‘irlanishi. Masalan: U, B va h.k
3. Davriy jadvalga qarab elementlarning atom massalarini topish mumkinligini (Mendeleyev usuli).

Davriy qonunning keyigi rivojlanishi yangi kashfiyotlar bilan bog‘liq bo‘ldi. Inert gazlarning ochilishi ular uchun maxsus guruh mavjudligini tasdiqladi.

Davriy qonunning keying rivojlanishi nemis olimi Mozli ishlari bilan bog‘liq. 1912 yil Mozli davriy qonunda elementlarning atom massasi emas, balki uning yadrosi musbat zaryadi muhim ekanligini isbotladi. Mozli qonuni davriy qonundagi “chetlashishlarni” tuzatishga asos bo‘ldi. Bular Ar – K, Co – Ni, Te –J, Th – Pa. Aynan Mozlining ishlari davriy jadvalda H va He orasida boshqa element joylashmasligini isbotladi.

Ta’rif: *Elementlarning xossalari, oddiy moddalar va elementlar birikmalarining xossalari ular atomlari yadro zaryadlari qiymatiga davriy ravishda bog‘liqdir.*

Mozlining ishlari Te, Pm va Re ning mavjudligini oldindan aytish imkonini berdi.

Mavzu: Davriy jadvalning tuzilishi

1869 yil Mendeleyev davriy jadvalning *uzun variantini* tuzadi.

1871 yili Mendeleyev davriy jadvalning ikkinchi *qisqa variantini* e’lon qiladi. Unda 8 ta vertikal, 10 ta gorizontal qator bor edi. Bitta vertikal qatorga joylashgan o‘xshash elementlar *guruh* deyiladi. Ishqoriy metalldan boshlanib inert gaz bilan tugaydigan elementlar *davr*larga joylashtiriladi.

Zamonaviy davriy jadvalda 7 ta davr, 8 ta guruh va 10 ta qator bor. 1, 2 va 3 davrlar faqat birgina qatordan tuzilgan bo‘lib, *kichik davrlar* deyiladi. IV,V,VI va VII davrlar ikkita qatordan tuzilgan va *katta davrlar* deyiladi. VII davr tugallanmagan davr deyiladi. Birinchi va VII davrdan boshqa barcha davrlar ishqoriy metall bilan boshlanib inert gaz bilan tugaydi.

Ta’rif: *Guruh deb, o‘xshash elektron tuzilishga ega bo‘lgan va o‘xshash kimyoviy xossaga ega elementlar vertikal qatoriga aytiladi.*

Qisqa variantda katta davrlarda ikkita qatorda xossalar parallel o‘zgaradi bunga *ikkilamchi davriylik* deyiladi.

1 davrda 2 ta
2 davrda 8 ta
3 davrda 8 ta
4 davrda 18 ta
5 davrda 18 ta
6 davrda 32 ta

7 davrda 24 ta element bor – *tugallanmagan davr*. Katta davrlarning juft qator elementlari faqat metalldan iborat bo‘lib, metallik xossasi chapdan o‘ngga tomon susayadi.

Davriy jadvalda 57 La dan keyingi 14 ta element pastga joylashtirilgan va *lantanoidlar* deyiladi. Ularning kimyoviy xossasi lantanga o‘xshaydi va 15 ta elementga bitta joy berilgan.

VII davrda 89 Ac dan keyin 14 ta element *aktinoidlar* ham pastga joylashtirilgan.

Har qaysi guruh 2 ta: *asosiy* va *qo‘shimcha* (*yonaki*) guruhchaga bo‘linadi. Asosiy guruh elementlari xossalari jihatidan yonaki guruhdan farq qiladi.

Davriy jadvalning uzun variantida 18 ta vertikal qator va 7 ta gorizontal qator bor. Asosiy guruhcha A bilan, qo‘shimcha guruh B bilan belgilanadi va ular maxsus nomga ega.

IA – ishqoriy metallar (Li - Fr)
IIA – ishqoriy yer metallari (Ca - Ra)
VA – pniktogenlar (N - Sb)
VIA – xalkogenlar (O -Po)
VIIA – galogenlar (F - At)
VIIIA – nodir gazlar (He - Rn)
VIIIB – guruh triadalarga Fe – Co – Ni – *temir oilasi*,
Ru – Rh – Pd, Os – Ir – Pt; - *platina oilasi* deyiladi.
La – Lu – lantanoidlar;
Ac – Lr – aktinoidlar.

Mavzu: Energetik pog‘ona va pog‘onachalarda elektronlarning taqsimlanishi. Atomlarning davriy xossalari

Har qanday atom uchun o‘z energiyasi bilan farq qiluvchi bir nechta energetik holatlar mavjud. Ular ichida eng minimal energiyalisi – bu qo‘zg‘olmagan yoki asosiy holat hisoblanadi. Boshqa holatlar qo‘zg‘olgan holat hisoblanadi.

Atomlarning elektron qobiqlarini to‘lishida 1) Eng kichik energiya sharti 2) Pauli prinsipi 3) Xund qoidasiga amal qilish lozim.

Davriy jadvalning qisqa variantiga nazar solsak davrda har bir elementdan keyingisiga o‘tishida bitta elektron ko‘proq bo‘ladi.

1 davr	qavat	n=1	$1s^2$			
2 davr	qavat	n=2	$2s^2$	$2p^6$		
3 davr	qavat	n=3	$3s^2$	$3p^6$	$3d^{10}$	
4 davr	qavat	n=4	$4s^2$	$4p^6$	$4d^{10}$	$4f^{14}$
5 davr	qavat	n=5	$5s^2$	$5p^6$	$5d^{10}$	$5f^{14}$
6 davr	qavat	n=6	$6s^2$	$6p^6$	$6d^{10}$	
7 davr	qavat	n=7	$7s^2$	$7p^6$		

Davriy sistemaga ko‘ra elektron qavatlarning to‘lishini quyidagicha tasvirlash mumkin:

Guruhlar

Davrlar	IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA
				Asosiy guruh				
n	ns^1	ns^2	$ns^2\ np^1$	$ns^2\ np^2$	$ns^2\ np^3$	$ns^2\ np^4$	$ns^2\ np^5$	$ns^2\ np^6$
				Qo'shimcha guruh				
Davrlar	IB	IIB	IIIB	IVB	VB	VIB	VIIB	VIIIB
n	$ns^1n\text{-}d^{10}$	$ns^2n\text{-}1d^{10}$	$ns^2n\text{-}1d^1$	$ns^2n\text{-}1d^2$	$ns^2n\text{-}1d^3$	$ns^2n\text{-}1d^4$	$ns^2n\text{-}1d^5$	$ns^2n\text{-}1d^6$ $ns^2n\text{-}1d^7$ $ns^2n\text{-}1d^8$

Lantanoid va aktinoidlarda $ns^2n\text{-}2f^{1\text{-}14}$ to'ladi.

1) Davr raqami elementning bosh kvant soni maksimal qiymatiga mos keladi.
2) Har qanday davr ishqoriy metall ns^1 bilan boshlanib, inert gaz ns^2np^6 bilan tugaydi.
3) Asosiy guruh elementlarida *ns* yoki *np* qavat to'ladi.
4) Qo'shimcha guruh elementlarida *n-1d* qavat to'ladi.
5) Lantanoid va aktinoidlarda *4f* va *5f (n-2f)* qavat to'ladi.

Ta'rif: *Elementning bosh kvant soni ortishi bilan tashqi elektron tuzilishi o'xshash elementlarda xossalarning davriy takrorlanishiga davriy qonunning fizik ma'nosi deyiladi.*

Elementlarning davriy sistemasida elementlarning kimyoviy va ba'zi fizikaviy xossalari davriy ravishda o'zgaradi.

Ular: 1) Valentligi 2) Yuqori oksidi va gidridining formulasi 3) Ularning asos yoki kislotalik tabiati 4) Atom radiusi 5) Ionlanish energiyasi va potensiali 6) t_q vat t_s 7) Rangli birikmalar hosil qilish qobiliyati 8) Elektromanfiylik 9) Elektronga moyillik energiyasi.

1) Valentligi davrda 1 dan 8 gacha o'zgaradi.

I	II	III	IV	V	VI	VII	VIII
1	2	3	2,4	1,3,5	2,4,6	1,3,5,7	2,4.6,8

2) Yuqori oksidi va gidridining formulasi.

I	II	III	IV	V	VI	VII	VIII
R_2O	RO	R_2O_3	RO_2	R_2O_5	RO_3	R_2O_7	RO_4
RH	RH_2	RH_3	RH_4	RH_3	H_2R	HR	

uchuvchan gidridlar

3) Yuqori oksidlarning kislota- asosligi davrda chapdan o'ngga o'tgan sari asoslikdan kislotalikgacha o'zgaradi.

Oksid	Na_2O	CaO	Al_2O_3	CO_2	P_2O_5	SO_3	Cl_2O_7
Gidroksid	NaOH	$Ca(OH)_2$	$Al(OH)_3$	H_2CO_3	H_3PO_4	H_2SO_4	$HClO_4$
	Asos		Amfoter		Kislota		

4) Ta'rif: *Yadrodan eng oxirgi elektrongacha bo'lgan masofaga atom radiusi deyiladi va r bilan belgilanadi.*

Davrda chapdan o'ngga o'tgan sari atom radiusi kamayadi, guruhda yuqoridan pastga ortadi.

5) Ta'rif: *Yadro bilan eng bo'sh bog'langan elektonni uzib chiqarish uchun kerak bo'lgan energiyaga ionlanish energiyasi deyiladi va I bilan belgilanadi.*

$$A+I=A^{+}+\bar{e}$$

Davrlarda chapdan o'ngga o'tgan sari ionlanish energiyasi ortadi, guruhda yuqoridan pastga kamayadi.

6) Ta'rif: *Neytral atomga bitta elektron birikkanda ajralib chiqadigan energiyaga elektronga moyillik energiyasi deyiladi va E bilan belgilanadi.*

$$A+\bar{e}=A^{-}+E$$

Davrlarda chapdan o'ngga o'tgan sari elektronga moyillik energiyasi ortadi, guruhda esa kamayadi

7) Ta'rif: *Atomlarning bog' hosil qilishda elektronlarning tortish qobiliyati elektromanfiylik deyiladi. uning qiymati quyidagicha topiladi:*

$$X = \frac{I+E}{2}$$

Odatda Poling tomonidan kiritilgan nisbiy elektromanfiylik qiymatidan foydalaniladi:

$$NEM = \frac{X}{X_{Li}}$$

Davrlarda chapdan o'ngga o'tgan sari nisbiy elektromanfiylik oshadi, guruhda esa kamayadi.

Elementning elektromanfiyligi qancha katta bo'lsa, u shuncha kuchli metallmas, qancha kichik bo'lsa, shuncha kuchli metalldir.

8) Elementlarning metallik xossalari davrda chapdan o'ngga kamayadi, guruhda yuqoridan pastga ortadi. Davriy jadvalning chap quyi qismida kuchli metallar(ishqoriy va ishqoriy-yer metallari), yuqori o'ng qismida kuchli metallmaslar(galogenlar, O, N, S) joylashgan.

9) Elementlarning t_s va t_q davrda chapdan o'ngga ortadi yuqoridan pastga kamayadi.

Davriy jadvalda elementlar o'rtasidagi o'xshashlik 3 yo'nalishda namoyon bo'ladi.

1. Gorizontal yo'nalishda. Bu o'xshashlik qo'shimcha guruh va f elementlarda kuzatiladi.
2. Vertikal o'xshashlik. Guruhdagi o'xshash xossalar.
3. Diagonal o'xshashlik. Li→Mg, Be→Al, B→Si, Ti→Nb

Masalan, Li ishqoriy metall bo'lsa ham uning karbonati qizdirirlganda parchalanadi:

$Li_2CO_3 \rightarrow Li_2O + CO_2$ $CaCO_3 \rightarrow CaO + CO_2$

Elementlarning quyidagi xossalarida davriylik kuzatilmaydi.

1. Yadro zaryadi 2. Atom massasi

IV BOB. KIMYOVIY TENGLAMALAR BILAN HISOBLASHLAR

Mavzu: Kimyoviy tenglamalar tuzish. Kimyoviy reaksiyalarning turlari

Har qanday kimyoviy jarayon (reaksiya) kimyoviy tenglamalar ko‘rinishida yoziladi. Tenglamaning chap tomonidagi moddalar *dastlabki moddalar* deyiladi. Tenglamaning o‘ng tomonidagi moddalar *reaksiya mahsulotlari* deyiladi. Modda massasining saqlanish qonuniga ko‘ra dastlabki modda massasi reaksiya mahsuloti massasiga teng. Tenglamaning moddalar oldida turgan raqamlar koeffitsientlar deyiladi. Koeffitsientlar moddaning molekulasi miqdorini ko‘rsatadi.

koeffitsient

$$3H_2+1N_2=2NH_3$$

indeks

Reaksiya tenglamasiga koeffitsientlar tanlashda reaksiya davomida element atomlari soni o‘zgarmasligiga asoslanadi. Agar element atomi soni chap yoki o‘ng tarafda juft yoki toq bo‘lsa, ular o‘zaro tenglashtiriladi.

$$2Al+3Cl_2=2AlCl_3$$

Agar reaksiya davomida funksional guruhlar o‘zgarmasa ular tengligiga e’tibor berish kerak.

$$3Ca(NO_3)_2+2Na_3PO_4=Ca_3(PO_4)_2+6NaNO_3$$

Kimyoviy reaksiyalar dastlabki va oxirgi mahsulotlar soniga ko‘ra 4 ga bo‘linadi:

1) Birikish
2) Ajralish
3) O‘rin olish
4) Almashinish.

Birikish reaksiyalarida ikki yoki undan ortiq moddadan bitta yangi modda hosil bo‘ladi:

$$Ca+Cl_2=CaCl_2 \qquad CaO+CO_2=CaCO_3$$

$$Na_2CO_3+CO_2+H_2O=2NaHCO_3$$

Ajralish reaksiyalarida bitta moddadan ikki yoki undan ortiq modda hosil bo‘ladi:

$$2H_2O\rightarrow 2H_2+O_2$$

$$(CuOH)_2CO_3\rightarrow 2CuO+CO_2+H_2O$$

Ajralish reaksiyasiga ko‘proq parchalanish reaksiyalari kiradi.

O‘rin olish reaksiyalarida murakkab modda tarkibidagi atom yoki funksional guruh boshqasiga almashinadi:

$$CuSO_4+Fe=FeSO_4+Cu$$

$$2NaBr+Cl_2=2NaCl+Br_2$$

O‘rin olish reaksiyalari ko‘proq oksidlanish-qaytarilish reaksiyalari hisoblanadi.

Almashinish reaksiyalarida ikkita murakkab modda o‘zaro reaksiyaga kirishib, o‘z tarkibiy qismlarini almashtiradi.

$$NaOH+HCl=NaCl+H_2O$$

$$BaCl_2+H_2SO_4=BaSO_4+2HCl$$

Almashinish reaksiyalariga ko‘proq eritmalarda boradigan reaksiyalar kiradi.

Shuningdek, reaksiyalar issiqlik effektiga ko‘ra 2 ga: *ekzotermik* va *endotermik* reaksiyalarga bo‘linadi.

Ta’rif: *Issiqlik chiqishi bilan boradigan reaksiyalar ekzotermik reaksiyalar deyiladi.*

$$2H_2+O_2=2H_2O\ +Q;\ -\Delta H$$

Ko‘pchilik birikish reaksiyalari ekzotermik hisoblanadi.

Ta’rif: *Issiqlik yutilishi bilan boradigan reaksiyalar endotermik reaksiyalar deyiladi.*

$$CaCO_3\rightarrow CaO+CO_2\ -Q;\ +\Delta H$$

Ko‘pchilik parchalanish reaksiyalari endotermik hisoblanadi.

Reaksiyalar qaytarlik alomatiga ko‘ra 2 ga: *qaytmaydigan* va *qaytar* reaksiyalarga bo‘linadi.

Ta'rif: *Faqat bir yo'nalishda sodir bo'ladigan reaksiyalar qaytmaydigan, ya'ni oxirigacha boradigan reaksiyalar deyiladi.*

Reaksiya oxirigacha borishi uchun quyidagi shartlardan biri bajarilishi kerak:

1) Ikkita eriydigan modda ta'siridan cho'kma hosil bo'lishi kerak:

$$BaCl_2+Na_2SO_4=BaSO_4\downarrow+2NaCl$$

2) Gaz bo'lmagan moddalar ta'siridan gaz ajralib chiqishi kerak:

$$CaCO_3+2HCl=CaCl_2+CO_2\uparrow+H_2O$$

3) Reaksiya davomida kuchli issiqlik ajralib chiqishi kerak:

$$C+O_2=CO_2 \quad +Q$$

4) Ikkita elektrolit ta'siridan noelektrolit (masalan, suv) hosil bo'lishi kerak:

$$H_2SO_4+2NaOH=Na_2SO_4+2H_2O$$

Bunday reaksiyalarga *neytrallanish* reaksiyalari ko'proq misol bo'ladi.

Ta'rif: *Asos va kislota reaksiyaga kirishib, tuz va suv hosil bo'lish reaksiyaga neytrallanish reaksiyasi deyiladi.*

Ta'rif: *Bir vaqtning o'zida qarama-qarshi yo'nalishda sodir bo'ladigan reaksiyalar qaytar reaksiyalar deyiladi*.

Qaytar reaksiyalarga qaytarlik alomati ↔ qo'yiladi.

$$3H_2+N_2\leftrightarrow 2NH_3$$

Bunday reaksiyalar oxirigacha bormaydi. Masalan, gazlar orasidagi reaksiyalar.

Ta'sirlashayotgan moddalardagi elementlarning oksidlanish darajasi o'zgarishiga ko'ra 2 ga:

1) Oksidlanish darajasi o'zgarmaydigan reaksiyalar;
2) Oksidlanish-qaytarilish reaksiyalariga bo'linadi.

Ta'sirlashayotgan moddalar agregat holatiga ko'ra 2 ga: *gomogen* va *geterogen* reaksiyalarga bo'linadi.

Ta'rif: *Ta'sirlashayotgan va reaksiya mahsulotlari bir xil agregat holda (gaz, suyuq, qattiq) bo'lsa, gomogen reaksiyalar deyiladi.*

$$Fe_{(q)}+S_{(q)}=FeS_{(q)}$$

Ta'rif: *Ta'sirlashayotgan va reaksiya mahsulotlari turli xil agregat holda (gaz, suyuq, qattiq) bo'lsa, geterogen reaksiyalar deyiladi.*

$$S_{(q)}+O_{2(g)}=SO_{2(g)}$$

Katalizator ishtirokiga ko'ra 2 ga: *katalizatorsiz* va *katalitik* reaksiyalarga bo'linadi.

Mavzu: Mahsulot unumi

Amalda hamma reaksiyalar ham oxirigacha sodir bo'lavermaydi. Chunki dastlabki moddalar tarkibidagi qo'shimchalar, asbob-uskunalarning yaxshi ishlamasligi va h.k. Shuning uchun *mahsulot unumi* degan tushuncha kiritilgan.

Ta'rif: *Amalda olingan mahsulot massa, miqdor, yoki hajmda reaksiya tenglamasi bo'yicha hisoblangan (nazariy) massa, miqdor yoki hajmning qanday qismini tashkil qilishini ko'rsatadigan kattalikka mahsulot unumi deyiladi va η harfi bilan belgilanadi*.

$$\eta = \frac{m_{amal}}{m_{naz}} \qquad \eta = \frac{V_{amal}}{V_{naz}} \qquad \eta = \frac{n_{amal}}{n_{naz}}$$

M1. 31,6 g $KMnO_4$ termik parchalanganda 2 l kislorod hosil bo'lsa, reaksiya unumini hisoblang.

$m(KMnO_4)$=31,6g	$2KMnO_4\rightarrow K_2MnO_4+MnO_2+O_2\uparrow$	
$V(O_2)$=2 l	316g	22,4 l
η-?	31,6g	*x*=2,24 l nazariy

$$\eta = \frac{V_{amal}}{V_{naz}} = \frac{2}{2,24} = 0,893 = 89,3\%$$

Dastlabki moddaga nisbatan reaksiya mahsulotining miqdori topilishi talab qilinganda, nazariy hisoblashga unum ko‘paytiriladi.

$$m_{amal}=m_{naz}\cdot\eta$$

M2. Reaksiya unumi 60% bo‘lganda 6g H_2 yonganda hosil bo‘lgan suv massasini hisoblang.

η=60%=0,6 $2H_2+O_2=2H_2O$
m(H_2)=6g 4g 36g
m(H_2O)-? 6g *x*=54g nazariy $m_{amal}=m_{naz}\cdot\eta=54\cdot0,6=32,4g$

Agar reaksiya mahsuloti ma’lum bo‘lib, dastlabki modda miqdori topilishi so‘ralsa, unum bo‘linadi.

$$m_{amal} = \frac{m_{naz}}{\eta}$$

M3. 5,6 l azot ajralib chiqishi uchun qancha massa ammoniy bixromat termik parchalanishi kerak. Reaksiya unumi 75%.

V(N_2)=5,6 l $(NH_4)_2Cr_2O_7\rightarrow N_2+Cr_2O_3+4H_2O$
η=75%=0,75 252g 22,4 l
m$(NH_4)_2Cr_2O_7$)-? *x* 5,6 l *x*=63g nazariy

$$m_{amal} = \frac{m_{naz}}{\eta} = \frac{63}{0,75} = 84g$$

Agar bir necha bosqich unumi berilsa, unumlar o‘zaro ko‘paytirilib, umumiy unum topiladi.

M4. Ammiakning katalitik oksidlanishida unum 70%, azot(IV) oksidining yuttirilishida 80% bo‘lsa, 5,6 l ammiakdan qancha massa nitrat kislota olish mumkin?

V(NH_3)=5,6 l $4NH_3+5O_2=4NO+6H_2O$ $2NO+O_2=2NO_2$ $4NO+2H_2O+O_2=4HNO_3$
η_1=70%=0,7 $\eta_{um}=\eta_1\cdot\eta_2=0,7\cdot0,8=0,56$ (56%)
η_2=80%=0,8 $NH_3 \rightarrow HNO_3$
m(HNO_3)-? 22,4 l 63g
5,6 l *x*=15,75g nazariy $m_{amal}=\eta\cdot m_{naz}=0,56\cdot15,75=8,82g$

V BOB. GAZ QONUNLARI

Mavzu: Avogadro qonuni. Nisbiy zichlik

Gazlarning hajmlari sharoitga (bosim, temperatura) bog‘liq bo‘ladi. Normal sharoitda bosim P_0 bilan belgilanadi.

P_0=1atm=760mm.s.u.=101,325KPa=760 torr

Temperatura 0°C va Kelvin shkalasida beriladi.

T=t+273 T_0=273K

Standart sharoitda bosim bir xil bo‘lib, temperatura 25°C ga teng.

T=298K

Gaz qonunlaridan eng muhimlaridan biri bu Avogadro qonuni bo‘lib, buni 1811 yili italyan olimi Amedeo Avogadro kashf etgan.

Ta’rif: *Bir xil sharoitda turli gazlarning teng hajmlarida molekulalar soni bir xil bo‘ladi.*

Avogadro qonunidan muhim xulosalar kelib chiqadi.

1 xulosa. Normal sharoitda har qanday gazning 1 moli 22,4 l hajmni egallaydi va bunga gazning molyar hajmi deyiladi. V_M bilan belgilanadi.

Shuningdek, har qanday gazning 1 molida $6{,}02\cdot10^{23}$ ta molekula bo‘ladi.

n	1	1	1	1
	H_2	Cl_2	CO_2	Ar
V	22,4	22,4	22,4	22,4
N	$6{,}02\cdot10^{23}$	$6{,}02\cdot10^{23}$	$6{,}02\cdot10^{23}$	$6{,}02\cdot10^{23}$

Har qanday gazning n.sh.dagi miqdori quyidagi formula bilan topiladi:

$$n = \frac{V}{V_M} = \frac{V}{22{,}4}$$

2 xulosa. Bir gazning ikkinchi gaz massasiga nisbati ularning molekulyar massalari nisbatiga tengdir.

$$\frac{m_1}{m_2} = \frac{M_1}{M_2}$$

Ta’rif: *Bir gazning ikkinchi gazga nisbatan zichligi ularning molyar massalari nisbatiga ko‘ra topiladi va D harfi bilan belgilanadi.*

$$D_x = \frac{M}{M_x}$$

H_2 ga nisbatan $D_{H_2} = \frac{M}{2}$

Havoga nisbatan $D_{havo} = \frac{M}{29}$

He ga nisbatan $D_{He} = \frac{M}{4}$

M1. Kislorodning vodorodga nisbatan zichligini hisoblang.

$$D_{H_2} = \frac{32}{2} = 16$$

Shuningdek, nisbiy zichlikni bilgan holda gazning molyar massasini hisoblash mumkin.

$M=M_x\cdot D_x$

M2. Geliyga nisbatan zichligi 7 ga teng bo‘lgan gazlarni belgilang.

$D_{He}=7$ $M(X)=4\cdot7=28$g/mol N_2, CO, C_2H_4

Mavzu: Gaz qonunlari

1662 yil Robert Boyl gazlarning siqilishini o‘rganib, quyidagi qonunni kashf qiladi.

Ta’rif: *O‘zgarmas temperaturada gazning hajmi uning bosimiga teskari proporsional bo‘ladi.*

T=const. PV=const.

Ya’ni, bosim qancha oshsa, hajm shuncha kamayadi va aksincha. Bu qonunga Boyl-Mariott qonuni ham deyiladi.

Gey-Lyussak qonuni quyidagicha ta’riflanadi:

Ta’rif: *O‘zgarmas bosimda gazning hajmi uning temperaturasiga to‘g‘ri proporsional bo‘ladi.*

Ya’ni temperatura ortishi bilan hajm oshadi.

P=const. V=kT

Boyl-Mariott va Gey-Lyussak qonuni yig‘indisi *birlashgan gaz qonuni* deyiladi va u quyidagicha ifodalanadi.

$$\frac{P_0V_0}{T_0} = \frac{P_1V_1}{T_1}$$

bu yerda P_0=101,325KPa

T_0=273K

V_0 n.sh. dagi gaz egallagan hajm, [l]

M1. 20°C da 100KPa bosimda biror gaz 10 l hajmni egallasa, uning n.sh. dagi hajmini hisoblang.

T_1=273+20=293K

V_1=10 l

P_1=100KPa

P_0=101,325KPa

T_0=273K

V_0-?

$$\frac{P_0V_0}{T_0} = \frac{P_1V_1}{T_1}$$

$$V_0 = \frac{P_1V_1T_0}{P_0T_1} = 9{,}2\ \text{l}$$

Ideal gazning holat tenglamasi quyidagicha:

$$PV = nRT$$

bu yerda

P – bosim [KPa]

V – gaz hajmi [l]

n – modda miqdori [mol]

R=8,314 – Universal gaz doimiysi

T – abs.temp. [K]

M2. 27°C da hajmi 100 l bo‘lgan idishda $3{,}01\cdot10^{24}$ ta gaz molekulalari bo‘lsa, idishdagi bosim (KPa) qanday bo‘ladi?

N=$3{,}01\cdot10^{23}$

T=300K

V=100 l

P-?

$$n = \frac{3{,}01\cdot10^{24}}{6{,}02\cdot10^{23}} = 5mol$$

PV=nRT $P = \frac{nRT}{V} = \frac{5\cdot8{,}314\cdot300}{100} = 124{,}71\ KPa$

Agar modda miqdori o‘rniga uning qiymatini qo‘ysak, Mendeleyev-Klapeyron tenglamasi kelib chiqadi.

$$PV = \frac{m}{M}RT$$

bu yerda

m – gaz massasi [g]

M – gazning molyar massasi [g/mol]

M3. CO_2 22°C da 500KPa bosimda hajmi 20 l bo‘lgan idishda saqlanadi. Uning massasini (g) hisoblang.

T=295K

P=500KPa

$$PV = \frac{m}{M}RT$$

V=20 l
m-?

$$m = \frac{PVM}{RT} = \frac{500 \cdot 20 \cdot 44}{8{,}314 \cdot 295} = 179{,}5g$$

Normal sharoitda gazning zichligi quyidagi formula bilan topiladi:

$$\rho = \frac{M}{V_M}$$

ρ – gaz zichligi [g/l]

M4. Zichligi 3,17g/l (n.sh.) bo‘lgan gazni aniqlang.

ρ=3,17g/l $M = \rho \cdot V_M = 3{,}17 \cdot 22{,}4 = 71g/mol$ Cl_2

Gaz zichligi bo‘yicha Mendeleyev-Klapeyron tenglamasi quyidagicha:

$$PM = \frac{m}{V}RT \qquad PM = \rho RT$$

M5. 27°C da zichligi 1,3g/l bo‘lgan qaysi gaz saqlanayotgan bo‘lishi mumkin?

T=300K
ρ=1,3g/l
M-?

$PM = \rho RT$

$$M = \frac{\rho RT}{P} = \frac{1{,}3 \cdot 8{,}314 \cdot 300}{101{,}325} = 32g/mol$$

Mavzu: Gaz aralashmalarining tarkibini ifodalash

Gazlar aralashmasining tarkibi massa va hajmiy ulushlarda ifodalanadi.

Massa ulushi – ω bilan

Hajmiy ulush – φ bilan belgilanadi.

Gazlarning hajmiy ulushlariga ko‘ra uning o‘rtacha molyar massasi quyidagi formula orqali topiladi:

$$\bar{M} = M_1 \cdot \varphi_1 + M_2 \cdot \varphi_2$$

M1. Tarkibida hajmiy jihatdan 70% CO va 30% CO_2 bo‘lgan gazlar aralashmasining havoga nisbatan zichligini hisoblang.

φ(CO)=70%=0,7
φ(CO_2)=30%=0,3
D_{havo}-?

$\bar{M}$ =M(CO) ·φ+M(CO_2) ·φ=28·0,7+44·0,3=32,8g/mol

$$D_{havo} = \frac{M}{29} = \frac{32{,}8}{29} = 1{,}13$$

Shunisi muhimki, gazlarning hajmiy ulushlari ularning miqdoriga (mol) mos keladi. Masalan, yuqoridagi gazlar aralashmasida 0,7mol CO va 0,3mol CO_2 mavjud deganidir.

Agar gazlar aralashmasining o‘rtacha molyar massasi berilsa, undagi har bir gazning hajmiy ulushini quyidagicha hisoblanadi:

$$\bar{M} = \frac{M_1 x + M_2(100 - x)}{100}$$

M2. Vodorodga nisbatan zichligi 18,8 bo‘lgan CO va CO_2 aralashmasidagi har bir gazning hajmiy ulushini hisoblang.

$D_{H_2} = 18{,}8$ $\bar{M}$=18,8·2=37,6g/mol
φ(CO)-?
φ(CO_2)-?

$$37{,}6 = \frac{28x + 44(100 - x)}{100}$$

3760=28x+4400-44x 16x=640 x=40% CO 60% CO_2

Shuningdek, gazlar aralashmasining hajmiy ulushini (φ) bilgan holda uning massa ulushini (ω) hisoblash mumkin.

φ→ω

yuqoridagi masala bo‘yicha

φ(CO)=40% n(CO)=0,4mol m(CO)=0,4·28=11,2g
m_{um}=11,2+26,4=37,6g
φ(CO_2)=60% n(CO_2)=0,6mol m(CO_2)=0,6·44=26,4g
$\omega(CO) = \frac{11{,}2}{37{,}6} \cdot 100\% = 29{,}8\%$ $\omega(CO_2) = \frac{26{,}4}{37{,}6} = 70{,}2\%$

Yoki gazlarning massa ulushini (ω) bilgan holda uning hajmiy ulushini (φ) hisoblash mumkin. Bunda gazlar aralashmasining massasi 100g deb olinadi.

$\omega \rightarrow \varphi$

M3. Tarkibi massa jihatdan 60% O_2 va 40% N_2 bo‘lgan gazlar aralashmasidagi har bir gazning hajmiy ulushini (φ) hisoblang.

$\omega(O_2)=60\%$ $m(O_2)=100\cdot0,6=60g$ $n(O_2)=\frac{60}{32}=1,875$ mol

$n_{um}=1,875+1,43=3,305$mol

$\omega(N_2)=60\%$ $m(N_2)=100\cdot0,4=40g$ $n(N_2)=\frac{40}{28}=1,43$ mol

$\varphi(O_2)=\frac{n_{O_2}}{n_{um}}=\frac{1,875}{3,305}\cdot100\%=56,7\%$ $\varphi(N_2)=\frac{n_{N_2}}{n_{um}}=\frac{1,875}{3,305}\cdot100\%=43,3\%$

Umumiy holda gazlar aralashmasidagi biror gazning hajmiy yoki massa ulushi orasida quyidagi bog‘liqlik bor:

$$\omega(A)=\frac{\varphi(A)\cdot M(A)}{\varphi(A)\cdot M(A)+\varphi(B)\cdot M(B)}=\frac{\varphi(A)\cdot M(A)}{\overline{M}}$$

$$\omega(B)=\frac{\varphi(A)\cdot M(A)}{\varphi(A)\cdot M(A)+\varphi(B)\cdot M(B)}=\frac{\varphi(B)\cdot M(B)}{\overline{M}}$$

yuqoridagi masalada,

$\varphi(CO)=40\%$, $\varphi(CO_2)=60\%$ bo‘lsa, $\overline{M}=37,6$ g/mol

$$\omega(CO)=\frac{\varphi(CO)\cdot M(CO)}{\overline{M}}=\frac{0,4\cdot28}{37,6}=29,8\%$$

$$\omega(CO_2)=\frac{\varphi(CO_2)\cdot M(CO_2)}{\overline{M}}=\frac{0,6\cdot44}{37,6}=70,2\%$$

Agar gazlar aralashmasining o‘rtacha molyar massasi (M) va hajmi (V) berilib, undagi har bir gazning hajmi so‘ralsa, quyidagi formuladan foydalaniladi:

$$M_1x+M_2(V-x)=\overline{M}V$$

M4. Metan va azotdan iborat 30 l gazlar aralashmasining geliyga nisbatan zichligi 5 ga teng. Undagi har bir gazning hajmini (l) hisoblang.

$V_{ar}=30$ l $M_1x+M_2(V-x)=\overline{M}V$

$\overline{M}=4\cdot5=20$g/mol $16x+28(30-x)=20\cdot30$

$V(CH_4)$-? $16x+840-28x=600$

$V(N_2)$-? $12x=240$ $x=20$ l CH_4 10 l N_2

M5. $CH_4+3N_2+2CO_2$ tarkibli 180 l gazlar aralashmasining molyar massasi, har bir gazning hajmiy ulushi va hajmini hisoblang.

Var=180 l $n=\frac{m}{M}$ dan $M=\frac{m}{n}=\frac{1\cdot16+3\cdot28+2\cdot44}{1+3+2}=\frac{188}{6}=31,3$g/mol

M-?

$\varphi(CH_4)$-? $\varphi(CH_4)=\frac{1}{1+3+2}\cdot100\%=16,7\%$

$\varphi(N_2)$-? $\varphi(N_2)=\frac{3}{1+3+2}\cdot100\%=50\%$

$\varphi(CO_2)$-? $\varphi(CO_2)=\frac{2}{1+3+2}\cdot100\%=33,3\%$

$V(CH_4)$-? $V(CH_4)=\frac{1\cdot180}{1+3+2}=30$ l $V(N_2)=\frac{3\cdot180}{1+3+2}=90$ l $V(CO_2)=\frac{2\cdot180}{1+3+2}=60$ l

$V(CO_2)$-?

VI BOB. KIMYOVIY BOG‘LANISH TURLARI

Mavzu: Valentlik va kimyoviy bog‘lanishning umumiy tavsifi

Valentlik 1853 yili ingliz olimi E. Franklend tomonidan kiritilgan.

Ta’rif: *Ayni element atomining boshqa element atomlaridan muayyan sondagisini biriktirib olish xossasiga valentlik deyiladi.*

Unga ko‘ra valentlik birligi sifatida vodorodning valentligi olingan.

Elementlar valentligiga ko‘ra o‘zgarmas va o‘zgaruvchan valentli elementlarga bo‘linadi.

Ta’rif: *Kimyoviy bog‘lanish – bu atomlarning elektron qobig‘lari qoplashib, molekulaning umumiy energiyasining pasayishidir.*

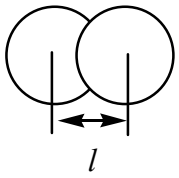
Kimyoviy bog‘lanishning energetik va geometik ko‘rsatkichlari bor. Bog‘lanishning energetik ko‘rsatkichi bog‘lanish energiyasi hisoblanadi.

Bog‘lanishning geometik ko‘rsatkichiga *bog‘lanish uzunligi* va *bog‘lanish burchagi* (*valent burchak*) kiradi.

Ta’rif: *1 mol moddadagi barcha bog‘lanishlarni uzish uchun kerak bo‘ladigan energiyaga bog‘lanish energiyasi deyiladi.*

Masalan: $H_2 \rightarrow H+H$ - 435 kJ/mol

Ta’rif: *Molekuladagi atomlar yadrolari orasidagi masofaga bog‘lanish uzunligi deyiladi.*



Bog‘lanish uzunligi atomlarning radiuslariga bog‘liq bo‘ladi.

Masalan: HF<HCl<HBr<HJ qatorida bog‘ uzunligi ortib boradi.

Shuningdek, oddiy bog‘larga qaraganda qo‘sh bog‘ va uchbog‘ning uzunligi kichikroq bo‘ladi.

$H_3C–CH_3$ $H_2C=CH_2$ $HC\equiv CH$

Kimyoviy bog‘lanish tabiatini yaxshi tushunish uchun elektromanfiylikni yaxshi bilish kerak. Elektromanfiylikni miqdoriy o‘lchash quyidagi formula bilan topiladi.

$$EM=\frac{(I+E)}{2}$$

Lekin, hisoblashlarda qulay bo‘lish uchun Poling tomonidan nisbiy elektromanfiylik (NEM) kiritilgan. Unga ko‘ra NEM Li atomining elektromanfiyligiga nisbatan olinadi. Poling shkalasi bo‘yicha ishqoriy metallar eng kichik elektromanfiylik qiymatiga galogenlar, kislorod, azot va oltingugurt eng kata elektromanfiylikka ega.

Bog‘lanishning 4 ta turi bor.

1. Kovalent bog‘lanish
2. Ion bog‘lanish
3. Metall bog‘lanish
4. Vodorod bog‘lanish.

Mavzu: Kovalent bog‘lanish

Ta’rif: *Umumiy elektron juftlari hosil bo‘lishi hisobiga vujudga keladigan bog‘lanish kovalent bog‘lanish deyiladi.*

ya’ni: $A^{\cdot}+B^{\cdot}\rightarrow A:B$

Kovalent bog‘lanish 2 ga bo‘linadi.

1) *Qutbsiz kovalent* bog‘lanish
2) *Qutbli kovalent* bog‘lanish

Qutbsiz kovalent bog‘lanish bir xil element atomlari yoki elektromanfiyliklari juda kam farq qiladigan metalmaslar bog‘lanishidan hosil bo‘ladi. Ular uchun NEM lari qiymati farqi $0<\Delta x<0,4$ ga teng.

Masalan: H_2, N_2, O_2, O_3, F_2, Cl_2, J_2, Br_2, P_4, S_8

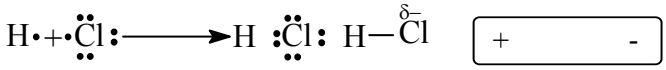
$H^{\cdot} + {\cdot}H \rightarrow H : H$ $:\dot{N}^{\cdot} + {\cdot}\dot{N}: \rightarrow :N:::N:$ $N\equiv N$

H° - H°

Qutbli kovalent bog‘lanishli elektromanfiyliklari bir – biridan kam farq qiladigan atomlar orasida hosil bo‘ladi. Bunday bog‘lanishda elektron juftlari elektromanfiyligi kichik atomdan elektromanfiyligi katta atomga siljigan bo‘ladi. Qutbli kovalent bog‘lanish hosil bo‘lishi uchun ularning elektromanfiyliklari farqi 0,4-1,7 oralig‘ida bo‘lishi kerak.

$$0{,}4<\Delta x<1{,}7$$

Masalan: HCl molekulasini olsak:



Kovalent bog‘lanishli moddalarning asosiy xossalari quyidagilar:

a) Ular suyuq va gaz moddalar, ba’zan qattiq moddalar hisoblanadi.
b) Ularning suyuqlanish va qaynash temperaturasi past.
c) Ular issiqlik va elektr tokini o‘tkazmaydi yoki yomon o‘tkazadi.
d) Kovalent bog‘lanish deyarli barcha organik moddalar uchun xos hisoblanadi.

Kovalent bog‘lanish quyidagi xossalarga ega.

1) *To‘yinuvchanlik* xossasi.
2) *Yo‘naluvchanlik* xossasi.

Kovalent bog‘lanish to‘yinuvchanligi deyilganda molekula hosil bo‘lishida faqat aniq sondagi atomlar ishtirok etishi tushuniladi. Masalan, H_2 molekulasi hosil bo‘lishida faqat 2 ta vodorod atomi o‘zaro tortishib, bog‘ hosil bo‘lishi, 3 vodorod esa aksincha itarilishi kuzatiladi.

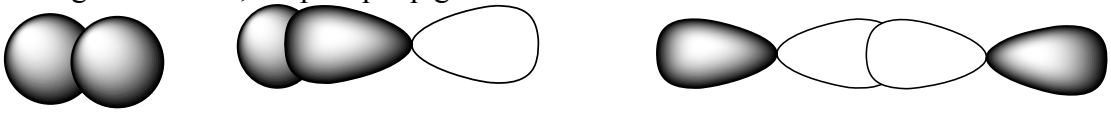
H·+H·+H·=H:H+H·

Kovalent bog‘lanish yo‘naluvchanligio deyilganda molekulaning fazoda ma’lum shaklni egallashi tushuniladi (gibridlanish).

Mavzu: σ va π bog‘lanishlar. Qo‘sh va karrali bog‘lanishlar

Ta’rif: *O‘zaro birikuvchi atomlar orasida birgina valent chizig‘i bilan tasvirlanadigan bog‘lanish hosil bo‘lganda, elektron bulutlar o‘sha atomlarning yadro markazlararo eng yaqin tog‘ri chiziq bo‘ylab bir – birini qoplasa, bunday bog‘lanishga σ – bog‘lanish deyiladi.*

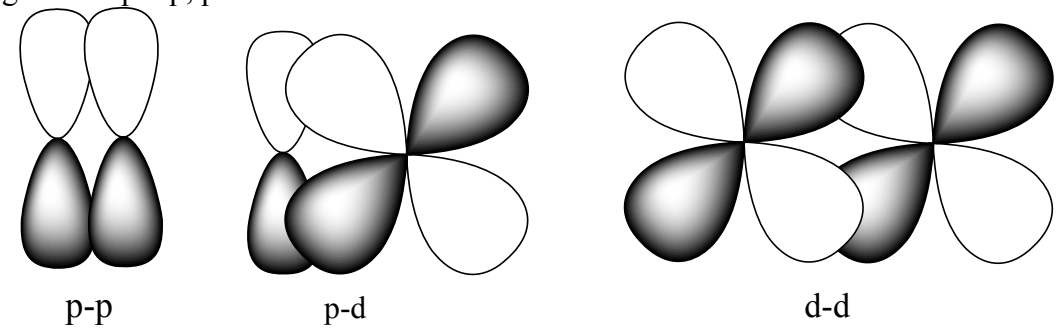
Sigma bog‘lanish s – s, s – p va p – p gibrid orbitallar o‘rtasida hosil bo‘ladi.



Barcha yakka bog‘lar σ – bog‘lanish hisoblanadi.

Ta’rif: *σ – bog‘lanish tekisligiga perpendikulyar tekislikda elektron bulutlarining o‘zaro qoplanishidan hosil bo‘lgan bog‘lanishga π – pi bog‘lanish deyiladi.*

π – bog‘lanish p – p, p – d va d – d orbitallar orasida hosil bo‘ladi.



Qo‘sh bog‘lardan bittasi, uchbog‘lardan ikkitasi π – bog‘ hisoblanadi.

σ – bog‘lanish atomlar orasidagi eng yaqin masofa bo‘ylab amalga oshirilganligi sababli u barqaror bo‘ladi. π – bog‘lanish esa kuchsizroq bo‘ladi.

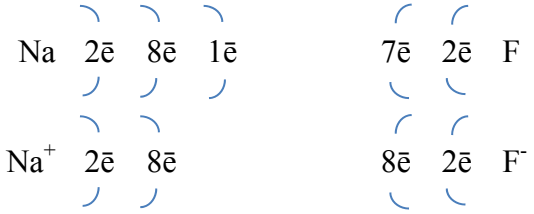
$$N\overset{\pi}{\equiv}\overset{\sigma}{}\overset{\pi}{}N$$

Mavzu: Ion bog‘lanish

Atomlar bog‘lanish hosil qilishida tugallangan tashqi qavat dublet yoki oktetga ega bo‘ishiga intiladi. Buning uchun ular elektron beradi yoki qabul qiladi.

Neytral atom elektron bergandan keyin u musbat zaryadlanadi (metallarda), elektron qabul qilsa manfiy zaryadlanadi (metallmaslarda).

Masalan: NaF da



yoki $Na^{\cdot} + :\ddot{F}: \rightarrow Na^{+} \cdot \ddot{F}:^{-}$

Ta’rif: *Elektrostatik kuchlar tasirida ionlar orasida hosil bo‘ladigan bog‘lanish ion bog‘lanish deyiladi.*

Ion bog‘lanish hosil bo‘lishi uchun atomlarning nisbiy elektromanfiyliklari qiymati farqi 1,7 dan katta bo‘lishi kerak.

$$\Delta x \geq 1{,}7$$

Tipik ion bog‘lanish ishqoriy, ishqoriy–yer metallari va galogenlar orasida, shuningdek tuzlarda va ishqorlarda uchraydi.

Ion bog‘lanishli moddalar uchun quyidagi xossalar o‘rinli.

a) Ularning barchasi qattiq moddalar.
b) Ularning suyuqlanish va qaynash temperaturalari yuqori.
c) Ular qutbli erituvchilarda, masalan, suvda yaxshi eriydi.
d) Ular suyuqlanma holida elektr tokini o‘tkazadi.

Ion bog‘lanish to‘yinuvchanlik va yo‘naluvchanlik xossasiga ega emas.

Masalan: NaCl molekulasida har bir Na^+ atrofida 6 tadan Cl^- ioni va aksincha joylashadi.

Ya’ni uni Na_6Cl_6 deb tasvirlash mumkin.

Ta’rif: *Ayni atom bilan bevosita bog‘langan atomlar soni koordinatsion son deyiladi.*

Masalan: Osh tuzida Na^+ va Cl^- larining koordinatsion soni 6 ga teng.

Mavzu: Izoelektron zarrachalar va moddalar

Ta’rif: *Elektronlar soni teng bo‘lgan atom, molekula va ionlar izoelektron (teng elektronli) hisoblanadi.*

Masalan: Na^+ ga Ne va F^- izoelektron hisoblanadi.

Moddalar uchun ham ushbu hodisa kuzatiladi. Izoelektron moddalar o‘xshash xossaga ega bo‘ladi.

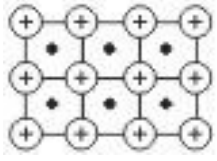
Masalan: CO va N_2 molekulalari.

	C≡O	N≡N
	6+8	7+7
ē	14	14

Mavzu: Metall bog‘lanish

Metallarda valent elektron unchalik ko‘p bo‘lmasa ham, ular metall atomi yadrosiga kuchli bog‘lanmagan, ya’ni nisbatan erkin.

Ta’rif: *Erkin elektronlar hisobiga metall ionlari orasidagi kimyoviy bog‘lanishga metall bog‘lanish deyiladi.*



Kovalent bog‘lanishdan farq qilib, bunda erkin elektronlar hamma metall ionlari uchun umumiy ya’ni “*elektron gaz*” holida bo‘ladi.

Metall boglanishli moddalar uchun quyidagi xossalar o‘rinli:

a) Metallardagi erkin elektronlar hisobiga ular issiqlik va elektr tokini yaxshi o‘takazadi.
b) Asosiy guruh metallari uchun past, o‘tish metallario uchun yuqori suyuqlanish va qaynash temperaturasi o‘rinli.
c) Metallar yuqori qayishqoqlikka ega.
d) Metallar metall yaltiroqligiga ega (ko‘pchiligi kumushsimon oq).

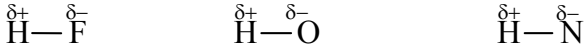
Metall bog‘lanish barcha 88 ta metallda mavjud.

Mavzu: Vodorod bog‘lanish

Yuqorida ko‘rib o‘tgan bog‘lanishlar elektronlar juftlashishi, almashinishi yoki umumiylashishi hisobiga hosil bo‘ladi.

Shuningdek, valent elektronlar va o‘zaro tortishish kuchlari bog‘lanishga sabab bo‘lishi mumkin.

Ta’rif: *Musbat qutblangan vodorod atomi bilan ikkinchi bir molekuladagi kuchli elektromanfiy elementlar – ftor, kislorod va azot (ba’zan xlor va oltingugurt) orasida vujudga keladigan bog‘lanish turiga vodorod bog‘lanish deyiladi.*

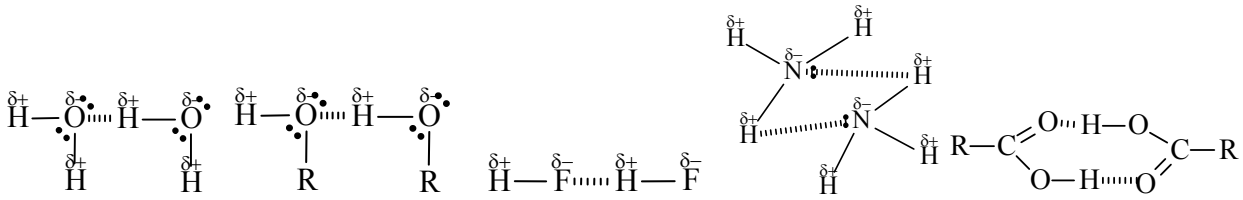


Kuchli elektromanfiy element bilan bo‘langan vodorod atomi nisbatan kationlashadi va erkin bo‘lib qoladi. Shundan keyin u ikkinchi elektromanfiy elementga tomon tortiladi.

Vodorod bog‘lanish 2 ga bo‘linadi:

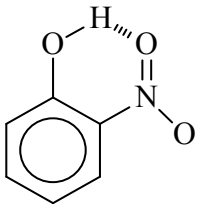
1. Molekulalararo vodorod bog‘lanish
2. Ichki molekulyar vodorod bog‘lanish.

Molekulalararo vodorod bog‘lanish H_2O, HF, NH_3, N_2H_4, NH_2OH, spirtlar, aminlar va karbon kislotalar o‘rtasida hosil bo‘ladi.

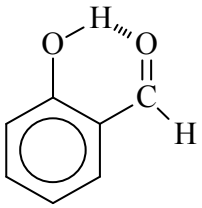


Ichki molekulyar vodorod bog‘lanish bitta molekulaning o‘zidagi elektromanfiy element va vodorod orasida hosil bo‘ladi.

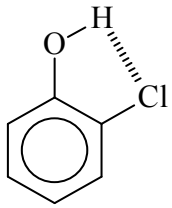
Bunday moddalarga



o‘-nitrofenol

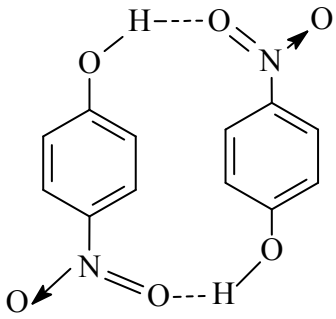


salitsil aldegid



o‘-xlorfenol

DNK va oqsil kiradi.



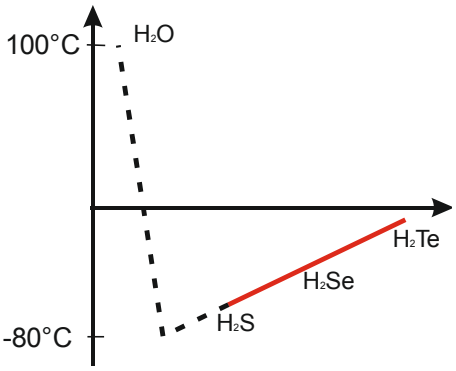
o‘-nitrofenoldan farq qilib, m’- va p’-nitrofenolda molekulalararo vodorod bog‘lanish mavjud. Shuning uchun o‘-nitrofenolga qaraganda yuqoriroq temperaturada qaynaydi.

Vodorod bog‘lanishning energiyasi kovalent bog‘lanish energiyasiga qaraganda 5-20 marta kuchsiz. Shunga qaramay vodorod bog‘lanish moddaning fizik - kimyoviy xossalariga kuchli ta’sir qiladi.

Masalan: VIA guruh elementlari gidridlari H_2O – H_2S – H_2Se qatorida suyuqlanish va qaynash temperaturasi ortib borishi kerak edi. Lekin suv molekulalari o‘rtasida vodorod bog‘lanish hisobiga u suyuq

holda bo‘ladi va qolgan vakillari gaz holida.

Agar suvda vodorod bog‘ bo‘lmaganda edi, u - 80°C da qaynashi lozim edi.



Vodorod bog‘lanish shuningdek moddalarning kimyoviy xossalariga ham ta’sir qiladi. Masalan, VII A guruh gidridlari kislotalik xossasini namoyon qiladi.

HF HCl HBr HI

kuchsiz kuchli k-ta

Ftorid kislota vodorodi ikkinchi ftorga bog‘langani uchun u harakatchan bo‘lmaydi. Vodorod bog‘lanish biokimyoviy jarayonlarda muhim rol o‘ynaydi. G – C va A – T, oqsil ikkilamchi strukturasi.

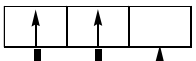
Mavzu: Donor – akseptor bog‘lanish

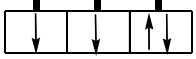
Kovalent bog‘lanish 2 xil mexanizmda

1. Umumiy elektron juftlashishi hisobiga:
   $A\cdot + B\cdot \rightarrow A:B$
2. Donor – akseptor mexanizmi bo‘yicha hosil bo‘ladi.
   $D: + A\square \rightarrow D:\square A$

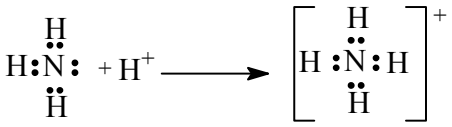
Ta’rif: *Donor atomining elektroni va akseptor atomining bo‘sh orbital hisobiga hosil bo‘ladigan kovalent bog‘lanish turiga donor – akseptor bog‘lanish deyiladi.*

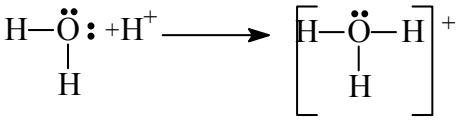
Masalan: CO molekulasida

$_{+6}C\ 2s^2\ 2p^2$  A

$_{+8}O\ \ 2s^2\ \ 2p^4$  D $C \Leftarrow\!= O$

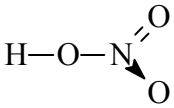
NH_4^+ va H_3O^+ (gidroksoniy) kationida

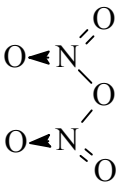


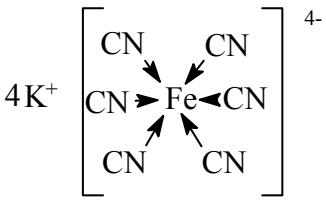


Donor – akseptor bog‘lanish azotning barcha +5 oksidlanish darajasiga ega birikmalarida va kompleks birikmalarda uchraydi. Shuning uchun u “koordinatsiion bog‘lanish” ham deyiladi.

HNO_3 da N_2O_5 da $K_4[Fe(CN)_6]$ molekulasida



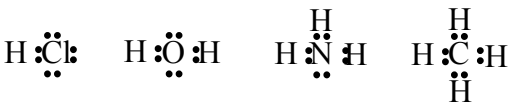




Mavzu: Elektron, struktura (tuzilish) va grafik formulalar

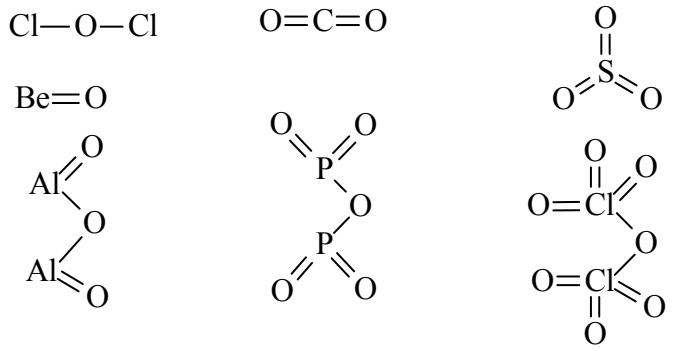
Modda molekulasi tuzulishini 3 xil elektron, struktur (tuzilish) va grafik formulalar bilan ifodalanadi.

Elektron formulalarda har bir atomning bog‘lanishda ishtirok etayotgan valent elektronlari ko‘rsatiladi.

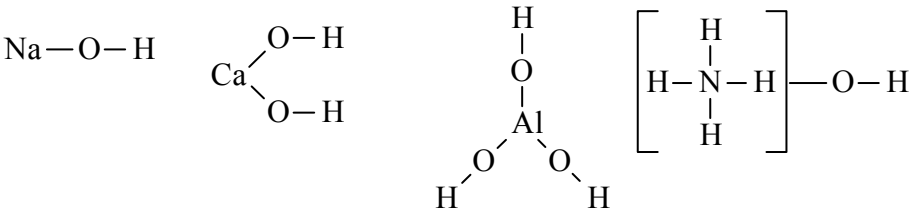


Struktur formulalarda har bir elektron jufti bitta chiziq bilan ifodalanadi.
Struktur formulalarni yozishda quyidagicha yo‘l tutiladi.

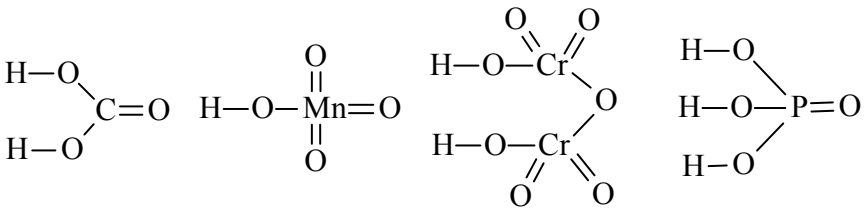
1. Kislorodsiz kislotalarda vodorod atomi tegishlicha metallmasga bog‘lanadi.
   H – Cl H – S – H H – C ≡ N H – S – C ≡ N
2. Bog‘lanishlar soni element valentligiga mos bo‘lishi kerak.



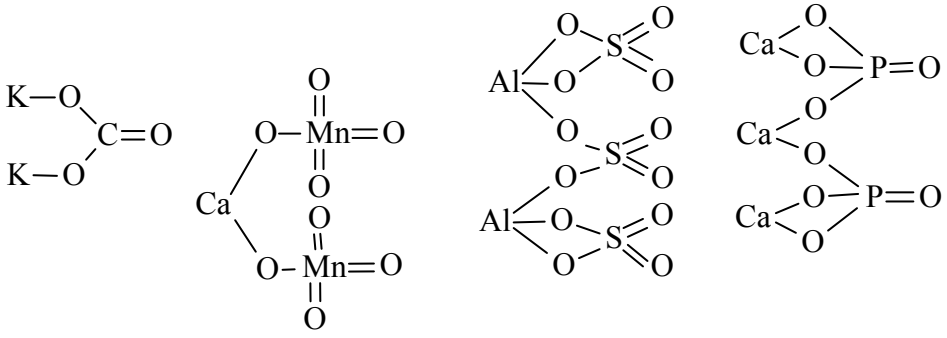
3. Asoslarning struktura formulasini tuzishda tegishli metallga (yoki ammoniy kationiga) –O–H guruhlar valentligiga muvofiq bog‘lanadi:



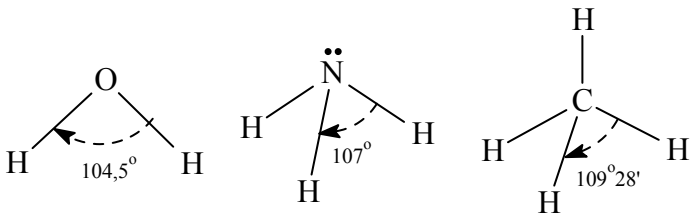
4. Kislorodli kislotalarda vodorod markaziy atomga kislorod orqali bog‘lanadi.



5. Tuzlarning formulalarini tuzishda avval tegishlicha kislota qoldiqlari yozib olinib, metallga kislorod orqali bog‘lanadi.



Grafik formulalarda bog‘lanishlar burchagi ko‘rsatiladi. Masalan:



Mavzu: Kristall panjara turlari

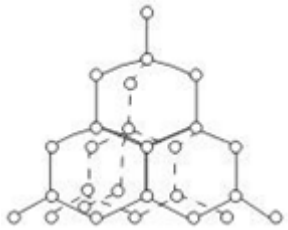
Moddalar 3 xil agregat holda bo‘ladi: gaz, suyuq va qattiq moddalar.

Ko‘pchilik anorganik moddalar qattiq holda bo‘ladi. Qattiq moddalar 2 xil: kristall va amorf holda bo‘ladi. Amorf tuzilishli moddalarda qattiq moddani tashkil etuvchi zarrachalar (atom, molekula, ion) aniq bir tartib bilan joylashmaydi.

Masalan: shisha va ko‘mir.

Kristall tuzilishli moddalarda zarrachalar fazoda aniq bir tartib bilan joylashgan bo‘ladi. Agar bu zarrachalar o‘zaro to‘g‘ri chiziqlar bilan tutashtirilsa, *kristall panjara* hosil bo‘ladi. Katakdagi bu zarrachalar kristall *panjara tugunlari* deyiladi. Kristall panjara tugunlaridagi zarracha tabiatiga ko‘ra kristall panjaralar 4 turga:

1. Atom kristall panjarali moddalar (K.P)
2. Molekulyar K.P moddalar
3. Ion K.P moddalar
4. Metall K.P moddalar

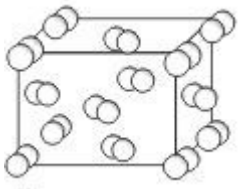


Atom kristall panjarali moddalar tugunlarida atomlar joylashgan bo‘ladi. Ularga olmos, grafit, karbin, qizil va qora fosfor, SiO_2, BN, SiC (karborund) va boshqalar kiradi.

Masalan, olmosda uglerod atomlari fazoda tetraedrik ko‘rinishda joylashgan.

Atom kristall panjarali moddalarda atomlar o‘zaro barqaror kovalent bog‘lanish bilan bog‘langan. Atom kristall panjarali moddalar yuqori suyuqlanish va qaynash temperaturasi, qattiqlikka ega. Ular elektr tokini o‘tkazmaydi. Masalan, olmos 3500°C da suyuqlanadi va eng qattiq modda hisoblanadi.

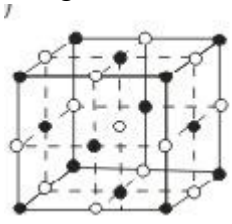
Kristall panjara tugunlarida molekulalar bo‘lsa, *molekulyar kristall panjarali* moddalar deyiladi. Molekulalar o‘zaro kuchsiz molekulalararo kuchlar va vodorod bog‘lanish orqli bog‘langan bo‘ladi.



Ularga muz, “quruq muz” (CO_2), qattiq galogenovodorodlar, qattiq holdagi inert gazlar, H_2, O_2, N_2, O_3, P_4(oq), S_8 va barcha organik moddalar kiradi.

Molekulyar kristall panjarali moddalar past suyuqlanish va qaynash temperaturasiga, past mustahkamlikka ega. Ular elektr tokini o‘tkazmaydi.

Ion kristall panjarali moddalar tugunlarida ionlar joylashgan bo‘ladi. Ularga barcha ion bog‘lanishli moddalar kiradi.



Masalan, NaCl kristall panjarasi tugunlarida Na^+ va Cl^- ionlari joylashgan bo‘ladi. Bunda har bir Na^+ ioni 6 tadan Cl^- ioni bilan va aksincha har bir Cl^- ioni 6 tadan Na^+ ionlari bilan o‘ralgan. Ya’ni har ikkala ionning koordinatsion 6 ga teng.

Ion kristall panjara moddalarga yuqori suyuqlanish va qaynash temperaturasi, yuqori qattiqlikka ega. Ular qattiq holda elektr va issiqlikni o‘tkazmaydi. Suyuqlanganda ionlar harakati tufayli elektr tokini yaxshi o‘tkazadi.

Ion kristall panjara moddalarning ko‘pchiligi qutbli erituvchilarda, masalan, suvda yaxshi eriydi.

Metall kristall panjarali moddalar tugunlarida metall kationlari joylashgan bo‘ladi. Ularga barcha 88 ta metall kiradi. Metall kristall panjarali moddalar yuqori mustahkamlikka ega. Asosiy guruh metallari uchun past, o‘tish guruhi metallari uchun yuqori suyuqlanish va qaynash temperaturasi xos.

Metall kristall panjarali moddalar elektr va issiqlik va elektr tokini yaxshi o‘tkazadi, metall yaltiroqligi va bolg‘alanuvchanlik (yuqori plastiklik) ga ega.

Mavzu: Allotropiya

Ta’rif: *Ayni elementning bir necha oddiy modda hosil qilishiga allotropiya deyiladi*.
Bu moddalarga allotropik modifikatsiyalar yoki allotropik shakl o‘zgarishlari deyiladi.
Allotropiyaning 2 ta sababi bor:

1. Molekuladagi atomlar sonining turlicha bo‘lishi. Masalan, kislorod elementi 2 xil: O_2 va O_3 (ozon) moddalarini hosil qiladi.
2. Modda kristall panjarasining turlicha bo‘lishi, masalan, uglerod 3 xil moddani: olmos, grafit va karbinni hosil qiladi.

Olmosdan uglerod atomlari tetraedrik, grafitda geksagonal va karbinda chiziqsimon joylashgan bo‘ladi.

Allotrpiya hodisasi O, C, S (rombik, monoklinik, amorf), P (oq, qizil, qora), metallardan Sn da (α- Sn, β - Sn), Fe da (α – Fe, β – Fe, γ - Fe) o‘rinli.

Allotropik o‘zgarishlar kimyoviy hodisa hisoblanadi:

$$S_{rombik} \rightarrow S_{monoklinik}$$

Allotrpiya hodisasi tufayli 110 ta kimyoviy elementga 400 ta oddiy modda mos keladi.

Mavzu: Atom orbitallarining gibridlanishi

Ta’rif: *Atom orbitallarining qo‘shilib, shakl va energiya jihatdan bir xil ko‘rinishga kelishiga gibridlanish deyiladi.*

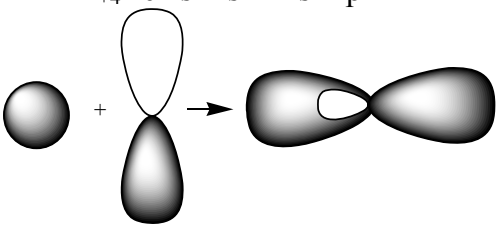
Gibridlanish AQSh lik olim L.Poling tomonidan fanga kiritilgan. (1937)

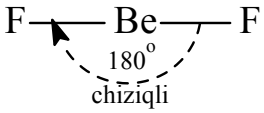
Gibridlanish jarayonida atom orbitallarining soni o‘zgarmaydi.

sp - gibridlanish

$BeCl_2$ molekulasi

$_{+4}Be\ 1s^2\ 2s^2 \rightarrow 2s^2\ 2p^1$ 2ta sp orbital



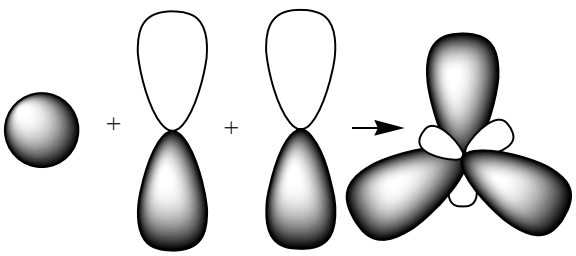


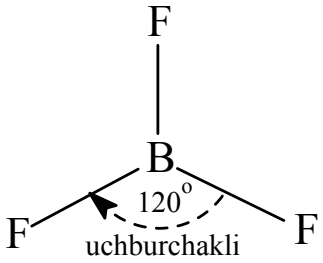
Bunday gibridlanishda markaziy atom faqat ikkita sigma bog‘ orqali bog‘langan bo‘ladi. Masalan, CO_2, N_2, CO, CS_2

sp^2 gibridlanish

BF_3 molekulasi

$_{+5}B\ 1s^2\ 2s^2\ 2p^1 \rightarrow 2s^1\ 2p^2$



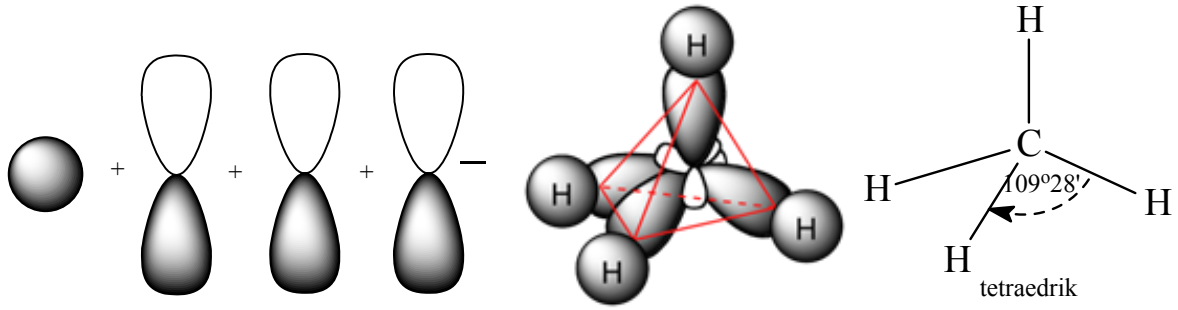


Bunday gibridlanishda markaziy atom faqat uchta sigma bog‘ orqali bog‘langan bo‘ladi. Masalan, $AlCl_3$, NO_3^-, CO_3^{2-} kabi molekulalar kiradi.

sp^3 – gibridlanish

CH_4 molekulasi

$_{+6}C\ 1s^2\ 2s^2\ 2p^2 \rightarrow 2s^1\ 2p^3$ 4 tasi sp^3 orbital



tetraedrik

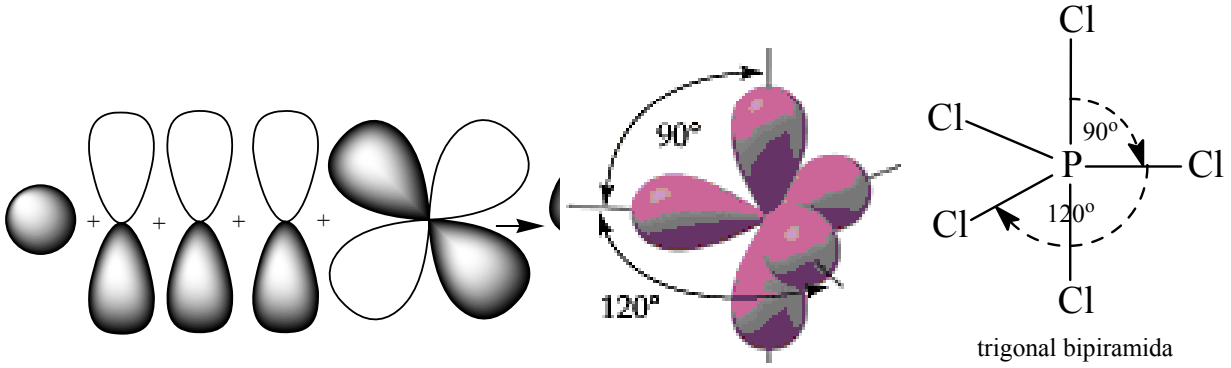
Bunday gibridlanish markaziy atom 4ta sigma bog‘lanish orqali bog‘langan molekulada kuzatiladi.

Masalan, SiO_2, H_2SO_4, H_3PO_4, $H_2Cr_2O_7$

sp^3d – gibridlanish

PCl_5 molekulasi

$_{+15}P\ 3s^2\ 3p^3 \rightarrow 3s^1\ 3p^3\ 3d^1$ 5 ta sp^3d orbital



trigonal bipiramida

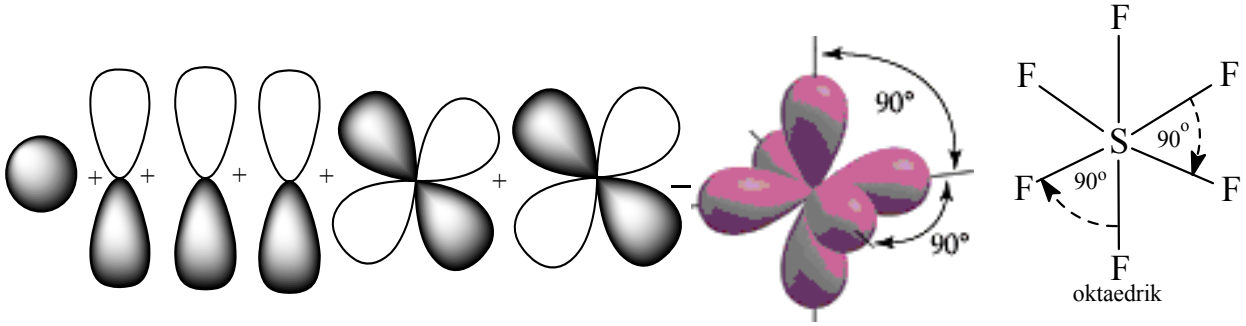
Bunda valent burchaklarning 3 tasi 120° 2 tasi 90° ga teng.

sp^3d gibridlanish 5 ta sigma bog‘ga ega barcha molekulalar uchun xos.

sp^3d^2 – gibridlanish

SF_6 molekulasi

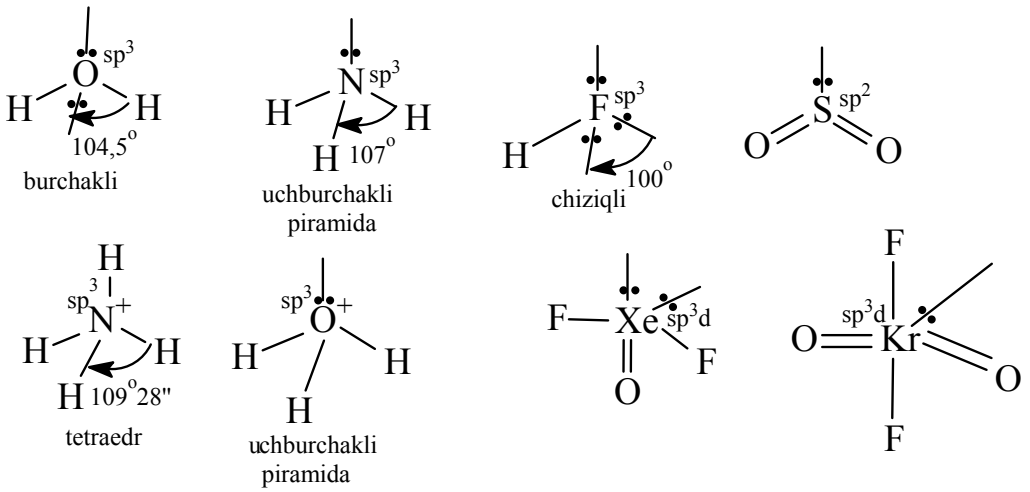
$_{+16}S\ 3s^2\ 3p^4 \rightarrow 3s^1\ 3p^3\ 3d^2$



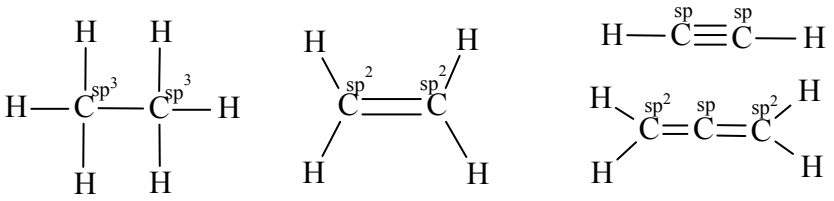
oktaedrik

sp^3d^2 gibridlanish 6 ta sigma bogli barcha molekulalar uchun xos. Valent burchaklar 6 tasi ham 90° dan.

Shuningdek gibridlanishda taqsimlanmagan elektron juftlari ham ishtirok etadi.



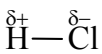
Organik moddalarda uglerod oddiy bog‘lar orqali bog‘langan bo‘lsa sp^3, bitta qo‘shbog‘ orqali bog‘langan bo‘lsa sp^2 va uchbog‘ yoki ikkita qo‘shbog‘ orqali bog‘langan bo‘lsa sp gibridlanish holida bo‘ladi.



π – bog‘lar gibridlanishda ishtirok etmaydi(ilovaga qarang).

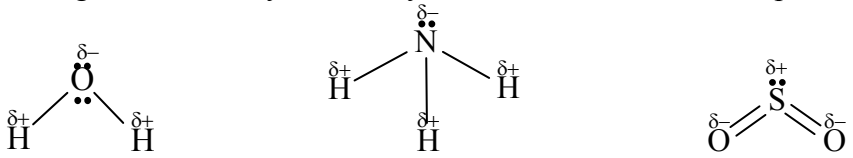
Mavzu: Qutblangan va qutblanmagan molekulalar

Hamma qutbli kovalent bog‘langan ikki atomli molekulalar qutblangan hisoblanadi.

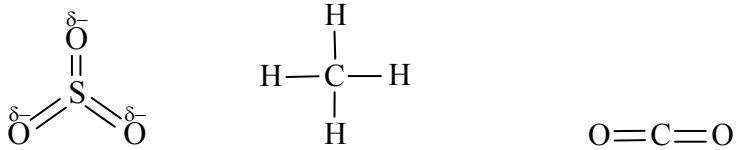
Masalan: 

Lekin uch yoki ko‘p atomli molekulalarda bog‘lanish qutbli bo‘lsa ham, molekula qutbsiz bo‘lishi mumkin. Qutbsiz molekulaning dipol momenti 0 ga teng. Qutbli molekulaniki 0 dan farq qiladi.

Molekulalarning qutblanishiga sabab gibridlangan orbitalldagi musbat va manfiy zarrachalar markazi bir – biriga mos tushmaydi. Bunday molekulalarda elektrik “dipol” hosil bo‘ladi.

Masalan: 

Qutblanmagan molekula:



VII BOB. ANORGANIK BIRIKMALARNING ASOSIY SINFLARI

Mavzu: Anorganik birikmalarning asosiy sinflari

Barcha murakkab anorganik moddalarni 4 ga bo‘lish mumkin:

1. Oksidlar.
2. Asoslar.
3. Kislotalar.
4. Tuzlar.

Mavzu: Oksidlar

Ta’rif: *Kimyoviy elementlarning kislorodli birikmalariga oksidlar deyiladi va ular binar(ikki elementli) birikmalarga kiradi.*

Umumiy formulasi: R_2O_n

Ularni nomlash uchun element nomidan keyin “oksid” so‘zi qo‘shiladi. Agar element o‘zgaruvchan valentli bo‘lsa, uning valentligi rim raqami bilan qavs ichida ko‘rsatiladi.

Na_2O – natriy oksidi, CO – uglerod (II) oksidi, Mn_2O_7 – marganets (VII) oksidi.

Amalda He, Ne va Ar dan boshqa barcha elementlarning oksidlari ma’lum.

Oksidlar quyidagicha bo‘linadi:

1. Indefferent (befarq) oksidlar – ular tuz hosil qilmaydi. Masalan, N_2O, NO, CO.
2. Tuz hosil qiluvchilar 3 ga bo‘linadi:
   a) Asosli oksidlar – suv bilan ta’sirlashib asoslarni hosil qiladi. Masalan, Li_2O – Cs_2O, CaO – BaO, MgO, FeO, CuO.
   b) Kislotali oksildar – ya’ni angidridlar. Ular suv bilan ta’sirlashib kislotalarni hosil qiladi. Masalan, CO_2, N_2O_5, SO_3, CrO_3, Mn_2O_7, Cl_2O_7.
   c) Amfoter oksidlar – ham kislota ham asos hosil qiluvchi oksidlar. Masalan, BeO, ZnO, SnO_2, PbO_2, Al_2O_3, Fe_2O_3.

Olinishi.

1) Elementlarning bevosita kislorod bilan ta’siridan:
$$C+O_2=CO_2 \qquad 2Mg+O_2=2MgO$$
2) Asoslarni parchalab olinadi:
$$Ca(OH)_2\rightarrow CaO+H_2O \qquad Cu(OH)_2\rightarrow CuO+H_2O$$
3) Tuzlarni parcahalab olinadi:
$$Mg(HCO_3)_2\rightarrow MgO+2CO_2+H_2O \qquad Cu(NO_3)_2\rightarrow CuO+2NO_2+{}^1/_2O_2$$
4) Murakkab moddalarni yoqib olinadi:
$$2CuS+3O_2=2CuO+2SO_2$$

Fizikaviy xossalari.

Asosli oksildar qattiq moddalar bo‘lib, faqat ishqoriy va ishqoriy-yer metallarining oksidlari suvda yaxshi eriydi. Kislotali oksidlar gaz, suyuq va qattiq holda bo‘ladi.

Kimyoviy xossalari.

1) Asosli oksidlardan faqat ishqoriy va ishqoriy-yer metallari oksidlari suv bilan ta’sirlashadi:
$$Na_2O+H_2O=2NaOH \qquad CaO+H_2O=Ca(OH)_2$$
2) Kislotali oksidlar suvda erib kislotalarni hosil qiladi:
$$SO_3+H_2O=H_2SO_4 \qquad Cl_2O_7+H_2O=2HClO_4$$
3) Asosli oksidlar kislotali oksidlar bilan tuz hosil qiladi:
$$CaO+SO_2=CaSO_3$$
4) Asosli oksidlar kislotalarda erib tuz hosil qiladi:
$$FeO+H_2SO_4=FeSO_4+H_2O$$
5) Kislotali oksidlar asoslar bilan ta’sirlashadi:
$$N_2O_5+Ca(OH)_2=Ca(NO_3)_2+H_2O$$
6) Amfoter oksidlar kislota va asoslar bilan ta’sirlashadi:

$$ZnO+2NaOH=Na_2ZnO_2+H_2O$$
$$ZnO+2HCl=ZnCl_2+H_2O$$

7) Oksidlar dissosilanmaydi.

Mavzu: Asoslar

Ta'rif: *Metall atomlari va bir yoki bir nechta gidroksil guruh (-OH) dan tashkil topgan moddalarga asoslar deyiladi.*

Umumiy formulasi: $Me(OH)_n$

Ular o'z navbatida uchga bo'linadi:

1) Ishqorlar
2) Amfoter gidroksidlar (amfolitlar)
3) Erimaydigan asoslar

Ishqorlar deb suvda yaxshi erib kuchli dissotsilanuvchi asoslarga aytiladi. Ularga LiOH, NaOH, KOH, RbOH, CsOH, $Ca(OH)_2$, $Sr(OH)_2$ va $Ba(OH)_2$ kiradi.

Erimaydigan asoslar suvda kam eriydi yoki umuman erimaydi. Ularga $Mg(OH)_2$, $Fe(OH)_2$, $Mn(OH)_2$, $Cu(OH)_2$ kiradi.

Amfoter gidroksidlar ham asos, ham kislota xossasini namoyon qiladi. Ularga $Be(OH)_2$, $Zn(OH)_2$, $Al(OH)_3$, $Fe(OH)_3$, $Cr(OH)_3$ kiradi.

Olinishi.

1) Ishqorlar metallarning bevosita suvda erishidan hosil bo'ladi:
$$2Li+2H_2O=2LiOH+H_2\uparrow$$
2) Asosli oksidlarning suvda erishidan hosil bo'ladi:
$$Na_2O+H_2O=2NaOH$$
3) Erimaydigan asoslarni olish uchun ularning tuzlariga ishqorlar ta'sir ettiriladi:
$$CuCl_2+2KOH=Cu(OH)_2+2KCl$$

Fizikaviy xossalari.

Asoslardan faqat NH_4OH eritma holida bo'lib, qolganlari qattiq moddalardir.

Kimyoviy xossalari.

1) Hamma asoslar kislotalar bilan ta'sirlashadi:
$$Ca(OH)_2+H_2SO_4=CaSO_4+2H_2O$$
2) Ishqorlar amfoter gidroksidlar bilan ta'sirlashadi:
$$2NaOH+Zn(OH)_2=Na_2ZnO_2+2H_2O$$
3) Asoslar kislotali oksidlar bilan ta'sirlashadi:
$$NaOH+CO_2=NaHCO_3$$
4) Ishqorlar tuzlar bilan ta'sirlashadi:
$$FeSO_4+2NaOH=Fe(OH)_2+Na_2SO_4$$
5) Ishqorlar dissosilanadi:
$$Me(OH)_n\leftrightarrow Me^{n+} + nOH^-$$

Mavzu: Kislotalar

Ta'rif: *Kislotalar deb vodorod atomlari va kislota qoldig'idan tashkil topgan murakkab moddalarga aytiladi.*

Umumiy formulasi: H_nAc

Kislotalar 2 ga bo'linadi:

1) Kislorodli
2) Kislorodsiz.

Kislorodsiz kislotalarga HF, HCl, HBr, HJ, H_2S, HCN, HCNS

Kislorodli kislotalarga $H\Gamma O$, $H\Gamma O_2$, $H\Gamma O_3$, $H\Gamma O_4$, H_2CO_3, H_2SO_4, HNO_3, HNO_2, H_3PO_3, H_3PO_4, H_2SiO_3, $HMnO_4$ kiradi.

Kislotalar tarkibidagi vodorod atomlari soniga ko'ra bir va ko'p negizliga bo'linadi.

a) Bir negizli kislotalar tarkibida faqat bitta vodorod bo'ladi. HCl, HF, HNO_3

b) Ko‘p negizli kislotalarda birdan ortiq vodorod atomlari bo‘ladi. H_2SO_4, H_3PO_4, $H_4P_2O_7$

Olinishi.

1) Angidridlarni suvda eritib olinadi:

$$SO_3+H_2O=H_2SO_4 \quad CO_2+H_2O=H_2CO_3$$

2) Metallmaslarning vodorod bilan to‘g‘ridan- to‘g‘ri ta’siridan olinadi:

$$H_2+Cl=2HCl \qquad H_2+S=H_2S$$

3) Kuchsiz kislota tuzlariga kuchli kislotalar ta’sir ettirib olinadi:

$$Na_2SO_3+2HCl=2NaCl+H_2SO_3$$

$$Ca_3(PO_4)_2+3H_2SO_4=3CaSO_4+2H_3PO_4$$

4) Metallmaslarning birikmalarini gidrolizlab olinadi:

$$PCl_5+4H_2O=H_3PO_4+5HCl$$

Fizikaviy xossalari.

Kislorodsiz kislotalar ko‘pchiligi gaz moddalardir. Kislorodli kislotalarning ko‘pchiligi suyuq (HNO_3, H_2SO_4, H_3PO_4) ba’zilari qattiq (H_2SiO_3, H_3BO_3) moddalar.

Kimyoviy xossalari.

1) Kislotalar amfoter va asosli oksidlar bilan ta’sirlashib tuz va suv hosil qiladi:

$$3H_2SO_4+Fe_2O_3=Fe_2(SO_4)_3+3H_2O$$

$$2HCl+CaO=CaCl_2+H_2O$$

2) Kislotalar asoslar bilan ta’sirlashib tuz va suv hosil qiladi (neytrallanish reaksiyasi):

$$HCl+KOH=KCl+H_2O$$

$$3HNO_3+Fe(OH)_3=Fe(NO_3)_3+3H_2O$$

3) Elektrod potensiallar qatorida vodoroddan oldingi metallar kislotallar bilan ta’sirlashib tuz va vodorodni hosil qiladi (HNO_3 va kons H_2SO_4 dan tashqari).

$$2HCl+Zn+ZnCl_2 \quad H_2SO_4+Fe=FeSO_4+H_2\uparrow$$

4) Kislotalar temperatura ta’sirida parchalanadi:

$$H_2CO_3 \xrightarrow{t^\circ C} CO_2+H_2O$$

$$H_2SiO_3 \xrightarrow{t^\circ C} H_2O+SiO_2$$

5) Kislotalar dissosilanadi:

$$H_nAc \leftrightarrow nH^+ + Ac^{n-}$$

Mavzu: Tuzlar

Ta’rif: *Metall kationlari va kislota qoldig‘i anionlaridan hosil bo‘lgan murakkab moddalarga tuzlar deyiladi.*

Umumiy formulasi: Me_mAc_n

m – kislota qoldig‘i valentligi

n – metall valentligi

Tuzlar 6 ga bo‘linadi:

1) O‘rta tuz
2) Nordon tuz
3) Asosli tuz
4) Qo‘sh tuz
5) Aralash tuz
6) Kompleks tuz

1. *O‘rta tuzlar:* tarkibida faqat metall atomi (NH_4^+ guruhi) va kislota qoldig‘idan iborat. Me_mAc_n ga mos keladi.

KF, $CaCO_3$, $Al_2(SO_4)_3$, NH_4NO_3.

2. *Nordon tuzlar:* Tarkibida metall atomi, kislota qoldig‘i va vodorod atomlari saqlaydi. Ular faqat ko‘p negizli kislotalardan hosil bo‘ladi. Masalan: $NaHCO_3$, K_2HPO_4, $Mg(HS)_2$.

3. *Asosli tuzlar:* Tarkibida metall atomi, kislota qoldig‘i va gidroksid –OH guruh saqlagan tuzlardir. Ular faqat ko‘p kislotali asoslardan hosil bo‘ladi. Masalan: MgOHCl, $(CuOH)_2CO_3$, $Fe(OH)_2NO_3$.
4. *Qo‘sh tuzlar:* Tarkibida ikki xil metall atomi va kislota qoldig‘i tutgan tuzlar. Masalan: $KAl(SO_4)_2$, $(NH_4)_2\ Fe(SO_4)_2$.
5. *Aralash tuzlar:* Tarkibida bitta metall atomi va ikkita kislota qoldig‘i tutgan tuzlardir: Masalan: $AlSO_4Cl$, MgClClO.
6. *Kompleks tuzlar:* Tarkibida kompleks ion tutgan tuzlardir. Masalan: $K_4[Fe(CN)_6]$, $Na_2[Zn(OH)_4]$.

Olinishi.

1) Metallarning metallmaslar bilan ta’siridan:

$Mg+Cl_2=MgCl_2$ $Fe+S=FeS$ $2Fe + 3Cl_2 = 2FeCl_3$

2) Metallarning kislotalar bilan ta’siridan:

$Fe+2HCl=FeCl_2+H_2$

3) Metallarning ishqorlar bilan ta’siridan:

$Zn+2KOH_{(k)}=K_2ZnO_2+H_2$

4) Metallarning tuzlar bilan ta’siridan:

$Cu+2AgNO_3=Cu(NO_3)_2+2Ag$

$Fe+CuSO_4=FeSO_4+Cu$

5) Asosli oksidlarning kislotalar bilan ta’siridan:

$CuO+2HNO_3=Cu(NO_3)_2+H_2O$

6) Asoslarning kislotali oksidlar bilan ta’siridan:

$Ca(OH)_2+CO_2=CaCO_3+H_2O$

7) Asoslar va kislotalarnning o‘zaro ta’sir: (neytrallanish reaksiyasi)

$Fe(OH)_2+H_2SO_4=FeSO_4+2H_2O$

8) Kislotali oksidlarning tuzlar bilan ta’siri:

$Na_2CO_3+SO_2=Na_2SO_3+CO_2\uparrow$

9) Yaxshi eriydigan 2 ta tuzning o‘zaro ta’siridan:

$AgNO_3+NaCl=AgCl\downarrow+NaNO_3$

10) Tuzlarning ishqorlar bilan ta’siridan:

$Cu(NO_3)_2+2NaOH=Cu(OH)_2\downarrow+2NaNO_3$

11) Tuzlarning kislotalar bilan ta’siridan:

$NaCl+H_2SO_{4(k)}=NaHSO_4+HCl$

12) Galogenlarning ishqorlarda erishidan:

$Cl_2+2KOH=KCl+KClO+H_2O$

13) Metallmaslarning tuzlar bilan ta’siridan:

$2NaJ+Cl_2=2NaCl+J_2$

14) Ikkita tuzning o‘zaro ta’siridan:

$4KCN+Fe(CN)_2=K_4[Fe(CN)_6]$

15) Ammiakning kislotalar bilan ta’siridan:

$NH_3+HNO_3=NH_4NO_3$

Fizikaviy xossalari.

Barcha tuzlar qattiq moddalardir. Ular suvda har xil eriydi.

Kimyoviy xossalari.

1) Tuzlar temperatura ta’sirida parchalanadi.

$CaCO_3 \xrightarrow{t^{\circ}C} CaO+CO_2$ $Cu(NO_3)_2 \xrightarrow{t} CuO+2NO_2+{}^1/_2O_2$

2) Nordon tuzlar ishqor va kislotalar bilan ta’sirlashadi.

$NaHCO_3+NaOH=Na_2CO_3+H_2O$

3) Asosli tuzlar ishqor ta’sirida asos va yangi tuz hosil qiladi.

$Fe(OH)_2Cl+KOH=Fe(OH)_3+KCl$

4)Tuz eritmalari va aktivroq metall orasida o‘rin olish reaksiyasi sodir bo‘ladi.

$$Fe+CuSO_4=Cu+FeSO_4$$

5)Barcha eruvchan tuzlar dissotsilanadi:

$$Me_nAc_m \leftrightarrow nMe^{m+} + mAc^{n-}$$

VIII BOB. KIMYOVIY EKVIVALENT

Mavzu: Kimyoviy ekvivalent. Ekvivalentlar qonuni

Ta'rif: *Oddiy va murakkab moddaning 1g vodorod yoki 8g kislorod bilan qoldiqsiz birika oladigan yoki almashinadigan qismiga kimyoviy ekvivalent deyiladi va E harfi bilan belgilanadi.*

Oddiy moddaning ekvivalentini topish uchun uning atom massasi valentligiga bo'linadi:

$$E_A = \frac{A_r}{Val} \qquad E_{Na} = \frac{23}{1} = 23g \qquad E_{Ca} = \frac{40}{2} = 20$$

$$E_{Al} = \frac{27}{3} = 9g \qquad E_{Fe^{II}} = \frac{56}{2} = 28g \qquad E_{Fe^{III}} = \frac{56}{3} = 18{,}67g$$

Murakkab moddaning ekvivalentini topish.

1) Oksidlarning ekvivalentini topish uning molyar massasi oksidning umumiy valentligiga bo'linadi:

$E_{Na_2O} = \frac{62}{2} = 31g$ $E_{CaO} = \frac{56}{2} = 28g$ $E_{Al_2O_3} = \frac{102}{6} = 17g$

2) Asosning ekvivalentini topish uchun uning molyar massasi metall valentligiga bo'linadi.

$E_{NaOH} = \frac{40}{1} = 40g$ $E_{Mg(OH)_2} = \frac{58}{2} = 29g$

$$E_{Al(OH)_3} = \frac{78}{3} = 26g$$

3) Kislotaning ekvivalentini topish uchun uning molyar massasi vodorod soni ya'ni uning negiziga bo'linadi.

$E_{HCl} = \frac{36,5}{1} = 36,5g$ $E_{H_2SO_4} = \frac{98}{2} = 49g$ $E_{H_3PO_4} = \frac{98}{3} = 32,67g$

4) Tuzning ekvivalentini topish uchun uning molyar massasi umumiy valentligiga bo'linadi.

$E_{NaCl} = \frac{58,5}{1} = 58,5g$ $E_{Na_2CO_3} = \frac{106}{2} = 53g$ $E_{Al_2(SO_4)_3} = \frac{342}{6} = 57g$

1793 yil nemis olimlari Vensel va Rixter ekvivalentlar qonuni kashf etishdi.

Ta'rif: *Moddalar reaksiyaga o'z ekvivalentlariga muvofiq kirishadi va hosil bo'ladi.*

$Mg+H_2SO_4 = MgSO_4 + H_2$

E= 12 49 60 1

$Al_2O_3+6HCl=2AlCl_3+3HOH$

17 36,5 44,5 9

Agar reaksiya davomida kislota yoki asos to'lig'icha o'z funksional guruhlarini almashtirmasa, ekvivalenti shunga ko'ra topiladi.

$3NaOH+H_3PO_4=Na_3PO_4+3H_2O$

40 32,67

$2NaOH+H_3PO_4=Na_2HPO_4+2H_2O$

40 49

$NaOH+H_3PO_4=NaH_2PO_4+H_2O$

40 98

Oksidlanish – qaytarilish reaksiyalarida oksidlovchi yoki qaytaruvchining ekvivalenti ular qabul qilgan yoki bergan elektronlar soniga bo'linadi.

$$10FeSO_4+2KMnO_4+8H_2SO_4=5Fe_2(SO_4)_3+2MnSO_4+K_2SO_4+8H_2O$$

$Fe^{+2} - \bar{e} \rightarrow Fe^{+3}$ 1

$Mn^{+7} + 5\bar{e} \rightarrow Mn^{+2}$ 5 $E_{FeSO_4} = \frac{152}{1} = 152g$ $E_{KMnO_4} = \frac{158}{5} = 31,6g$

IX BOB. KIMYOVIY KINETIKA

Mavzu: Kimyoviy reaksiyalar tezligi

Ba'zi reaksiyalar juda sekin (masalan, temirning zanglashi, fermentativ reaksiyalar) boshqalari juda tez (masalan, "qaldiroq gaz" ning portlashi) boradi. Bu esa reaksiya tezligiga bog'liq.

Kimyoviy reaksiya tezligi bilan shug'ullanadigan kimyo bo'limiga *kimyoviy kinetika* deyiladi.

Ta'rif: *Vaqt birligi ichida reaksiyaga kirishuvchi yoki reaksiya natijasida hosil bo'luvchi moddalar konsentratsiyalarining o'zgarishiga kimyoviy reaksiya tezligi deyiladi.*

Masalan: $A+B \leftrightarrow AB$

Reaksiyada, A modda konsentratsiyasi C_0 bo'lsin t_1 vaqtdan keyin A modda konsetratsiyasi C_1 ga kamayadi($C_1<C_0$).

Reaksiya tezligi quydagi formula bilan ifodalanadi.

$$\upsilon=\pm\frac{c_1-c_0}{t_1-t_0}=\pm\frac{\Delta c}{\Delta t}$$

bu yerda c_0 – dasrlabki konsenrtatsiya [mol/l]

c_1 – keying konsentratsiya [mol/l]

Δt – vaqt oralig'i yoki reaksiya davom etish vaqti [sek]

Agar $c=\frac{n}{V}$ ifodani qo'ysak

$$\upsilon=\pm\frac{\Delta n}{V\Delta t}\ \text{[mol/l sek]}$$

bu yerda, Δn – modda miqdorining o'zgarishi [mol]

V – reaktor hajmi [l]

M1. Hajmi 5 l bo'lgan reaktorda reaksiya borishi natijasida 30 sek davomida konsentratsiyasi 6,8 moldan 3,4 molgacha kamaysa shu reaksiya tezligi ($mol\cdot l^{-1}\cdot sek^{-1}$) hisoblang.

V=5 l

Δt=30sek

n_1=6,8 mol

n_2=3,4 mol

υ-?

$$\upsilon=\frac{n_1-n_2}{V\Delta t}=\frac{6,8-3,4}{5\cdot 30}=0,023\ \text{mol/l sek}$$

M2. Agar tenglamasi A+B=2C bo'lgan reaksiyada B moddaning konsentratsiyasi 2 minut davomida 0,4 mol/l dan 0,15mol/l gacha kamaygan bo'lsa, reaksiya tezligi B modda konsentratsiyasi uchun qanday bo'ladi?

Δt=2min=120sek

c_1=0,4mol/l

c_2=0,15mol/l

υ-?

$$\upsilon=\frac{c_1-c_2}{\Delta t}=\frac{0,4-0,15}{120}=2,1\cdot 10^{-3}\text{mol/l sek}$$

Mavzu: Kimyoviy reaksiya tezligiga ta'sir etuvchi omillar.

Kimyoviy reaksiya tezligiga quyidagi omillar ta'sir qiladi:

1) Konsentratsiya
2) Temperatura
3) Moddalarning maydalanish darajasi
4) Bosim (agar gaz modda ishtirok etsa)
5) Katalizator.

1. Konsentratsiya ta'siri.

Konsentratsiya ta'siri "Massalar ta'siri qonuni" bilan aniqlanadi. Bu qonunni 1867 yil Norvegliyalik ikki olim Guldberg va Vaage kashf etishgan.

Ta’rif: *Kimyoviy reaksiya tezligi reaksiyaga kirishayotgan moddalar konsentratsiyalari ko‘paytmasiga to‘g‘ri proporsional.*

$$\upsilon = k \cdot C_A \cdot C_B$$

yoki $\upsilon = k[A][B]$

bu yerda C_A, [A] – A modda konsentratsiyasi [mol/l]

C_B, [B] – B modda konsentratsiyasi [mol/l]

k – tezlik konstantasi.

Agar $C_A=C_B=1$ bo‘lsa, $\upsilon=k$

Ya’ni tezlik konstantasi reaksiyaga kirishayotgan moddalar konsentratsiyalari 1 ga teng bo‘lgandagi kimyoviy reaksiya tezligidir.

k– tezlik konstantasi moddalar tabiatiga, temperaturaga va katalizatorga bog‘liq. U konsentratsiyaga bog‘liq emas.

aA+bB=cC+dD reaksiya uchun

$\upsilon=k \cdot C_A^a \cdot C_B^b$ yoki $\upsilon=k \cdot [A]^a \cdot [B]^b$

M3. Agar SO_2 konsentratsiyasi 4 marta oshirilsa, quyidagi $2SO_2+O_2=2SO_3$ reaksiya tezligi necha marta ortadi?

$\upsilon=k \cdot [SO_2]^2=1 \cdot 4^2=16$ marta ortadi.

M4. Quyidagi reaksiyada kislorod o‘rniga havo ishlatilsa ($\varphi(O_2)=20\%$), reaksiya tezligi qanday o‘zgaradi.

$$4NH_3+5O_2=4NO+6H_2O$$

$[O_2]=\frac{1}{5}$ $\upsilon=[O_2]^5=\frac{1}{5^5}=\frac{1}{3125}$ 3125 marta kamayadi.

Umuman olganda, moddalar konsentratsiyasi ortsa, reaksiya tezlashadi, kamaysa reaksiya sekinlashadi.

2. Bosim ta’siri.

Bosim faqat gaz moddalar ishtirokidagi reaksiyalar tezligiga ta’sir qiladi.

Bosim ta’sirini xuddi konsentratsiya ta’siridek yozish mumkin.

$$\upsilon=k \cdot P_A^a \cdot P_B^b$$

Ya’ni bosim ortsa, tezlik oshadi.

M5. Quyidagi sistemaning bosimi 3 marta oshirilsa, reaksiya tezligi necha marta oshadi.

$2CO_{(g)}+O_{2(g)}=2CO_{2(g)}$

$\upsilon=P_{CO}^2 \cdot P_{O_2} = 3^2 \cdot 3 = 27$ marta ortadi.

Shuningdek, bosim ta’siri idish hajmi misolida ham berilishi mumkin. Ya’ni idish hajmi necha marta kamaytirilsa bosim shuncha ortadi. Natijada reaksiya tezlashadi.

Bosimga bog‘liq masalalarda u faqat gaz moddaga ta’sir qilishiga e’tibor qaratish kerak.

M6. Kislorodning qaysi moddalar bilan reaksiya tezligi faqat kislorodning bosimga bog‘liq.

1) H_2	$2H_2+O_2=2H_2O$	$\upsilon=k \cdot P_{H_2}^2 \cdot P_{O_2}$	
2) CO	$2CO+O_2=2CO_2$	$\upsilon=k \cdot P_{CO}^2 \cdot P_{O_2}$	
3) N_2	$N_2+O_2 \xrightarrow{2000^\circ C} 2NO$	$\upsilon=k \cdot P_{N_2} \cdot P_{O_2}$	
4) C	$C+O_2 \rightarrow CO_2$	$\upsilon=k \cdot P_{O_2}$	(+)
5) Cl_2	$Cl_2+O_2 \rightarrow ?$		
6) Fe	$3Fe+2O_2=Fe_3O_4$	$\upsilon=k \cdot P_{O_2}^2$	(+)

3. Maydalanish darajasi ta’siri.

Moddalar qancha ko‘p maydalangan bo‘lsa, reaksiya tezligi shuncha ortadi. Chunki, bunda yuza sirti ortadi.

Masalan, granula holidagi moddalarga qaraganda kukun holidagi moddalar tezroq reaksiyaga kirishadi. Chunki, reaksiya rezligi zarrachalar to‘qnashishlari soniga bog‘liq.

4. Temperatura ta’siri.

Kimyoviy reaksiya tezligi temperaturaga bog‘liq va bu bog‘liqlik Vant – Goff qoidasiga binoan aniqlanadi.(1884)

Ta’rif: *Ko‘pchilik reaksiyalar tezligi temperatura har 10°C ga ortganda 2 – 4 marta ortadi.*

$$\frac{v_{t_2}}{v_{t_1}} = \gamma^{\frac{t_2-t_1}{10}}$$

Bu yerda $v_{t_1} - t_1 -$ temperaturadagitezlik;

$v_{t2} - t_2 -$ temperaturadagi tezlik;

t_1 va $t_2 -$ dastlabki va keying temperatura, [°C].

γ – reaksiya tezligining temperatura koeffitsiyenti, u 2 – 4 oralig‘ida bo‘ladi.

M1. Agar temperatura 10°C dan 50°C gacha oshsa, reaksiya tezligi qanday o‘zgaradi.

Reaksiya tezligining temperaturaga koeffitsiyenti 2 ga teng.

γ=2
t_1=10°C
t_2=50°C
$\frac{v_{t_2}}{v_{t_1}} -$?

$\frac{v_{t_2}}{v_{t_1}} = \gamma^{\frac{t_2-t_1}{10}} = 2^{\frac{50-10}{10}} = 2^4 =$16 marta oshadi

Har bir temperaturada reaksiyaning tugallanish vaqti va ushbu temperaturalardagi tezlik orasida quyidagi bog‘liqlik bor.

$$\frac{v_{t_2}}{v_{t_1}} = \frac{\tau_1}{\tau_2}$$

$\tau_1 - t_1$ temperaturada reaksiyaning tugash vaqti, [sek]

$\tau_2 - t_2$ temperaturadagi reksiyaning tugash vaqti, [sek]

Qoidaga binoan temperatura qancha yuqori bo‘lsa, reaksiya shuncha tez tugaydi.

M2. Reaksiya tezligining temperatura koeffitsiyenti 3 ga teng bo‘lgan reaksiya 20°C da 9 minutda tugaydi. Shu reaksiya 40°C da qancha vaqt davom etadi?

γ=3
t_1=20°C
t_2=40°C
τ_1=9 min =540sek
τ_2-?

$v_{t_1} = \gamma^{\frac{t_1-0}{10}} = 3^2 = 9$ $\quad v_{t_2} = \gamma^{\frac{t_2-0}{10}} = 3^4 = 81$

$\frac{v_{t_2}}{v_{t_1}} = \frac{\tau_1}{\tau_2}$

$\tau_2 = \frac{v_{t_1} \cdot \tau_1}{v_{t_2}} = \frac{9 \cdot 540}{81} = 60$ sek=1minut

Mavzu: Katalizatorning reaksiya tezligiga ta’siri. Aktivlanish energiyasi.

Ta’rif: *Kimyoviy reaksiya tezligi vaqt birligi ichida sodir bo‘ladigan aktiv to‘qnashuvlar sonidir.*

Nazariy hisoblasak, barcha reaksiyalarda to‘qnashuvlar soni 10^{28} tani tashkil qiladi. Unda barcha reaksiya portlash orqali sodir bo‘lishi kerak edi.

Lekin amalda barcha to‘qnashuvlar ham reaksiyaga sabab bo‘lavermaydi. Chunki reaksiyaga aktiv molekulalar kirisha oladi.

Ta’rif: *Zarrachalarga to‘qnashishda reaksion to‘qnashish uchun kerak bo‘lgan energiya aktivlanish energiyasi deyiladi va E_a harfi bilan belgilanadi. [kJ/mol]*

Molekula va atomlarning kerakli aktivlanish energiyasini temperaturani oshirib va katalizator qo‘llab berish mumkin.

Ta’rif: *Reaksiya tezligini o‘zgartiradigan, lekin reaksiya natijasida kimyoviy jihatdan o‘zgarmaydigan moddalarga katalizatorlar deyiladi.*

Ya’ni katalitik reaksiyalarda tezlik oshishi yoki kamayishi mumkin. Uning ta’siriga ko‘ra katalizatorlar 2 ga:

1) (+) Musbat kataliz - reaksiya tezligini oshiradi.
2) (-) Manfiy kataliz – reaksiya tezligini pasaytiradi.

Ta'rif: *Reaksiya tezligini pasaytiruvchi moddalarga ingibitorlar deyiladi.*

Katalitik reaksiyalar o'ziga xos xususiyatlarga ega. Birinchidan, ular juda kam miqdor qo'shiladi. Masalan, 1 dona Pt zarrachasi 1 sek davomida 10^5 ta (100000 ta) H_2O_2 molekulasini parchalaydi.

Katalizator reaksiya davomida sarflanmaydi, balki ma'lum bosqichda reaksiyada ishtirok etib, oxirida erkin holda ajraladi.

Barcha katalitik jarayonlar gomogen va geterogen katalizga bo'linadi.

Gomogen katalizda dastlabki moddalar va katalizatorlar bir xil agregat holda (fazada) bo'ladi.

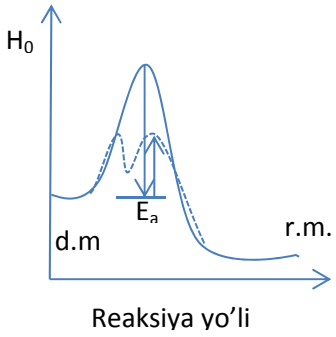
Masalan: $2SO_{2(g)} + O_{2(g)} \overset{NO_{(g)}}{\longleftrightarrow} 2SO_{3(g)}$

Geterogen katalizda dastlabki moddalar va katalizator turli xil agregat holda bo'ladi.

$$2SO_{2(g)} + O_{2(g)} \overset{V_2O_5}{\longleftrightarrow} 2SO_{3(g)}$$

Geterogen katalizda katalizator asosan to'rsimon qilib yasalgan bo'lib, reaksiya katalizatorning sirtida amalga oshadi.

Katalizator reksiyaning aktivlanish energiyasini pasaytiradi: Masalan,



$2N_2O \rightarrow 2N_2+O_2$ reaksiyaning
E_a(kat - siz)=244,8 kJ/mol
E_a(Pt)=136 kJ/mol.

Ba'zi moddalar katalizatorga qo'shilsa, uning katalitik aktivligi kuchayadi. Ular promotorlar deyiladi.

Masalan: $N_2+3H_2 \overset{Fe}{\rightarrow} 2NH_3$ reaksiyada Fe katalizatorga ozroq ishqoriy metall yoki Al_2O_3 qo'shilsa, katalitik aktivligi kuchayadi.

Boshqa xil moddalar qo'shilsa, katalitik aktivligi keskin pasayadi, yoki umuman yo'qoladi. Ularga katalitik zaharlar deyiladi. Masalan, yuqoridagi katalizatorga ozgina S qo'shilsa, Fe katalizator ishdan chiqishi mumkin.

Katalizator nafaqat tezlikni, balki reaksiya yo'nalishini ham o'zgartirishi mumkin.

Masalan, Bertole tuzi termik va katalitik parchalanishi 2 xil:

$$4KClO_3 \overset{450°C}{\longrightarrow} 3KClO_4+KCl \quad \text{(katalizatorsiz)}$$

$$2KClO_3 \overset{MnO_2\,150°C}{\longrightarrow} 2KCl+3O_2 \text{ (katalitik)}$$

Biologik organizmlarda katalizator rolini oqsil moddalar – fermentlar o'ynaydi. Ular juda ham spesifik va faol. Masalan hazm qilish fermenti – pepsin oqsil gidrolizida ishtirok etadi.

Eng muhim katalitik reaksiyalar:

1) Ammiyak sintezi- Fe katalizator:
$$N_2+3H_2 \overset{Fe}{\rightarrow} 2NH_3$$
2) Ammiakni katalitik oksidlash –Pt katalizator:
$$4NH_3+5O_2 \overset{Pt}{\rightarrow} 4NO+6H_2O$$
3) SO_2 ni kontakt apparatida oksidlash –V_2O_5 katalizator:
$$2SO_2+O_2 \overset{V_2O_5}{\longrightarrow} 2SO_3$$

X BOB. KIMYOVIY MUVOZANAT

Mavzu: Qaytar reaksiyalar va kimyoviy muvozanat

Ko‘pchilik reaksiyalar qaytar hisoblanadi.

Ta’rif: *Bir vaqtning o‘zida qarama – qarshi yo‘nalishda sodir bo‘ladigan reaksiyalar qaytar reaksiyalar deyiladi.*

Masalan: $H_2+J_2\rightarrow 2HJ$ reaksiyani olaylik

1 – reaksiya $H_2+J_2=2HJ$ to‘g‘ri reaksiya hisoblanadi. Uning tezligi

$$\upsilon_{to‘g‘ri}=k_1 \cdot C_{H_2} C_{J_2}$$

bo‘ladi, chunki bu reaksiyada dastlab HJ konsentratsiyasi 0 ga teng bo‘ladi. Vaqt o‘tishi bilan dastlabki moddalar konsentratsiyasi kamayib boradi. Shu bilan birga HJ konsentratsiyasi oshib 2 – reaksiya boshlanadi va u teskari reaksiya hisoblanadi.

2 – reaksiya $2HJ=H_2+J_2$

$$\upsilon_{teskari}=k_2 \cdot C_{HJ}^2$$

Vaqt o‘tishi bilan ikkala reaksiya tezligi tenglashadi va muvozanat vujudga keladi.

Ta’rif: *To‘g‘ri va teskari reaksiya tezligi tenglashgan sistema holatiga kimyoviy muvozanat deyiladi.*

Kimyoviy muvozanat dinamik holat hisoblanadi.

Kimyoviy muvozanatning sharti quyidagicha.

$$\upsilon_{to‘g‘ri} = \upsilon_{teskari}$$

$$k_1 \cdot C_{H_2} \cdot C_{J_2} = k_2 \ C_{HJ}^2 \ ; \qquad \frac{k_1}{k_2} = \frac{C_{HJ}^2}{C_{H_2} \cdot C_{J_2}};$$

$\frac{k_1}{k_2}$ – qiymat o‘zgarmas va u kimyoviy muvozanat konstantasi deyiladi va K_M bilan belgilanadi.

$$\frac{k_1}{k_2} = \text{const} = K_M$$

Muvozanat konstantasi qaytar reaksiyaning asosiy holatini ko‘rsatadi.

Umuman: $aA+bB\leftrightarrow cC+dD$

$$K_M = \frac{C_c^c \cdot C_D^d}{C_A^a \cdot C_B^b}; \qquad K_M = \frac{[C]^c\,[D]^d}{[A]^a\,[B]^b};$$

Muvozanat konstantasi kimyoviy reaksiyaning asosiy belgilaridan biri hisoblanadi. Uning qiymatiga qarab reaksiya qay darajada oxirigacha borish bormasligini aytish mumkin.

Qaytmas reaksiyalar uchun $K_M\rightarrow\infty$

Agar $K_M\rightarrow 0$ reaksiya deyarli sodir bo‘lmaydi.

Ta’rif: *Har qanday qaytar reaksiyada kimyoviy muvozanat holatiga kelguncha to‘g‘ri reaksiya tezligi kamayib, teskari reaksiya tezligi oshadi.*

Kimyoviy muvozanat holati bir qator tashqi omillarga bog‘liq bo‘ladi.

Ular:

1) Temperatura
2) Bosim
3) Konsentratsiya

Ularning aqalli bittasi o‘zgarsa muvozanat siljiydi.

Mavzu: Kimyoviy muvozanat siljitish shartlari

Kimyoviy muvozanatga turli omillarning ta’siri Le-Shatelye prinsipi bilan aniqlanadi(1884).

Ta’rif: *Kimyoviy muvozanatda turgan sestemada biror tashqi ta’sir o‘zgartirilsa, muvozanat shu ta’sirni kamaytiradigan tomonga siljiydi.*

1. Temperatura ta’siri.

Barcha kimyoviy reaksiyalarda entalpiya o‘zgaradi. Har qanday kimyoviy reaksiya 2 xil:

Ekzotermik - $\Delta H<0$

Endotermik- $\Delta H>0$ jarayonga muvofiq keladi.

Masalan:

$H_2+J_2 \leftrightarrow 2HJ$ $\Delta H < 0$ reaksiya ekzotermik

to‘g‘ri reaksiya $H_2+J_2 \leftrightarrow HI$ $\Delta H < 0$

teskari reaksiya $2HJ \leftrightarrow H_2+J_2$ $\Delta H > 0$

Ta’rif: *Temperatura ortishi muvozanatni endotermik reaksiya tomoniga, pasayishi ekzotermik reaksiya tomoniga siljitadi.*

Yuqoridagi reaksiyada temperatura ortishi muvozanatni chap tomonga, kamayishi o‘ng tomonga siljitadi.

2. Konsentratsiya ta’siri.

Agar temperatura o‘zgarmas bo‘lgan sharoitda (T=const) biror modda konsentratsiyasi o‘zgartirilsa muvozanat buziladi. Ma’lum vaqtdan so‘ng yangi muvozanat yuzaga keladi. Lekin bu yerda muvozanat konstantasi (K_M) o‘zgarmay qolaveradi.

Ta’rif: *Reaksiyada ishtirok etayotgan biror modda konsentratsiyasi o‘zgartirilsa shu konsentratsiyasi o‘zgartirilgan modda sarf bo‘ladi yoki hosil bo‘ladi. Ya’ni dastlabki moddalar konsentratsiyasi oshirilsa, muvozanat o‘ngga, reaksiya mahsulotlarni konsentratsiyasi oshirilsa, chap tamonga siljiydi.*

Masalan, $CO+H_2O \leftrightarrow CO_2+H_2$ reaksiyada

Suv bug‘lari yoki CO konsentratsiyasi oshirilsa muvozanat o‘ngga, CO_2 yoki H_2 konsentratsiyasi oshirilsa chap tomonga siljiydi.

$$K_M = \frac{[CO_2][H_2]}{[CO][H_2O]} = const \quad (T=const)$$

3. *Bosim ta’siri.*

Gaz moddalar ishtirok etadigan qaytar reaksiyalarda bosim bilan konsentratsiya o‘rtasida bog‘liqlik bor.

$$CO+H_2O \leftrightarrow CO_2+H_2 \quad (T=const)$$

$$K_P=\frac{P_{CO_2} \cdot P_{H_2}}{P_{CO} \cdot P_{H_2O}}$$

Ta’rif: *Gazlar ishtirokida sodir bo‘ladigan qaytar reaksiyalarda bosim oshirilsa muvozanat kam molekulali tomonga, kamaytirilsa ko‘p molekulali tomonga siljiydi*.

Masalan: $N_2+3H_2 \leftrightarrow 2NH_3$

Reaksiyada bosim oshirilsa muvozanat o‘ngga, kamaytirilsa chapga siljiydi.

Agar ikkala tarafda molekulalar soni teng bo‘lsa bosim o‘zgarishi muvozanatga ta’sir qilmaydi.

Masalan: $N_2+O_2 \leftrightarrow 2NO$ $H_2+Cl_2 \leftrightarrow 2HCl$

4. Katalizator ta’siri.

Katalizator kimyoviy muvozanatni siljitmaydi. Lekin muvozanat qaror topishini tezlatadi.

Umumiy holda

$$3H_2+N_2 \leftrightarrow 2NH_3 \quad \Delta H < 0$$

Reaksiyani o‘ng tomonga siljitish shartlari quydagicha:

(T) 1. Reaksiya ekzotermik, shuning uchun temperaturani pasaytirish;

(C) 2. H_2 va N_2 konsentratsiyasini oshirish yoki NH_3 konsentratsiyasini kamaytirish;

(P) 3. Bosimni oshirish.

Mavzu: Muvozanatga doir miqdoriy masalalar yechish

Agar muvozanat holatidagi barcha dastlabki moddalarning konsentratsiyalari va reaksiya mahsulotining birining konsentratsiyasi berilsa, reaksiya mahsulotining konsentratsiyasi asosida sarflangan dastlabki moddaning konsentratsiyasi topilib, muvozanat konsentratsiyasiga qo‘shilib ularning boshlang‘ich (dastlabki) konsentratsiyasi hisoblanadi.

Ya’ni D=S+M

bu yerda D – dastlabki konsentratsiya (faqat dastlabki modda uchun);

S – sarflangan dastlabki modda konsentratsiyasi;

M – dastlabki moddaning muvozanat konsentratsiyasi.

M1. Ammiakning oksidlanish tenglamasi $NH_3 + O_2 \leftrightarrow NO + H_2O$ bo‘yicha sodir bo‘ladigan jarayon muvozanat holatiga kelganda, moddalar konsentratsiyalari $[NH_3]$=0,9mol/l, $[O_2]$=2mol/l, [NO]=0,3mol/l ga teng bo‘lgan. Muvozanat holatida suvning, ammiak va kislorodning konsentratsiyalarini [mol/l] hisoblang.

$4NH_3 + 5O_2 \leftrightarrow 4NO + 6H_2O$

	4	5	4	6
M:	0,9	2	0,3*	0,45
S:	0,3	0,375		
D:	1,2	2,375	-	-

Agar masalada dastlabki moddalardan birortasi sarf bo‘lish miqdori berilsa, uning qiymati asosida hisoblanadi.

M2. $N_2 + H_2 \leftrightarrow NH_3$ reaksiyada azot va vodorodning dastlabki konsentratsiyasi 3 va 11 mol/l ga teng. Vodorodning 12% miqdori reaksiyaga kirishganda muvozanat qaror topdi. Sistemadagi azot, vodorod va ammiaklarning konsemtratsiyalarini hisoblang.

	N_2 +	$3H_2$ ↔	$2NH_3$
	1	3	2
D:	3	11	-
S:	0,44	11x0,12*	0,88
M:	2,56	9,68	0,88

Agar reaksiyaning muvozanat konsentratsiyasi berilib, dastlabki moddalarning muvozanat konsentratsiyalari topilishi so‘ralsa, muvozanat holatida dastlabki moddadan *x* mol/l sarf bo‘ladi va tenglama asosida hisoblanadi.

M3. $CO_{(g)} + H_2O_{(g)} \leftrightarrow CO_{2(g)} + H_{2(g)}$ reaksiyaning muvozanat konstantasi 850°C da 1 ga teng. CO va H_2O ning boshlang‘ich konsentratsiyalari 2 va 3 mol/l bo‘lsa, ularning muvozanat holidagi konsentratsiyalarini (mol/l) aniqlang.

	$CO_{(g)} + H_2O_{(g)} \leftrightarrow CO_{2(g)} + H_{2(g)}$			
	1	1	1	1
D:	2	3		
S:	*x*	*x*	*x*	*x*
M:	2-*x*	3-*x*	*x*	*x*
J:	0,8	1,8		

$K_M = \frac{[CO][H_2O]}{[CO_2][H_2]}$ $\quad 1 = \frac{x \cdot x}{(2-x)\cdot(3-x)}$

$6-5x+x^2=x^2$

$5x=6$

$x=1,2$

har biridan 1,2 ayriladi.

Agar muvozanatda turgan sistemada biror modda konsentratsiyasi o‘zgartirilsa, muvozanat siljiydi. Bunda muvozanat konstantasi 1 muvozanat qiymatlari asosida hisoblanadi. ikkinshi muvozanatda sarf bo‘layotgan moddadan *x* mol/l ayrilib, hosil bo‘layotgan moddaga qo‘shiladi.

M4. Quyidagi sistemada A + B ↔ C + D tenglamadagi tartibda yozilgan moddalarning konsentratsiyalari (mol/l) 8 : 3 : 2 : 12 bo‘lgan. Muvozanat holatidagi sistemadan C moddadan 2 mol/l chiqarib yuborilgan. A va D larning yangi konsentratsiyalarini hsioblang.

	A + B ↔ C + D			
	1	1	1	1
M1:	8	3	2	12
M2:	8-*x*	3-*x*	*x*	12+*x*
J:	6,96			13,04

$K_M = \frac{[C][D]}{[A][B]} = \frac{2 \cdot 12}{8 \cdot 3} = 1$

$1 = \frac{x \cdot (12+x)}{(8-x)(3-x)}$ $\quad 24-11x+x^2 = 12x+x^2$

$24=23x$ $\quad x=1,04$

M5. $2NO + Cl_2 \leftrightarrow 2NOCl$ reaksiya hajmi 0,005m^3 bo‘lgan idishda olib borildi. Kimyoviy muvozanat qaror topganda (K_M=1) NOCl konsentratsiyasi 0,1mol/l ni tashkil qildi. NO ning boshlang‘ich miqdori 1,5mol bo‘lsa, xlorning muvozanat konsentratsiyasini (mol/l) hisoblang.

$2NO + Cl_2 \leftrightarrow 2NOCl$

2 1 2

M: 0,2 x 0,1*

D: 0,3

S: 0,1 0,05

$K_M = \frac{[NOCl]^2}{[NO]^2[Cl_2]}$ $1 = \frac{0{,}1^2}{0{,}2^2 \cdot x}$ x=0,25

Xlorning dastlabki konsentratsiyasi D=S+M=0,05+0,25=0,3mol/l

M6. $3H_2 + N_2 \leftrightarrow 2NH_3$ reaksiyasida vodorod va azotning dastlabki konsentratsiyalari 0,3 va 0,2 mol/l ga teng. 0,24mol/l vodorod sarf bo‘lgandan so‘ng qaror topgan holatning muvozanat konstantasini aniqlang.

$3H_2 + N_2 \leftrightarrow 2NH_3$

3 1 2

D: 0,3 0,2 -

S: 0,24* 0,08 0,16

M: 0,06 0,12 0,16

$K_M = \frac{[NH_3]^2}{[H_2]^3[N_2]} = \frac{0{,}16^2}{0{,}06^3 \cdot 0{,}12} = 988$

XI BOB. ERITMALAR

Mavzu: Dispers sistemalar va kolloid eritmalar

Ko‘pchilik moddalar bir-birida tarqaladi va bu tarqalish natijasida gomogen yoki geterogen sistema hosil bo‘ladi.

Ta’rif: *Bir modda ichida ikkinchi bir moddaning mayda zarrachalari tarqalishidan hosil bo‘lgan mikrogeterogen sistemalar dispers sistemalar deyiladi.*

Dispers sistemalar (DS) *dispersion muhit* (DM) va *dispers fazadan* (DF) iborat.

DS lar bir-biridan DM va DF ning agregat holati va zarrchalarning o‘lchamiga(disperslik darajasiga) ko‘ra farqlanadi.

DS larning agregat holatiga ko‘ra sinflanishi:

DM		DF	DM		DF	DM		DF
G		G	S	ko‘piklar	G	Q	pemza	G
G	aerozol, tuman	S	S	emulsiya	S	Q	marvarid	S
G	chang, tuman	Q	S	suspenziya	Q	Q	brilliant	Q

Disperslik darajasiga DS lar 3 ga bo‘linadi:

1) Dag‘al DS lar;
2) Kolloid eritmlar;
3) Chin eritmalar.

Chin eritmalar	Kolloid eritmalar	Dag‘al DS lar
<1 nm		>100 nm

Dag‘al DS larda zarrachalar o‘lchami 100nm dan katta bo‘ladi. Ular *suspenziya* va *emulsiyaga* bo‘linadi.

Suspenziyada suyuqlik ichida qattiq modda zarrachalari tarqalgan bo‘ladi. Masalan, loyqa suv. Emulsiyalarda suyuqlik ichida ikkinchi bir suyuqlik tarqaladi. Masalan, sut va bo‘yoqlar. Suspenziya va emulsiyalar barqaror bo‘lmaydi.

Kolloid eritmalarda zarrachalar o‘lchami 1÷100nm bo‘ladi. Ular *“zollar”* ham deyiladi. Ular nisbatan barqaror. Masalan, AgJ, $Fe(OH)_3$, As_2S_3, oqsillar.

Kolloid eritmalar nurni konussimon sochadi va bunga Tindal effekti deyiladi (1868). Shuningdek ularning zarrachalari qo‘shilishib yiriklahsadi va bu hodisaga *koagulyatsiya* deyiladi.

Chin eritmalarda zarrachalar o‘lchami 1nm dan kichik bo‘ladi. Ularda zarrachalar atom yoki molekula holida bo‘ladi. Uning zarrachalarini hatto mikroskop ostida ham ko‘rib bo‘lmaydi.

Ta’rif: *Ikki yoki undan ortiq tarkibiy qismdan (komponent) tashkil topgan bir jinsli (gomogen) sistemaga eritma deyiladi.*

Eritma *erituvchi* va *erigan modda*dan tashkil topadi.

Eritmalar ularni tashkil qiluvchi moddalarning agregat holatiga ko‘ra gaz, suyuq yoki qattiq holda bo‘ladi. Gazsimon eritmalarga havo misol bo‘lsa, qattiq eritmalarga qotishmalar misol bo‘ladi.

Eng ko‘p o‘rganilgani bu – chin eritmalardir.

Mavzu: Moddalarning suvda erishi. Eruvchanlik

Eritmalar hosil bo‘lishida fizikaviy va kimyoviy jarayonlar sodir bo‘ladi. Qattiq moddalar erishida uning zarrachalari erituvchi ta’siridan “buziladi”. Suyuq moddalar eritmlarining hosil bo‘lishida eriydigan va erituvchi moddalarning molekulalari o‘zaro aralashadi.

Eritmalar hosil bo‘lishida erigan modda bilan erituvchi molekulalari o‘zaro ta’sirlashadi. Masalan, kristallogidratlar hosil bo‘ladi.

$$Na_2CO_3 + 10H_2O = Na_2CO_3 \cdot 10H_2O$$

$$CuSO_4 + 5H_2O = CuSO_4 \cdot 5H_2O$$

Barcha sistemadagi kabi, eritmalar hosil bo‘lishida ham entalpiya o‘zgaradi (ΔH). Ko‘pchilik moddalar suvda eriganda issiqlik ajralib chiqadi. Ya’ni jarayon ekzotermik ($\Delta H<0$). bunday

moddalarga NaOH, KOH, H_2SO_4, HCl, HNO_3, glitserin va shakar misol bo‘ladi. Boshqa xil moddalar suvda eriganda issiqlik yutiladi. Ya’ni jarayon endotermik ($\Delta H>0$). Bunday moddalarga $NaNO_3$, KNO_3, NH_4NO_3, KSCN va $CuSO_4$ misol bo‘ladi. Shuningdek ba’zi moddalar erishida hech qanday issiqlik hodisasi kuzatilmaydi. Masalan, J_2 ning CCl_4 da erishida.

Ta’rif: *Moddaning biror erituvchida eriy olish qobiliyatiga eruvchanlik deyiladi.*

Eruvchanlik quyidagilarga bog‘liq.

1. Modda tabiatiga
2. Temperaturaga
3. Bosimga

1. Qutbli moddalar qutbli erituvchilarda (masalan, suvda) yaxshi eriydi. Qutbsiz moddalar qutbsiz erituvchilarda (organik moddalar, CCl_4, xloroform, benzol, geksan) yaxshi eriydi. Masalan: tuzlar, kislotalar va asoslar suvda yaxshi eriydi. J_2 xloroformda, yog‘ benzolda yaxshi eriydi.
2. Temperatura ortishi bilan qattiq va suyuq moddalarning eruvchanligi temperatura ortishi bilan ortadi. Gazlarniki kamayadi.
3. Gazlarning suyuqliklarda erishi ekzotermik jarayon hisoblanib, bosim ortishi bilan ularning eruvchanligi ortadi. (Genri qonuni 1802 yil).

Moddalarning eruvchanligini miqdoriy ifodalash uchun eruvchanlik koeffitsiyentidan foydalaniladi.

Ta’rif: *Ayni temperaturada 100g erituvchida erigan moddaning grammlar soniga eruvchanlik koeffitsiyenti deyiladi va S harfi bilan belgilanadi.*

Ko‘pchilik hollarda erituvchi sifatida suv ishlatiladi va eruvchanlik koeffitsiyentiga ko‘ra moddalar 3 ga bo‘linadi .

1. Yaxshi eriydigan S>10g
2. Oz eriydigan S=0,001-10g
3. Erimaydigan S<0,001g

Shuningdek eritmalar erigan moddaning eruvchanlik koeffitsiyentiga nisbatan 3 ga bo‘linadi.

1. To‘yinmagan
2. To‘yingan
3. O‘ta to‘yingan eritmalar

1. To‘yinmagan eritmada ma’lum miqdor erituvchida eruvchanlik koeffitsiyentidan kam miqdorda modda erigan bo‘ladi.

2. To‘yingan eritmalarda ayni temperaturada ma’lum miqdordagi erituvchida eruvchanlik koefetsiyentiga teng modda erigan bo‘ladi.

3. O‘ta to‘yingan eritmada ayni temperaturada eruvchanlik koeffitsiyentidan ko‘p modda bo‘ladi. Bunday eritma o‘z cho‘kmasi bilan dinamik muvozanatda bo‘ladi. O‘ta to‘yingan eritmadan qayta kristallashda foydalaniladi. Buning uchun o‘ta to‘yingan eritma sovutiladi va kristallar hosil bo‘ladi.

Lekin eritmalarning to‘yinuvchanligi temperaturaga bog‘liq. Ayni temperaturada to‘yingan eritma temperatura ortirilganda to‘yinmagan eritmaga aylanishi mumkin.

Mavzu: Konsentrlangan va suyultirilgan eritmalar. Eritmalar konsentratsiyasi

Eritmalarning asosiy miqdoriy tavsifi sifatida ularning konsentratsiyasi ishlatiladi.

Ta’rif: *Eritmada yoki erituvchining ma’lum massa miqdorida yoki ma’lum hajmida erigan modda miqdori eritmaning konsentratsiyasi deyiladi va C harfi bilan belgilanadi.*

Eritmalarning konsentratsiyasini taxminiy ifodalash uchun *suyultirilgan* va *konsentrlangan* eritmalar tushunchachalaridan foydalaniladi.

Erituvchi miqdori erigan modda miqdoridan ko‘p bo‘lgan eritmalar suyiltirilgan eritmalar deyiladi. Masalan: 10% li sulfat kislota eritmasi . $m(H_2SO_4):m(H_2O)=10:90=1:9$

Konsentrlangan eritmalarda erigan modda miqdori erituvchi miqdoridan ko‘p bo‘ladi. Masalan: 98% li H_2SO_4 eritmasi $m(H_2SO_4):m(H_2O)=98:2=49:1$

Eritmalar konsentratsiyasini aniq ifodalash uchun quyidagi konsentratsiya birliklaridan foydalaniladi:

1. Foiz konsentratsiya, massa ulush-ω [%];
2. Molyar konsentratsiya – C_M, [M; mol/l];
3. Normal konsentratsiya – C_N, [N; mol-ekv/l];
4. Titr -T [g/ml];
5. Molyal konsentratsiya – C_m, [mol/kg]
6. Mol qismi – *X*.

Mavzu: Massa ulushi yoki foiz konsentratsiya

Ta'rif: *100g eritmada erigan modda massasiga eritmaning massa ulushi deyiladi va ω harfi bilan belgilanadi [%] larda ifodalanadi.*

$$\omega = \frac{m_{modda}}{m_{eritma}} \cdot 100\% = \frac{m_{modda}}{m_{modda} + m_{suv}} \cdot 100\%$$

Eritma zichligi quyidagi formula bilan ifodalanadi:

$$\rho = \frac{m}{V} \text{ [g/ml; g/sm}^3\text{]}$$

bu yerda *m* – eritma massasi [g];
V – eritma hajmi [ml].

M1. 10g sulfat kislota 190 g suvda eriganda hosil bo'ladigan eritmaning foiz konsentratsiyasini hisoblang.

$m_{H_2SO_4}$ =10g
m_{suv}=190g
$\omega_{H_2SO_4}$ -?

$m_e=m_m+m_{suv}=10+190=200g$
$\omega_{H_2SO_4}=\frac{m_m}{m_e}=\frac{10}{200}\cdot 100\%=5\%$

M2. 400g 12% li shakar eritmasini hosil qilish uchun necha gramm shakar va suv olish kerak?

m_e=400g
ω_{sh}=12%=0,12
m_{sh} -?
m_{suv}-?

$\omega=\frac{m_m}{m_e}$
$m_{sh}=\omega\cdot m_e=0,12\cdot 400=48g$
$m_{suv}=400-48=352g$
Suvning zichligi 1g/ml ga tengligi uchun $m_{suv}=V_{suv}$, yoki 352 ml suv kerak.

Agar modda erish jarayonida uning tarkibi o'zgarib, yangi modda hosil bo'lsa o'zgarish hisobga olinadi. Masalan, ishqoriy va ishqoriy yer metallari, oksidlar va ba'zi tuzlar suvda eriganda o'zgarishga uchraydi.

M3. 20g Ca 100g suvda eriganda hosil bo'ladigan eritmaning massa ulushini hisoblang.

m(Ca)=20g
$m(H_2O)$=100g
$\omega(Ca(OH)_2)$-?

$Ca + 2HOH = Ca(OH)_2 + H_2$
40 74 2
20 *x* *y*

x=37g $Ca(OH)_2$ hosil bo'ladi
y=1g H_2 ajralib, eritma massasi kamayadi.

$m_e(20+100)-1=119$ $\omega(Ca(OH)_2)=\frac{37}{119}=0,311=31,1\%$

Agar ikkita turli konsentratsiyali eritmalar aralashtirilsa hosil bo'lgan yangi eritmaning konsentratsiyasini ifodalash uchun har bir eritmadagi moddalar massasi topiladi. Shuningdek eritma massalari qo'shilib yangi eritma konsentratsiyasi hisoblanadi.

M 4. 200g 20% li NaOH eritmasiga 300g 10% li eritma qo'shildi. Hosil bo'lgan eritmaning foiz konsentratsiyasini hisoblang.

$^{1E}m_e$=200g
m_m=20%=0,2
$^{2E}m_e$=300g

$m_e = m_e+m_e=200+300=500g$
$m_m=m_m+m_m=40+30=70g$

ω=10%=0,1 $\omega=\frac{m_m}{m_e}\cdot 100\%=\frac{70}{500}\cdot 100\%=14\%$

ω-?

yoki,

	m_e	m_m	ω
1	200	40	20%
2	300	30	10%
3	500	70	14%

Agar ma'lum konsentratsiyali eritmaga suv qo'shsak, yani suyultirsak, uning konsentratsiyasi pasayadi.

M5. 200g 10% li osh tuzi eritmasiga 200ml suv qo'shildi. Hosil bo'lgan eritma konsentratsiyasini (%)ni toping.

m_e=200g m_m= 200·0,1=20g

ω_1=10%=0,1 m_e=200+200=400g

m_s=200g $\omega=\frac{mn}{me}\cdot 100\%=\frac{20}{400}\cdot 100\%=5\%$

ω_2-?

M6. 205g 17%li shakar eritmasining konsentratsiyasini 7% ga tushirish uchun qancha suv qo'shish kerak?

m_e =205g m_m=205·0,17=34,85g

ω_1=17%=0,17 $\omega=\frac{m_m}{m_e}$

ω_2=7%=0,07 $0,07=\frac{34,85}{205+x}$

m_{suv}-? $14,35+0,07x=34,85$ x=293g

M7. 330g 30% li osh tuzi eritmasining konsentratsiyasini 60% ga oshirish uchun qancha suvni bug'latish talab etiladi?

m_e=330g m_e=330·0,3=99g

ω_1=30%=0,3 $\omega=\frac{m_m}{m_e}$

ω_2=60%=0,6 $0,6=\frac{99}{330-x}$ x=165g

m_{suv}-?

Agar eritma tayyorlanishida kristallogidrat berilgan bo'lsa, avval kristallogidrat tarkibidagi tuzning massasi topiladi keyin eritma massasiga bo'linadi.

M8. 114,8g $ZnSO_4\cdot 7H_2O$ kristallogidrati 85,2g suvda eritilganda hosil bo'lgan tuzning massa ulushini toping.

$m(ZnSO_4\cdot 7H_2O)$=114,8g $ZnSO_4\cdot 7H_2O = ZnSO_4$

m_{suv}=85,2g 287g - 161g

$\omega(ZnSO_4)$-? 114,8g - x=64,4g

m_e=114,8+85,2=200g

$\omega(ZnSO_4)=\frac{m_m}{m_e}=\frac{64,4}{200}\cdot 100\%=32,2\%$

Mavzu: Molyar konsentratsiya yoki molyarlik

Ta'rif: *1 litr eritmada erigan moddaning mollar soniga eritmaning molyar konsentratsiyasi deyiladi va C_M harfi bilan belgilanadi.*

$$C_M=\frac{n}{V} \quad [M; mol/l]$$

$n=\frac{m}{M}$ formuladan $C_M=\frac{m}{M\cdot V}$

bu yerda n- erigan modda miqdori [mol];

V-eritma hajmi [l];

m- erigan modda massasi [g];

M- erigan modda molyar massasi [g/mol].

M1. 2 litr eritmada 49g sulfat kislota erigan bo‘lsa, eritmaning molyar konsentratsiyasini toping.

V=2 l
$m(H_2SO_4)$=49g
C_M-?

$n(H_2SO_4)=\frac{49}{98}=0,5\ mol$

$C_M=\frac{n}{V}=\frac{0,5}{2}=0,25M$

Agar eritmaning foiz konsentratsiyasi (ω) va zichligi (ρ) berilgan bo‘lsa o‘tish formulasidan foydalaniladi. Bu formulada foiz konsentratsiya 100 ga bo‘lmasdan ishlatiladi.

$$\omega \rightarrow C_M$$

$$C_M=\frac{10\cdot\omega\cdot\rho}{M}$$

bu yerda ω- eritmaning foiz konsentratsiyasi [%];
ρ- eritma zichligi [g/ml];
M-erigan modda molyar massasi [g/mol].

M2. 20% li (ρ=1,2g/ml) NaOH eritmasining molyar konsentratsiyani hisoblang.

ω=20%
ρ=1,2g/ml
C_M-?

$C_M=\frac{10\cdot w\cdot\rho}{M}=\frac{10\cdot20\cdot1,2}{40}$=6M

Mavzu: Normal konsentratsiya yoki normallik

Ta’rif: *1 litr eritmada erigan moddaning gramm ekvivalentlar soni bilan ifodalanishiga eritmaning normal konsentratsiyasi deyiladi va C_N bilan belgilanadi.*

$$C_N=\frac{m}{E\cdot V}$$ [mol-ekv/l]

bu yerda m-erigan modda massasi [g];
E-erigan modda gramm ekvivalenti[g/ekvivalent];
V-eritma hajmi [l].

M1. 4 l eritmada 30g H_3PO_4 erigan bo‘lsa, eritmaning normal konsentratsiyasini hisoblang.

V=4 l
$M_{H_3PO_4}$= 30g
C_N-?

$C_N=\frac{m}{E\cdot V}=\frac{30}{32,67\cdot4}=0,23N$

Agar eritmaning foiz konsentratsiyasi (ω) va zichligi (ρ) berilgan bo‘lsa, uning normal konsentratsiyasini topish uchun o‘tish formulasidan foydalaniladi.

$$\omega \rightarrow C_N$$

$$C_N=\frac{10\cdot\omega\cdot\rho}{E}$$

bu yerda ω-eritma foiz konsentratsiyasi[%];
ρ-eritma zichligi [g/ml];
E-erigan modda ekvivalenti [g/ekv].

M2. 45% li (ρ=1,34g/ml) sulfat kislota eritmasining normal konsentratsiyasi nechaga teng?

ω=45%
ρ-1,34g/ml
C_N-?

$C_N=\frac{10\cdot\omega\cdot\rho}{E}=\frac{10\cdot45\cdot1,34}{49}=12,3N$

Eritma molyar va normal konsentratsiyasi orasida quyidagi bog‘liqlik bor. Ya’ni molyar massasi ekvivalent massasiga teng moddalar uchun $C_M=C_N$

Agar kislota asos yoki tuzning ekvivalent faktori 2, 3, 4 yoki 6 ga teng bo‘lsa, eritmaning normal konsentratsiyasi uning molyar konsentratsiyasidan shuncha katta bo‘ladi.

Masalan:

	C_M	C_N
NaOH	1	1
$Ca(OH)_2$	1	2
H_3PO_4	1	3
$Al_2(SO_4)_3$	1	6
H_2SO_4	1	2

M3 500 ml eritmada 10,4g $BaCl_2$ erigan bo‘lsa, eritmaning molyar va normal konsentratsiyasini hisoblang.

V_e=500ml=0,5 l
m($BaCl_2$)= 10,4g
C_M-?
C_N-?

N($BaCl_2$)=$\frac{10,4}{208}0,05ml$
$C_M=\frac{n}{V}=\frac{0,05}{0,5}=0,1M$
C_N=0,2N

Mavzu: Eruvchanlik koeffitsiyentiga doir masalalar

Eruvchanlik koeffitsiyenti (S) bilan eritmaning massa ulushi (ω) orasida quyidagi bog‘liqlik bor:

$$\omega=\frac{S}{S+100}\cdot 100\%$$

bu yerda S – moddaning eruvchanlik koeffitsiyenti [g].
Eruvchanlik koeffitsiyentiga doir masalalarni yechishda doim tegishli eruvchanlik koeffitsiyent qiymatini 100g suvga nisbatan olish kerak.

M1. 30°C da KNO_3 ning 50g 20% li eritmasining to‘yinishi uchun yana 6,8g KNO_3 qo‘shilishi kerak. Shu tuzning eruvchanligini aniqlang.

m_e^1=50g
ω_{KNO_3}=0,2
+m_{KNO_3}=6,8
S-?

m_{KNO_3}=50·0,2=10g
$m^1_{KNO_3}$=10+6,8g=16,8g
m_{suv}=(50+6,8)-16,8=40g
16,8g KNO_3 - 40g suv
42 = x -100g suv
$S_{30°C}$=42g

Agar turli temperaturadagi ayni tuzning eruvchanlik koeffitsentlari berilib, eritma sovutilganda qancha cho‘kma hosil bo‘lishi so‘ralsa, cho‘kma massasini hisoblash uchun eruvchanlik koeffitsentlari ayriladi.

M2. Agar ammoniy xloridning 100°C dagi to‘yingan eritmasi tarkibida 50 ml suv bo‘lsa, bu eritma 0°C gacha sovutilganda qancha ammoniy xlorid cho‘kmasi tushadi ($S_{0°C}$=37,0g $S_{100°C}$=77,0g).

$S_{0°C}$ =37g
$S_{100°C}$ =77g
m_{suv}=50g
$m_{cho‘kma}$- ?

100g suv - 40g cho‘kma
50g suv - x=20g cho‘kma

M3. $AgNO_3$ ning 60°C dagi to‘yingan eritmasi 20°C gacha sovutilganda 15g tuz cho‘kmaga tushishi uchun talab etiladigan tuz va suvning massasini toping.

$S_{20°C}$ =222g
$S_{60°C}$=450g
228g cho‘kma
$m_{cho‘kma}$=15g
m($AgNO_3$)-?
m_{suv}-?

450g $AgNO_3$ – 228g cho‘kma
x= 29,6g $AgNO_3$ - 15g cho‘kma
100g suv – 228g cho‘kma
y=6,6g suv – 15g cho‘kma

M4. 80°C da 300g to‘yingan $NaNO_3$ eritmasi 20°C gacha sovutilganda cho‘kmaga tushgan tuzning massasini va eritmada qolgan tuzning massa ulushini (%) aniqlang.

$S_{20°C}$=88g
$S_{80°C}$=148g 248g eritma – 60g cho‘kma
60g cho‘kma 300g -x= 72,6g cho‘kma
m_e=300g $\omega = \frac{S}{S+100} = \frac{88}{188} \cdot 100\% = 46{,}8\%$
$m_{cho‘kma}$ - ?
ω - ?

M5 Bir tuzning xona temperaturasidagi to‘yingan eritmasidagi massa ulushi 0,2 ga teng. Shu tuzning massa ulushi 0,3 bo‘lgan 300g eritmasi xona temperaturasigacha sovutilganda , qancha (g) tuz cho‘kmaga tushadi.

ω_1=0,2=20% $\omega=\frac{S}{S+100}$
ω_2=0,3=30%
m_e=300g $0{,}2=\frac{S}{S+100}$ $0{,}85S_1=20$ $S_1=25$g
$m_{cho‘kma}$-? $0{,}3=\frac{S}{S+100}$ $0{,}75S_2=30$ $S_2=42{,}9$g

17,9 g cho‘kma
142,9g eritma – 17,9g cho‘kma
300g - x=37,5g cho‘kma

M6. $CaBr_2$ ning 80g to‘yingan eritmasiga 20g suvsiz tuz solinib, aralashmadagi tuz erib ketgunga qadar qizdirildi va so‘ngra boshlang‘ich temperaturaga qadar sovutildi. Bunda 41,32g kristallogidrat cho‘kmaga tushdi. To‘yingan eritmadagi suvsiz tuzning massa ulushi 58,7% ga teng. Kristallogidrat formulasini toping.

$m_e^1 = 80$g $m(CaBr_2)=80\cdot0{,}587=46{,}96$g
ω_{CaBr_2}=58,7=0,587 $m_{um}(CaBr_2)=66{,}96$g
+ m_{CaBr_2}=20g (sovuq eritmada) $m(CaBr_2)=(100-41{,}52)\cdot0{,}587=34{,}33$g
$CaBr_2\cdot nH_2O$-? $m_{cho‘kma}(CaBr_2)=66{,}96-34{,}33=32{,}63$g
$m_{suv}=m_{krist} - m_{CaBr_2}=41{,}32 - 32{,}63=8{,}89$g
200g $CaBr_2$ – x | x=54g $n(H_2O)=\frac{54}{18}=3$
32,63 – 8,89g suv $CaBr_2\cdot3H_2O$

Mavzu: Plastinkalarga doir masalalar yechish.

Bunday masalalarda biror passivroq metallning eruvchan tuzi eritmasiga biror massali aktivroq metall plastinka botirilganda, aktivroq metall passivroq metallni tuzidan siqib chiqaradi. Natijada metall plastinka massasida *farq* paydo bo‘ladi. Bu farq ikkala metall molyar massalari ayirmasiga asoslanib topiladi.

$$farq = M(Me_1) - M(Me_2)$$

shu bilan birga eritmada yangi tuz hosil bo‘ladi. Masalan:

$CuSO_4 + Fe = FeSO_4 + Cu$
farq = 64-56=8g

M1. Massasi 40g bo‘lgan temir plastinka mis sulfat eritmasiga tushirildi. Plastinka massasi 43g ga yetganda eritmaga necha gramm temir o‘tadi?

farq = 43 – 40 = 3g $CuSO_4 + Fe = FeSO_4 + Cu$
56g Fe – 8g farq
x – 3g farq x=21g Fe

M2. Xlorid kislota eritmasiga massasi 50g bo‘lgan metall plastinka tushirib qo‘yildi. 336 ml (n.sh). vodorod ajaralib chiqqanda plastinka massasi 1,68% ga kamaygan. Plastinka qaysi metalldan yasalgan?

m(pl)=50g $Me + HCl = MCl_x + H_2$
ω=1,68=0,0168 0,84 0,336 l
$V(H_2)$=336ml=0,336 l x 11,2 l
M(Me)-? x=28 Fe^{II}

M3. 10g li Fe plastinka tarkibida 1,6g $CuSO_4$ bo‘lgan eritmaga tushirilganda plastinkaning massasi qanday o‘zgaradi?

m(pl)=10g $CuSO_4 + Fe = FeSO_4 + Cu$
$m(CuSO_4)$=16g 160g – 8g farq
farq-? 1,6g – x=0,08g ga ortadi.

M4. Tarkibida 4g $CuSO_4$ bo‘lgan eritmaga Cd plastinka tushirib qo‘yilgan. Mis batamom siqib chiqarilgandan keyin, plastinkaning massasi 3% ga kamaydi. Eritmaga tushirib qo‘yilgan plastinka massasini aniqlang.

$m(CuSO_4)$=4g $Cd + CuSO_4 = Cu + CdSO_4$ farq = 112 – 64 = 48 ga kamayadi
ω=3%=0,03 160g – 48g farq
m(plastinka)-? 4g – x=1,2g farq

. $\frac{farq}{m(pl)} = 0{,}03$ $\frac{1{,}2}{x} = 0{,}03$ x=40g

M5. $CuCl_2$ va $CdCl_2$ eritmalariga +2 ion hosil qiluvchi metalldan yasalgan bir xil massali plastinkalar tushirildi. Birinchi eritmaga tushirilgan plastinka massasi 1,2% ga ikkinchisi 8,4% ga ortdi. Eritmalarning molyar konsentratsiyalari bir xilda kamaygan. Plastinka qaysi metalldan iborat bo‘lgan?

ω_1=1,2% $CuCl_2 + Me = MeCl_2 + Cu$
ω_2=8,4% farq = 64–x
M(Me)-? $CdCl_2 + Me = MeCl_2 + Cd$
farq = 112–x

$\frac{64-x}{112-x} = \frac{1{,}2}{8{,}4}$ 134,4 – 1,2x = 537,6 – 8,4x

403,2 = 7,2x x=56 (Fe)

M6. Og‘irligi 100g bo‘lgan temir plastinka $CuSO_4$ ning 20% li 250g eritmasiga botirildi. Ma’lum vaqtdan so‘ng plastinka eritmadan olinib, yuvilib, quritilib tortilganda, uning massasi 102g ni tashkil etdi. Reaksiyadan so‘ng eritma tarkibidagi moddalarning massa ulushini % da aniqlang.

m_1(pl)=100g farq=2g $m(CuSO_4)$=250·0,2=50g
m_2(pl)=102g (farq=8g)
m_e =250g
$\omega_1(CuSO_4)$=20%=0,2 $CuSO_4 + Fe = FeSO_4 + Cu$
$\omega(FeSO_4)$-? 160g - 152g 8g farq
$\omega_2(CuSO_4)$-? y - x - 2g farq

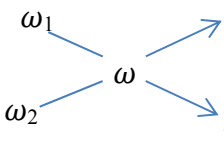
x=38g $FeSO_4$ hosil bo‘ldi $\omega_2(CuSO_4) = \frac{10}{248} \cdot 100\% = 4{,}0\%$

y=40g $CuSO_4$ sarf bo‘ldi. $\omega(FeSO_4) = \frac{38}{248} \cdot 100\% = 15{,}3\%$

$m_o(CuSO_4)$=50-40=10g m_e=250-2=248g

Mavzu: Aralashtirish usuli yoki “krest” qoidasiga asosan eritmalar tayyorlash

Agar biror massa ulushli va biror massali eritmani tayyorlash uchun ikki xil konsentratsiyalari eritmalardan qanchadan olish so‘ralsa “krest” qoidasi bilan hisoblanadi.

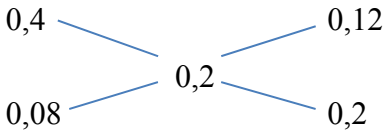


$m_1(e)=\frac{x\cdot m_e}{x+y}$

$m_2(e)=\frac{y\cdot m_e}{x+y}$

bu yerda, ω_1 – 1-eritmaning massa ulushi;
ω_2 – 2-eritmaning massa ulushi;
ω – tayyorlanishi kerak bo‘lgan eritmaning massa ulushi;
m_1 (e) – 1 eritmadan olinishi kerak bo‘lgan massa[g];
m_2 (e) – 2 eritmadan olinishi kerak bo‘lgan massa[g];
m_e – umumiy eritma massasi[g].

M1. Osh tuzining 20% li eritmasidan 300g tayyorlash uchun uning 8% li va 40% li eritmalardan qanchadan olish kerak.



$m(40\%)=\frac{0,12\cdot 300}{0,2+0,12}=112,5g$

$m(8\%)=\frac{0,2\cdot 300}{0,2+0,12}=187,5g$

Agar tayyorlanishi zarur bo‘lgan eritma massasi berilmasa massa ulushi tenglamasidan foydalaniladi.

M2. O‘yuvchi kaliyning 30% li eritmasini hosil qilish uchun uning 15% li 300g eritmasiga 40% li eritmasidan qancha miqdorda qo‘shish kerak.

ω=30% =0,3
$m_e^1=300g$
ω_1(KOH)= 15%=0,15
ω_2(KOH)=40%=0,4
$m_e^2-?$

$\omega=\frac{m_m}{m_e}$

$0,3=\frac{45+0,4x}{300+x}$

$90+0,3x=45+0,4x$

$0,1x=45$ x=450g (40%)li

Agar ma’lum massali va konsentratsiyali eritma tayyorlash uchun kristallogidrat tuzi va pastroq konsentratsiyali eritmadan qanday nisbatda olish so‘ralsa kristallogidratdagi suvsiz tuzning massa ulushi topiladi va “krest” qoidasiga qo‘yib hisoblanadi. Bunda suvsiz tuzning massa ulushi 100% dan kam (1dan kam) bo‘ladi.

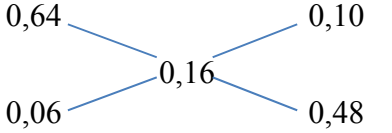
M3. 16% li $CuSO_4$ eritmasidan 600g tayyorlash uchun mis kuporosi ($CuSO_4\cdot 5H_2O$) va 6% li $CuSO_4$ eritmasidan qanchadan olish kerak?

$\omega(CuSO_4)$=16%=0,16
m_e=600g
$m_{CuSO_4\cdot 5H_2O}-?$
m_e(6%) - ?

$CuSO_4\rightarrow CuSO_4\cdot 5H_2O$

160 – 250

$\omega(CuSO_4)=\frac{160}{250}=0,64=64\%$



$m(CuSO_4\cdot 5H_2O)=\frac{0,1\cdot 600}{0,58}=103,5g$

$m_e(6\%)=\frac{0,48\cdot 600}{0,58}=496,5g$

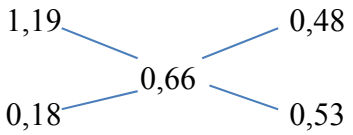
Agar kristallogidrat o‘rniga oksidlar, masalan ishqoriy, ishqoriy-yer metallari, ularning oksidlari oksidlari, SO_3, P_2O_5 berilgan bo‘lsa, ularga mos keladigan asos yoki kislotaning konsentratsitasi 100% dan (1 dan) kata bo‘ladi.

M4. O‘yuvchi kaliyning 66% li eritmasidan 750g tayyorlash uchun uning 18% li eritmasidan va K_2O dan qancha miqdorda olish zarur?

ω(KOH)=66%=0,66
$K_2O + H_2O \rightarrow 2KOH$

m_e=750g
m_e (18%)-?
m(K_2O)-?

94 112
(KOH)=$\frac{112}{94}$ = 1,19 (119%)



m(K_2O)=$\frac{0,48750}{0,48+0,53}$ = 356,4g

m_e(18%)=393,6g

Agar masalada suvsiz kislota yoki asos tayyorlash so‘ralgan bo‘lsa, tayyorlanishi kerak bo‘lgan eritma konsentratsiyasi 100% ga teng (1 ga teng) deb qabul qilinadi.

M5. Suvsiz sulfat kislota tayyorlash uchun 98% li 500g sulfat kislota eritmasida qancha massa (g) sulfat angidrid eritilishi zarur?

ω(H_2SO_4)=100%=1
m_e =500g
ω_1(H_2SO_4)=98%=0,98
m_{SO_3}-?

$SO_3 + H_2O = H_2SO_4$
80 98
ω(H_2SO_4)=$\frac{98}{80}$ = 1,225(122,5%)

$\omega = \frac{m_m}{m_e}$ m(H_2SO_4) = 500·0,98= 490g

1=$\frac{490+1,225x}{500+x}$; x = 44,44g SO_3

Umuman olganda turli konsentratsiyali eritmalardan foydalanib ma’lum konsentratsiyali eritma tayyorlashda

1) Agar tayyorlanishi lozim bo‘lgan eritmaning massasi berilgan bo‘lsa *“krest”* qoidasidan;
2) Agar tayyorlanishi lozim bo‘lgan eritmaning massasi berilmagan bo‘lsa, *massa ulushi* formulasidan foydalanish kerak.

Mavzu: Eritma titri

Ta’rif: *1ml eritmada erigan modda grammlar soniga eritma titri deyiladi va T harfi bilan belgilanadi.*

T=$\frac{N \cdot E}{1000}$ [g/ml]

bu yerda N – eritmaning normal konsentratsiyasi [N; mol-ekv/l]
E – erigan moddaning ekvivalenti [g/ekv].

M1. Titri 0,0735 g/ml bo‘lgan sulfat kislota eritmasining normalligini hisoblang.

T = 0,0735g/ml
N - ?

T=$\frac{N \cdot E}{1000}$ N=$\frac{1000 \cdot T}{E} = \frac{1000 \cdot 0,0735}{49} = 1,5N$

M2. Sulfat kislotaning 5M li eritmasining titrini hisoblang.

C_M = 5M
C_N = 10N
T-?

T=$\frac{N \cdot E}{1000} = \frac{10 \cdot 49}{1000} = 0,49g/ml$

Mavzu: Eritmalarga doir aralash masalalarning yechimlari

M1. 20g O‘yuvchi natriy eritmasiga 23,6g oleumni neytrallashda sarf bo‘ldi. Oleumdagi sulfat angidridning har bir molekulasiga nechta sulfat kislota molekulasi to‘g‘ri keladi.

m(NaOH) = 20g
m(oleum) = 23,6g
$H_2SO_4 \cdot nSO_3$ - ?

1usul $H_2SO_4 \cdot (1-x)SO_3 + 2NaOH = Na_2SO_4 + 2H_2O$
98x + 80 - 80x – 80
23,6 – 20
x=0,8 $0,8H_2SO_4 \cdot 0,2SO_3 = 4H_2SO_4 \cdot SO_3$

2^{usul} $H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$

98 – 80 $y=\frac{80x}{98e}$

x – y

$SO_3 + 2NaOH = Na_2SO_4 + H_2O$

80 80

(23,6-x) (20-x) $23,6 - x = 20 - y$

x = 19,6g H_2SO_4 $n(H_2SO_4)=0,2mol \mid 4$

4g SO_3 $n(SO_3)=0,05mol \mid 1$

M2. Massasi 15g bo‘lgan eritma tarkibida $4,8\cdot10^{23}$ ta kislorod atomi bo‘lgan eritmaning tarkibidagi. $NaNO_2$ ning massa ulushini (%) hisoblang.

m_e=15g
$N_O=4,8\cdot10^{23}$
$\omega(NaNO_2)$-?

88,89% 46,38%

H_2O — 85,07% — $NaNO_2$

$m(O)=\frac{4,8\cdot10^{23}}{6,02\cdot10^{23}}\cdot 16 = 12,76g$ $\omega(O)=\frac{12,76}{15}\cdot 100\% = 85,07\%$

0,8889 — 0,3869

0,8507

0,4638 — 0,0382 $\longrightarrow \omega(NaNO_2) = \frac{0,0382}{0,3969+0,0382}\cdot 100\% = 8,9\%$

M3. $KHSO_3$ ning 1,6M li eritmasining 80ml hajmiga 80ml K_2SO_3 eritmasi aralashtirildi. Hosil bo‘lgan eritmaga 2ml KOH eritmasi qo‘shildi. Natijada $KHSO_3$ konsentratsiyasi 0,617 mol/l ga yetgan. Eritmaga qo‘shilgan KOH eritmasining molyar konsentratsiyasini hisoblang.

$V_e(KHSO_3)$=80ml=0,08 l
$C_M(KHSO_3)$=1,6M
+ $V_e(K_2SO_3)$=80ml=0,08 l
+ V_e(KOH)=2ml=0,002 l
$C'_M(KHSO_3)$=0,617M
C_M(KOH)-?

V_e=0,08+0,08+0,002=0,162l
$n_1(KHSO_3)$=0,08·1,6=0,128ml
$n_2(KHSO_3)$=0,162·0,617=0,1ml
0,028ml $KHSO_3$ reaksiyada ishtirok etgan.
$KHSO_3 + KOH = K_2SO_3 + H_2O$
1 - 1
0,028 - x=0,02ml KOH
$C_M(KOH)=\frac{n}{V}=\frac{0,028}{0,002}=14M$

Agar ma’lum konsentratsiyali oleum eritmasi tayyorlash uchun past konsetratsiyali sulfat kislota va SO_3 so‘ralsa massa ulush formulasidan oleumdagi kislotaning massa ulushi bo‘yicha hisoblanadi. Bunda massa ulish 1 dan (100% dan) katta bo‘ladi.

M4. 100% li sulfat kislotada erigan sulfat angidridning 20% li eritmasini hosil qilish uchun 1kg massali 94,6% li sulfat kislotada qancha SO_3 eritish kerak?

m_e=1000g
$\omega(H_2SO_4)$=94,6%=0,946
$\omega(SO_3)$=20%=0,2
$m(SO_3)$-?

1^{usul}
20%li oleumdagi kislotaning massa ulushi:
(H_2SO_4)=0,8+0,2·1,225=1,045 (104,5%)
$\omega=\frac{m_m}{m_e}$ $1,405=\frac{946+1,225x}{1000+x}$ x=550g
2^{usul}
$m(H_2SO_4)$=100·0,946=946g $m(H_2O)$=1000·946=54g
1^{usul} $H_2O + SO_3 = H_2SO_4$
18 - 80
54 - x=240g SO_3 100% li H_2SO_4 olishga sarflanadi.
$\omega=\frac{m_m}{m_e}$ $0,2=\frac{x}{1240+x}$ x=310g
Um. SO_3 $m(SO_3)$=240+310=550g

M5. Hajmi 2ml bo‘lgan 37% li eritmada erigan modda miqdori 0,762g bo‘lsa, eritma zichligini hisoblang?

V_e=2ml
ω=37%=0,37
m_m=0,762g
ρ-?

$\omega=\frac{m_m}{m_e}$ $m_e=\frac{m_m}{\omega}=\frac{0,762}{0,37}=2,06g$
$\rho=\frac{m}{V}=\frac{2,06}{2}=1,03g/ml$

M6. 2,61M (ρ=1,02g/ml) sirka kislotaning qancha hajmiga (ml) 31,6%li (ρ=1,04g/ml)10ml shu modda eritmasidan quyilganda, 23,1% li (ρ=1,03g/ml) eritma hosil bo‘ladi?

1-Eritma	2-Eritma	Oxirgi eritma
C_M=2,61M	ω=31,6%=0,316	ω=23,1%=0,231
ρ=1,02g/ml	ρ=1,04g/ml	ρ=1,03g/ml
V_e-?	V_e=10ml	

1-eritma foiz konsentratsiyasi:

$C_M=\frac{10\cdot\omega\cdot\rho}{M}\Rightarrow$ $\omega=\frac{C_M.M}{10\cdot\rho}=\frac{2,61\cdot60}{10\cdot1,02}=15,35\%$

demak, 15,35% va 31,6% li eritmadan foydalanib 23,1% li eritma tayyorlash kerak.

2-eritma massasi: $m_e^2=V\cdot\rho=10\cdot1,04=10,4g$

m(CH_3COOH)=10,4·0,316=3,286g

$\omega=\frac{m_m}{m_e}$ $0,231=\frac{3,286+0,1535x}{10,4+x}=11,4g$ $V_e=\frac{m}{\rho}=\frac{11,4}{1,02}=11,2ml$

Agar biror foizli eritma massasi berilmagan bo‘lsa, 100g ga teng deb qabul qilinadi.

M7. 30% li xlorid kislota bilan tegishli miqdordagi soda o‘zaro to‘la ta’sirlashishi natijasida hosil bo‘lgan eritmadagi tuzning konsentratsiyasi (%) hisoblang.

m_e=100g
ω(HCl)=30%
ω(NaCl)-?

$Na_2CO_3 + 2HCl = 2NaCl + CO_2 + H_2O$
106 - 2·36,5- 2·250,5 44
x - 30 *y* *z*

x=43,56g Na_2CO_3 erigan
y=48,08g NaCl hosil bo‘lgan
z=18,08 CO_2 ajralgan (eritma massasi kamayadi.)
m_e=(100+43,56)-18,08=125,48g
ω(NaCl)=$\frac{48,08}{125,48}\cdot100\%=38,3\%$

Agar eritma tayyorlashda suvning hajmi 1 hajmi deb olinsa uning massasi 1000g/1000ml olinadi.

M8. Bir hajm suvda 125 hajm (n.sh) HCl eritilgan. Hosil bo‘lgan xlorid kislota eritmasining massa ulushini (%) da aniqlang.

m_{suv}=1000g
V_{HCl}=125 l
ω_{HCl} - ?

22,4 l – 36,5g
125 l – *x*=203,7g
m_e=1000+203,7=1203,7g
$\omega_{HCl}=\frac{203,7}{1203,7}\cdot100\%=16,9\%$

M9, Vodorod xlorid gazi to‘ldirilgan idish tiqini suv ostida ochilganda u suvga to‘lgan. Hosil bo‘lgan eritmadagi xlorid kislotaning massa ulushini hisoblang.

Banka hajmi=1 l
22,4 l – 36,5g
1 l – *x*=1,63g

m_{suv} =1000g m_e=1000+1,63=1001,63g

V_{HCl}=1 l $\omega_{HCl}=\frac{1,63}{1001,63}\cdot 100\% = 0,163\%$

ω_{HCl}-?

Mavzu: Mol qism va hajmiy ulush

Eritmadagi erituvchi va erigan moddaning mol qismlari quyidagi formula orqali ifodalanadi.

$X_1=\frac{n_1}{n_1+n_2}$ X_1- erituvchi mol qismi

$X_2=\frac{n_2}{n_1+n_2}$ X_2- erigan modda mol qismi

$X_1+X_2=1$ Ya'ni ayni eritmada erituvchi va erigan modda mol qismlari yig'indisi 1 ga teng.

M1. 5 mol suvda 1mol sulfat kislota erigan bo'lsa, eritmaning mol qismini toping.

$n(H_2O)$=5mol $n(H_2SO_4)$=1mol

$X(H_2O)=\frac{5}{5+1}=0,83$ $X(H_2SO_4)=\frac{1}{5+1}=0,17$

$X(H_2O)+X(H_2SO_4)=1$

M2. 20% li HCl eritmasining mol qismini toping.

ω(HCl)=20%=0,2 m(HCl)=20g $n(HCl)=\frac{20}{36,5}=0,548mol$

ω(suv)=80%=0,8 m(H_2O)=80g $n(H_2O)=\frac{80}{16}=4,44mol$

$X(HCl)=\frac{0,55}{0,55+4,44}=0,11$

$X(H_2O)=\frac{4,44}{0,55+4,44}=0,89$

Eritmadagi biror moddaning hajmiy ulushini topishda massa ulush formulasidan foydalaniladi. Faqat 100g emas 100 ml eritmada erigan modda hajmiga nisbatan topiladi.

$$\omega(\text{hajmiy})=\frac{V_m}{V_e}$$

bu yerda – ω(hajmiy) – eritma hajmiy ulushi (%)

V_m – erigan modda hajmi [ml];

V_e – eritma hajmi [ml].

M3. Massa ulushi 49,5% bo'lgan atsetonning suvli eritmasi (ρ=0,99g/ml) dagi atsetoning hajmiy ulushini aniqlang. Atsetoning 25°C dagi zichligi 0,786 g/ml.

ω(ats)=49,5%=0,495 m_e=100g m(ats)=49,5

ρ(eritma)=0,99 g/ml $V_{ats}=\frac{49,5}{0,786}=62,98ml$

ρ(atseton)=0,786 g/ml $\omega_{ats}=\frac{62,98}{101}\cdot 100\% = 62\%$

ω(hajmiy)-?

XII BOB. OKSIDLANISH-QAYTARILISH REAKSIYALARI

Mavzu: Oksidlanish darajasi

Ta'rif: *Oksidlanish darajasi – bu birikma faqat ionlardan tashkil topgan deb faraz qilib hisoblab topilgan shartli zaryaddir.*

Elementlarning oksidlanish darajasini topish quyidagi qoidalarga asoslanadi.

1) Vodorodning oksidlanish darajasi faqat +1 ga teng (ion gidridlardan LiH^{-1}-FrH^{-1}, BeH_2^{-1}-BaH_2^{-1} va SiH_4^{-1} dan tashqari).
2) Kislorodning oksidlanish darajasi faqat -2 ga teng. Masalan: $H_2^{+1}O^{-2}$
   Peroksidlarda -1; $Na_2O_2^{-1}$ $=O_2^{-1} - peroksid\ guruh$
   Nadperoksidlarda(superoksidlarda) $-\frac{1}{2}$; $KO_2^{-1/2}$
   Ozonidlarda $-\frac{1}{3}$; $KO_3^{-1/3}$
3) Ishqoriy metallar faqat +1 (Li - Fr), ishqoriy yer metallari +2 (Ca - Ba), qolgan metallarniki ular valentligining musbat qiymatiga teng. *Metallar hech qachon manfiy oksidlanish darajasini namoyon qilmaydi.*
4) Metallmaslardan ftor faqat -1, qolgani ham manfiy, ham musbat oksidlanish darajasini namoyon qiladi. Kislorod faqat ftorli birikmasida musbat oksidlanish darajasiga ega. $F_2^{-1}O^{+2}$
5) Elementlarning yuqori oksidlanish darajasi ular joylashgan guruh raqamiga teng.

	I	II	III	IV	V	VI	VII	VIII		
O.d;	+1	+2	+3	+4	+5	+6	+7	+8		
	Cu^{+2}					O^{+2}	F^{-1}	Co^{+3}	Ni^{+3}	Fe^{+3}
	Au^{+3}									

6) Metallmaslarning yuqori oksidlanish darajasi ular joylashgan guruh raqamiga, quyi oksidlanish darajasi (8 - *x*) qiymatga teng.

	I	II	III	IV	V	VI	VII	VIII
Yuqori				+4	+5	+6	+7	
Quyi				-4	-3	-2	-1	

7) Har qanday 3 xil elementli kislorodli birikmada faqat kislorod manfiy oksidlanish darajasiga ega bo'ladi.

$\overset{+1}{H_2}\ \overset{+6}{S}\ \overset{-2}{O_4}$

8) Oddiy modda va molekulaning oksidlanish darajasi 0 ga teng.

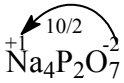
$$Al^{\circ},\quad Cl_2^{\circ},\quad O_3^{\circ},\quad (H_2S)^{\circ},\quad (K_2Cr_2O_7)^{\circ}$$

Murakkab moddaning tarkibidagi elementlarning oksidlanish darajasini topish uchun umumiy yig'indi 0 ga tengligidan foydalaniladi.

$\overset{+1}{H_2}\ \overset{x}{S}\ \overset{-2}{O_4}$ 2(+1)+x+4(-2)=0 +2+x-8=0 x=+6

$\overset{+1}{K_2}\ \overset{x}{Cr_2}\ \overset{-2}{O_7}$ 2(+1)+2x+7(-2)=0 x=+6

Umuman har qanday guruh (radikal) dagi oksidlanish darajasini bilish mumkin.
$=S^{+6}O_4$; $=S^{+4}O_3$; $=S^{-2}$; $-I^{+1}O$; $-I^{+3}O_2$; $-I^{+5}O_3$; $-I^{+7}O_4$; $-I^{-1}$; $=C^{+4}O_3$; $=Si^{+4}O_3$; $-N^{+5}O_3$; $-N^{+3}O_2$; $-Mn^{+7}O_4$ (permanganat); $=Mn^{+6}O_4$ (manganat); $=Cr^{+6}O_4$; $=Cr_2{}^{+6}O_7$; $N^{-3}H_4$- (ammoniy)
Yoki har qanday 3 elementli kislorodli birikma uchun noma'lum oksidlanish darajasi quyidagicha topiladi:



Mavzu: Oksidlanish-qaytarilish reaksiyalari

Reaksiyalar ularda ishtirok etadigan elementlarning oksidlanish darajasi o‘zgarishiga ko‘ra 2 ga bo‘linadi:

1) Oksidlanish darajasi o‘zgarmaydigan reaksiyalar, ularga ko‘pchilik almashinish va neytrallanish reaksiyalari kiradi.

$$BaCl_2 + Na_2SO_4 = BaSO_4 + 2NaCl$$

$$NaOH + HCl = NaCl + HOH$$

Ularning eng muhim belgisi – funksional guruh o‘zgarmasligidir.

2) Oksidlanish darajasi o‘zgaradigan reaksiyalar.

Ta’rif: *Elementlarning oksidlanish darajasi o‘zgarishi bilan sodir bo‘ladigan reaksiyalar oksidlanish-qaytarilish reaksiyalari deyiladi.*

Bunday reaksiyalarga:

1) Barcha sintez reaksiyalari:

$$H_2^0 + Cl_2^0 = 2HCl$$

2) Barcha oddiy moddalarga parchalanish reaksiyalari:

$$2N^{-3}H_3^{+1} \rightarrow N_2^0 + 3H_2^0$$

3). Barcha o‘rin olish reaksiyalari kiradi:

$$Fe^{\circ} + Cu^0SO_4 = Fe^{+2}SO_4 + Cu^0$$

Oksidlanish – qaytarilish reaksiyalari davomida atom, molekula yoki ion elektron beradi yoki qabul qiladi:

Ta’rif: *Reaksiya davomida elektron beradigan atom, molekula yoki ion qaytaruvchi deyiladi.*

Natijada uning oksidlanish darajasi ortadi.

(-)→(+) $Fe^0 - 2\bar{e} \rightarrow Fe^{+2}$ $S^{-2} - 8\bar{e} \rightarrow S^{+6}$

Metallar faqat qaytaruvchi bo‘ladi (erkin holda bo‘lsa).

Ta’rif: *Reaksiya davomida elektron qabul qiladigan atom, molekula yoki ion oksidlovchi deyiladi.*

Natijada oksidlanish darajasi pasayadi.

(+)→(-) $Mn^{+7} - 5\bar{e} \rightarrow Mn^{+2}$ $S^{\circ} + 2\bar{e} \rightarrow S^{-2}$

Har qanday oksidlanish – qaytarilish reaksiyasida oksidlovchi qaytariladi, qaytaruvchi oksidlanadi.

Masalan:

$$Fe^0 + S^0 = Fe^{+2}S^{-2}$$

$Fe^0 - 2\bar{e} \rightarrow Fe^{+2}$	2	1	Red	Oksidlanadi
$S^0 + 2\bar{e} \rightarrow S^{-2}$	2	1	Ox	Qaytariladi

Mavzu: Oksidlanish – qaytarilish reaksiyalarining klassifikatsiyasi

Oksidlanish – qaytarilish reaksiyalari 5 ta turga bo‘linadi:

1) Molekulalararo oksidlanish – qaytarilish reaksiyalari;
2) Ichki molekulyar oksidlanish – qaytarilish reaksiyalari;
3) Molekulalararo disproporsiyalanish reaksiyalari;
4) Ichki molekulyar disproporsiyalanish reaksiyasi;
5) Sinproporsiyalanish reaksiyasi.

1) *Molekulalararo oksidlanish – qaytarilish* reaksiyasida oksidlovchi bir modda tarkibida, qaytaruvchi ikkinchi bir modda tarkibida bo‘ladi:

$$Fe^{+2}O + C^{+2}O = Fe^0 + C^{+4}O_2$$

$Fe^{+2} + 2\bar{e} \rightarrow Fe^0$	2	1	Ox	Qaytariladi
$C^{+2} - 2\bar{e} \rightarrow C^{+4}$	2	1	Red	Oksidlanadi

2) *Ichki molekulyar oksidlanish – qaytarilish* reaksiyasida bitta modda tarkibidagi 2 elementning oksidlanish darajasi o‘zgaradi:

$$2KCl^{+5}O_3^{-2} \xrightarrow{MnO_2} 2KCl^{-1} + 3O_2^0$$

$Cl^{+5}+6\bar{e}\rightarrow Cl^{-1}$	6	2	Ox
$2O^{-2}-4\bar{e}\rightarrow O_2^0$	4	3	Red

3) *Molekulalararo disproporsiyalanish* reaksiyasida oksidlovchi va qaytaruvchi ikkita alohida modda bo‘lsa ham, ikkalasi bir xil element hisoblanadi:

$$2H_2S^{-2} + S^{+4}O_2 = 3S^0 + 2H_2O$$

$S^{-2}-2\bar{e}\rightarrow S^0$	2	2	Red
$S^{+4}+4\bar{e}\rightarrow S^0$	4	1	Ox

4) *Ichki molekulyar disproporsiyalanish* reaksiyasida bitta molekula tarkibidagi element bir xil oksidlanish darajasidan ham oksidlanadi ham qaytariladi:

$$3H_2Mn^{+6}O_4=2HMn^{+7}O_4+Mn^{+4}O_2+2H_2O$$

$Mn^{+6}-\bar{e}\rightarrow Mn^{+7}$	1	2	Red
$Mn^{+6}+2\bar{e}\rightarrow Mn^{+4}$	2	1	Ox

$$4KCl^{+5}O_3 \xrightarrow{450^\circ C} KCl^{-1}+3KCl^{+7}O_4$$

$Cl^{+5}+6\bar{e}\rightarrow Cl^{-1}$	6	1	Ox
$Cl^{+5}-2\bar{e}\rightarrow Cl^{+7}$	2	3	Red

5) *Sinproporsiyalanish* reaksiyasida bitta molekula tarkibidagi bir xil element turli oksidlanish darajasidan bitta oksidlanish darajasiga o‘tadi.

Bunday reaksiyaga NH_4NO_3 va NH_4NO_2 larning termik parchalanish reaksiyalari kiradi:

$$N^{-3}H_4N^{+3}O_2 \xrightarrow{t^\circ C} N_2^0+2H_2O$$

$N^{-3}-3\bar{e}\rightarrow N^0$	3	1	Red	
$N^{+3}+3\bar{e}\rightarrow N^0$	3	1	Ox	

$$N^{-3}H_4N^{+5}O_3 \xrightarrow{t^\circ C} N_2^{+1}O+2H_2O$$

$N^{-3}-4\bar{e}\rightarrow N^{+1}$	4	1	Red	
$N^{+5}+4\bar{e}\rightarrow N^{+1}$	4	1	Ox	

Mavzu: Oksidlanish – qaytarilish reaksiyalariga koeffitsiyentlar tanlash. Elektron – balans usuli

Oksidlanish – qaytarilish reaksiyalari tenglamalarini tuzishda quyidagiga rioya qilish kerak:

Ta’rif: *Qaytaruvchi bergan elektronlar soni oksidlovchi qabul qilgan elektronlar soniga teng.*

Oksidlanish – qaytarilish reaksiyalariga 2 xil usulda koeffitsiyentlar tanlanadi.

1) Elektron – balans usuli;
2) Yarim reaksiyalar (ion – elektron usul).

Elektron- balans usulida quyidagicha tenglashtiriladi:

1) Dastlab oksidlanish darajasi o‘zgargan elementlar aniqlanib, sxema tuziladi va oksidlovchi va qaytaruvchi ko‘rsatiladi.

$$KMn^{+7}O_4+Fe^{2+}SO_4+H_2SO_4\rightarrow K_2SO_4+Mn^{2+}SO_4+Fe_2^{3+}(SO_4)_3+H_2O$$

2) Agar har ikkalasi toq son bo‘lsa, 2 ga ko‘paytiriladi:

$Fe^{+2}-\bar{e}\rightarrow Fe^{+3}$	1	5	10	Red
$Mn^{+7}+5\bar{e}\rightarrow Mn^{+2}$	5	1	2	Ox

Tanlangan koeffitsiyentlar tegishli modda oldiga qo‘yiladi. Koeffitsiyent odatda tenglamaning o‘ng tomonidan qo‘yiladi.

$$2KMnO_4+10FeSO_4+8H_2SO_4=2MnSO_4+K_2SO_4+5Fe_2(SO_4)_3+8H_2O$$

3) Tenglashtirishda avval metallar, keyin kislota qoldig‘i, vodorod va oxirida kislorod tengligiga e’tibor beriladi.

4) Agar tenglamaning chap tomonida oksidlovchi yoki qaytaruvchi atomlari bittadan ko‘p bo‘lsa, ular sxemada ko‘rsatiladi:

$K_2Cr_2^{+6}O_7+6Fe^{+2}SO_4+7H_2SO_4=Cr_2^{+3}(SO_4)_3+3Fe_2^{+3}(SO_4)_3+K_2SO_4+7H_2O$

$2Cr^{+6}+2\cdot3\bar{e}\rightarrow2Cr^{+3}$	6	1	Ox
$Fe^{+2}-\bar{e}\rightarrow Fe^{+3}$	1	6	Red

5) Agar tenglamaning o‘ng tomonida molekulyar holda oddiy modda ajralsa (O_2, Cl_2, Br_2, J_2), sxemada ular ko‘rsatiladi:

$Mn^{+4}O_2+4HCl^{-1}=Mn^{+2}Cl_2+Cl_2^0+2H_2O$

$Mn^{+4}+2\bar{e}\rightarrow Mn^{+2}$	2	1	Ox
$2Cl^{-1}-2\bar{e}\rightarrow Cl_2^0$	2	1	Red

6) Agar tenglamada bittadan ortiq oksidlovchi yoki qaytaruvchi bo‘lsa, ularning elektronlar soni umumlashtiriladi. Odatda bunday reaksiyalarda 2 ta qaytaruvchi va bitta oksidlovchi ishtirok etadi:

$As_2^{+3}S_3^{-2}+HN^{+5}O_3+H_2O=H_3As^{+5}O_4+H_2S^{+6}O_4+N^{+2}O$

$2As^{+3}-2\cdot2\bar{e}\rightarrow2As^{+5}$	28ē	3	Red
$3S^{-2}-3\cdot8\bar{e}\rightarrow3S^{+6}$			
$N^{+5}+3\bar{e}\rightarrow N^{+2}$	3ē	28	Ox

$3As_2S_3+28HNO_3+4H_2O=6H_3AsO_4+9H_2SO_4+28NO$

Bunday reaksiyalarda agar biror molekla tarkibidagi barcha elementlarning oksidlanish darajasi o‘zgarsa, har bir atomning oksidlanish darajasini 0 ga teng deb shartli olish mumkin.

$As_2^0S_3^0+HN^{+5}O_3+H_2O=H_3As^{+5}O_4+H_2S^{+6}O_4+N^{+2}O$

$2As^0-2\cdot5\bar{e}\rightarrow2As^{+5}$	28ē	3	Red
$3S^0-3\cdot6\bar{e}\rightarrow3S^{+6}$			
$N^{+5}+3\bar{e}\rightarrow N^{+2}$	3ē	28	Ox

$3As_2S_3+28HNO_3+4H_2O=6H_3AsO_4+9H_2SO_4+28NO$

Mavzu: Eng muhim oksidlovchi va qaytaruvchilar

Biror moddaning oksidlovchi yoki qaytaruvchi bo‘lishi uning tarkibidagi elementning oksidlanish darajasiga bog‘liq.

1) Agar element biror birikmasida o‘zining eng quyi oksidlanish darajasida bo‘lsa, u faqat *qaytaruvchi* bo‘ladi.

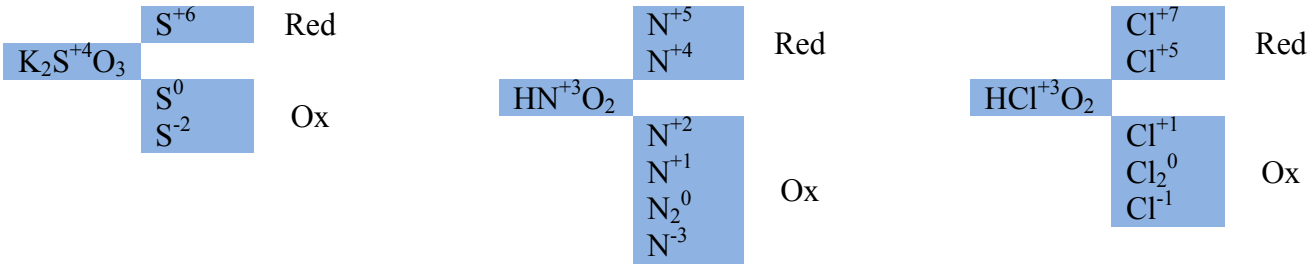
Masalan: H_2S^{-2}; NH_3^{-3}; HI^{-1}; metallar

2) Agar element biror birikmasida o‘zining eng yuqori oksidlanish darajasida bo‘lsa, u faqat *oksidlovchi* bo‘ladi.

Masalan: F_2, Cl_2, O_3, O_2; $KMn^{+7}O_4$; $K_2Cr_2^{+6}O_7$; $K_2Cr^{+6}O_4$; $H_2S^{+6}O_4$; $HN^{+5}O_3$; PbO_2

3) Agar element biror birikmasida o‘zining oraliq oksidlanish darajasi da bo‘lsa, u ham *oksidlovchi* ham *qaytaruvchi* bo‘ladi.

Masalan:



Mavzu: Oksidlanish-qaytarilish reaksiyalariga muhitning ta'siri

Oksidlanish – qaytarilish reaksiyalarida odatda oksidlovchi va qaytaruvchi bilan birga kislota, ishqor yoki suv ta'sirlashadi. Agar tenglamaning chap tomonida suv bo'lmasa (kislota yoki ishqor bo'lsa) reaksiya natijasida suv ajraladi.

$$KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow \ldots + H_2O$$
Ox Red Muhit

Oksidlovchi yoki qaytaruvchining qaysi oksidlanish darajasiga o'tishi muhitga bog'liq bo'ladi.

Masalan: $KMnO_4$

1) Kislotali muhitda $Mn^{+7}O_4^- \rightarrow Mn^{+2}$ ga o'tib, eritma rangsizlanadi:

$$2KMn^{+7}O_4+5K_2S^{+4}O_3+3H_2SO_4=2Mn^{+2}SO_4+6K_2S^{+6}O_4+3H_2O$$

$Mn^{+7}+5\bar{e}\rightarrow Mn^{+2}$	5	2	Ox
$S^{+4}-2\bar{e}\rightarrow S^{+6}$	2	5	Red

2) Ishqoriy muhitda $Mn^{+7}O_4^- \rightarrow Mn^{+6}O_4^{2-}$ manganat ioniga o'tadi va eritma yashil-zangori rangga kiradi:

$$2KMn^{+7}O_4+K_2S^{+4}O_3+2KOH=2K_2Mn^{+6}O_4+K_2S^{+6}O_4+H_2O$$

$Mn^{+7}+\bar{e}\rightarrow Mn^{+6}$	1	2	Ox
$S^{+4}-2\bar{e}\rightarrow S^{+6}$	2	1	Red

3) Neytral muhitda $Mn^{+7}O_4^- \rightarrow MnO_2\downarrow$ qo'ng'ir cho'kma hosil bo'ladi.

$$2KMn^{+7}O_4+3K_2S^{+4}O_3+H_2O=2Mn^{+4}O_2+3K_2S^{+6}O_4+2KOH$$

$Mn^{+7}+3\bar{e}\rightarrow Mn^{+4}$	3	2	Ox
$S^{+4}-2\bar{e}\rightarrow S^{+6}$	2	3	Red

Umuman olganda $KMnO_4$ ning muhitga ko'ra qaytarilishi quyidagi sxema asosida amalga oshadi:

	$\xrightarrow{+5\bar{e}\ (H^+)} Mn^{+2}$	rangsizlanadi
$KMn^{+7}O_4$	$\xrightarrow{+3\bar{e}\ (HOH)} MnO_2\downarrow$	qo'ng'ir cho'kma
binafsha	$\xrightarrow{+\bar{e}\ (OH^-)} K_2MnO_4$	yashil-zangori

Xuddi shunday vodorod peroksid ham oksidlovchi, ham qaytaruvchi bo'lishi mumkin; ya'ni H_2O_2 kuchli oksidlovchilar $KMnO_4$, $K_2Cr_2O_7$ bilan kelsa u qaytaruvchi bo'ladi va erkin kislorod ajralib chiqadi.

$$H_2O_2^{-1}+Ox\xrightarrow{(H^+)}O_2^0\uparrow+2H^+$$

Masalan:

$$2KMnO_4+5H_2O_2+3H_2SO_4=5O_2+K_2SO_4+2MnSO_4+8H_2O$$

$Mn^{+7}+5\bar{e}\rightarrow Mn^{+2}$	5	2	Ox
$2O^{-1}-2\bar{e}\rightarrow O_2^0$	2	5	Red

Agar qaytaruvchilar bilan kelsa, u oksidlovchi bo'ladi. Bunday reaksiyada kislorod ajralmaydi:

$$H_2O_2+Red\rightarrow 2OH^-$$

Masalan:

$$PbS^{-2}+4H_2O_2^{-1}=PbS^{+6}O_4+4H_2O^{-2}$$

$S^{-2}-8\bar{e}\rightarrow S^{+6}$	8	1	Red
$2O^{-1}-2\bar{e}\rightarrow 2O^{-2}$	2	4	Ox

Lekin, vodorod peroksidining oksidlovchilik xossalari kuchliroq!

Vodorod peroksid MnO_2 katalizatori ishtirokida disproporsiyalanadi:

$$2H_2O_2^{-1}\xrightarrow{MnO_2}2H_2O^{-2}+O_2^0$$

Eng muhim oksidlanish – qaytarilish reaksiyalari(ilovaga qarang).

XIII BOB. ELEKTROLITIK DISSOTSIYALANISH
Mavzu: Elektrolitik dissotsilanish nazariyasi. Kuchli va kuchsiz elektrolitlar

Moddalar suyuqlanma va eritmalarining ionga ajralishiga qarab 2 ga bo‘linadi:

1. Noelektrolitlar
2. Elektrolitlar

Ta’rif: *Noelektrolitlar – ionlarga ajralmaydigan (dissotsilanmaydigan), shuning uchun suyuqlanma yoki eritmalari elektr tokini o‘tkazmaydigan moddalardir.*

Noelektrolitlarga qutbsiz kovalent bog‘li va kuchsiz qutbli bog‘li moddalar:

1) Ko‘pchilik organik moddalar;
2) Og‘ir metallarning sulfidlari, fosfidlari , nitridlari;
3) Barcha oksidlar;
4) Erimaydigan tuzlar;
5) Suv kiradi.

Ta’rif: *Elektrolitlar – bu suyuqlanmalari yoki eritmalari dissotsilanadigan (ionlarga ajraladigan) moddalardir. Ular elektr tokini o‘tkazadi.*

Elektrolitlarga

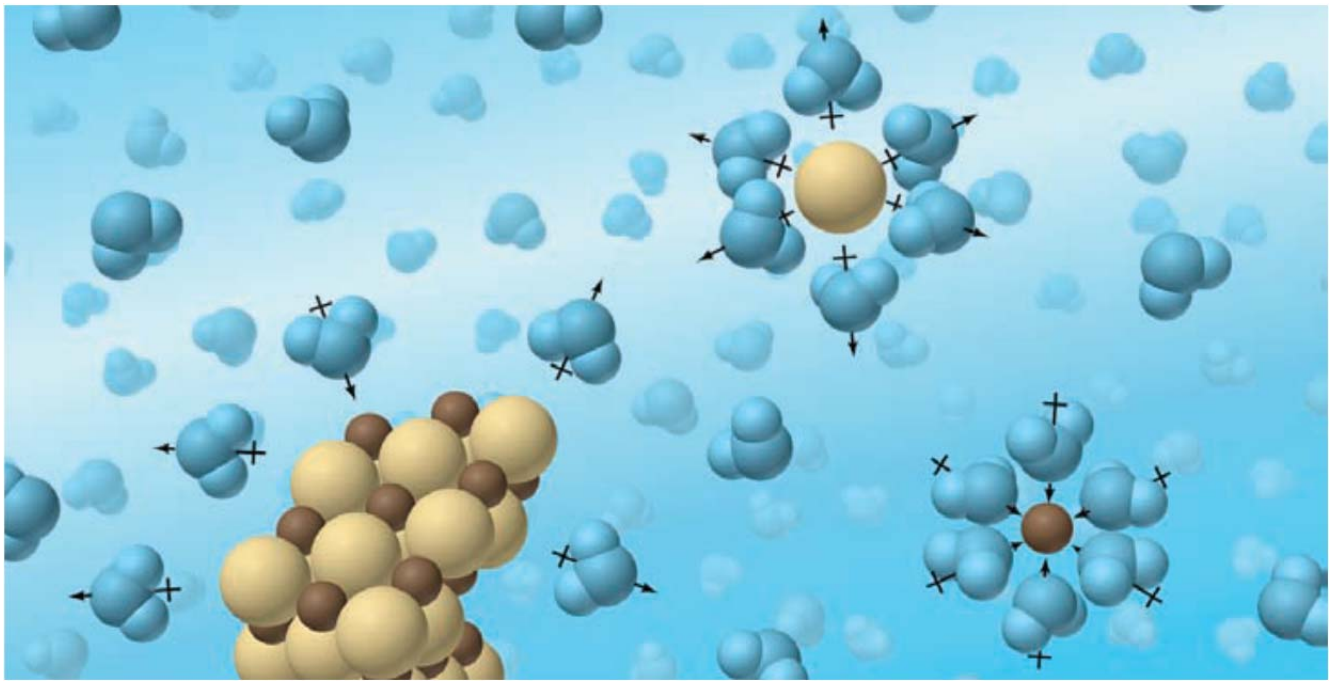
1) Barcha eruvchan tuzlar, kislotalar, asoslar;
2) Ion bog‘lanishli yoki qutbli kovalent bog‘li barcha moddalar;
3) Organik kislota va tuzlar kiradi.

Ta’rif: *Modda suyuqlanmalari yoki eritmalarining ionlarga ajralish jarayoni elektrolitik dissotsiatsiya deyiladi.*

Elektrolitlar suyuqlanma yoki eritmalari musbat ion (kation $–K^+$) va manfiy ion – A^- ga parchalanadi.

$$KA \leftrightarrow K^+ + A^-$$

Dissotsiatsiani NaCl ning suvda erishi misolida ko‘ramiz:



Ionlarning suv molekulalari bilan o‘ralishi *gidratlanish* deyiladi va elektrolitlar suvli eritmalarida *kristallogidratlar* holida ajralib chiqadi.

Kristallogidrat hosil bo‘lishi moddalarning xossalari va rangiga ta’sir qiladi.

$CuSO_4+H_2O \leftrightarrow CuSO_4 \cdot 5H_2O$ yoki $[Cu(H_2O)_4]SO_4 \cdot H_2O$

oq ko‘k

Agar erituvchi sifatida suvdan boshqa modda ishlatilsa – *solvatlanish* deyiladi.

Elektrolitik dissotsilanish nazariyasini 1887 - yil shved kimyogari Svante Arrenius fanga kiritgan.

Uning asosiy hollari:

1) Elektrolitlarning ionlarga ajralish jarayoni – dissosilanish deyiladi.

2) Dissotsilanish qaytar jarayon.

Elektrolitlar dissotsilanishga ko‘ra 3 ga

1) Kuchli elektrolitlar;

2) O‘rtacha kuchdagi elektrolitlar ;

3) Kuchsiz elektrolitlarga bo‘linadi.

Kuchli elektrolitlarga:

1) Ishqorlar va $Mn(OH)_2$;

2) Mineral kislotalar: HJ, HBr, HCl, HNO_3, $HClO_4$, H_2SO_4, $HMnO_4$, $H_2Cr_2O_7$;

3) Ularning barcha eruvchan tuzlari kiradi.

O‘rtacha kuchdagi elektrolitlarga:

1) O‘rtacha kuchdagi kislotalar H_2SO_3, H_3PO_4, HNO_2, HF;

2) $Mg(OH)_2$ kiradi.

Kuchsiz elektrolitlarga:

1) NH_4OH;

2) Organik kislotalar: HCOOH, CH_3COOH;

3) Kuchsiz mineral kislotalar: H_2CO_3, HCN, H_2S kiradi.

Shunisi muhimki, dissotsilanish jarayoni qattiq moddalar suyuqlantirilganda yoki suvda eriganda, suyuq moddalar suvda eritilganda ro‘y beradi.

Masalan: qattiq holdagi NaCl elektr tokini o‘tkazmaydi. 100% li H_2SO_4 ham elektrolit emas. U suvda eritilgandagina ionlar hosil bo‘ladi.

Mavzu: Dissotsilanish darajasi va konstantasi

Ta’rif: *Ionlarga ajralgan molekulalar sonining umumiy molekulalar soniga nisbati dissotsilanish darajasi deyiladi va α bilan belgilanadi.*

$$\alpha=\frac{n}{N}100\%$$

bu yerda: n – dissotsilangan molekulalar soni;

N – umumiy molekulalar soni ;

Dissotsilanish darajasi – α $0\leq\alpha\leq1$ qiymatga ega.

ya’ni 0 – 100% gacha bo‘ladi.

M1. Agar kislota molekulalaridan 200 tasidan 25 tasi dissotsilangan bo‘lsa, uning dissotsilanish darajasini hisoblang.

n=25ta

N=200ta $\alpha=\frac{n}{N}\cdot 100\%=\frac{25}{200}\cdot 100\%=12{,}5\%$

α=?

Dissotsilanish darajasi temperatura va eritma konsentratsiyasiga bog‘liq.

Temperatura ortishi bilan dissotsilanish darajasi ortadi. Chunki bunda ionlar harakati tezlashadi.

Eritma konsentratsiyasi pasayishi bilan dissotsilanish darajasi ortadi. Masalan: 98% li sulfat kislotaga qaraganda 10% li kislota dissotsilanish darajasi yuqoriroq.

Dissotsilanish darajasining qiymati elektrolit kuchini ham belgilaydi.

1) Agar $\alpha>30\%$ bo‘lsa, kuchli elektrolit;

2) Agar $3<\alpha<30\%$ bo‘lsa, o‘rtacha kuchdagi elektrolit;

3) Agar $\alpha<3\%$ bo‘lsa, kuchsiz elektrolit bo‘ladi.

Dissotsilanish jarayoni qaytar bo‘lganligi uchun u “Massalar ta’siri qonuni”ga bo‘ysinadi.

$$KA\leftrightarrow K^+ + A^-$$

$$K_D=\frac{[K^+][A^-]}{[KA]}=const \text{ (T=const)}$$

Dissotsilanish konstantasi eritma konsentratsiyasiga bog‘liq emas. U temperatura va erituvchi tabiatiga bog‘liq.

Dissotsilanish konstantasi elektrolit kuchini ko‘rsatadi. Uning qiymati qancha katta bo‘lsa, elektrolit shuncha kuchli hisoblanadi.

Dissotsilanish darajasi va konstantasi “Suyultirish qonuni” bilan o‘zaro bog‘lanadi. Buni nemis olimi V.Ostvald fanga kiritgan.

$$K_D=\frac{\alpha^2 C}{1-\alpha}$$

Kuchsiz elektrolitlar uchun α<<1

$$K_D=\alpha^2 C \qquad \alpha=\sqrt{\frac{K_D}{C}}$$

M2 Dissotsilanish darajasi 0,032 bo‘lgan 0,2M li chumoli kislotaning dissotsilanish konstantasini aniqlang.

α=0,032

C_M=0,2M $K_D=\alpha^2 C=(0{,}032)^2\cdot 0{,}2=2\cdot 10^{-4}$

K_D-?

M3 Dissotsilanish konstantasi $2{,}8\cdot 10^{-8}$ bo‘lgan gipoxlorit kislotaning 25°C da 0,02M li eritmasinning dissotsilanish darajasini hisoblang.

$K_D=2{,}8\cdot 10^{-8}$

C_M=0,02M $\alpha=\sqrt{\frac{K_D}{C}}=\sqrt{\frac{2{,}8\cdot 10^{-8}}{0{,}02}}=\sqrt{1{,}4\cdot 10^{-6}}=1{,}2\cdot 10^{-3}$ (0,12%)

α-?

Mavzu: Dissotsilanishga ko‘ra asoslar, kislotalar va tuzlar

Ta’rif: *Dissotsilanganda anion sifatida faqat gidroksil ionlarini (OH^-) hosil qiladigan moddalarga asoslar deyiladi.*

$$Me(OH)_x \leftrightarrow Me^{x+}+xOH^-$$

Suvli eritmalarda faqat ishqoriy va ishqoriy yer metallari asoslari dissotsilanadi.

Ishqoriy metallar asoslari 1 bosqichli dissotsilanadi:

$$NaOH \leftrightarrow Na^+ + OH^-$$

Ishqoriy – yer metallari asoslari 2 bosqichli dissotsilanadi:

1. $Ba(OH)_2 \leftrightarrow BaOH^+ + OH^-$
2. $BaOH^+ \leftrightarrow Ba^{2+}+OH^-$

$Ba(OH)_2 \leftrightarrow Ba^{2+}+2OH^-$

Ta’rif: *Dissotsilanganda kation sifatida faqat vodorod kationlarini (H^+) hosil qiluvchi moddalarga kislotalar deyiladi.*

$$H_nAc \leftrightarrow nH^+ + Ac^{n-}$$

Bir negizli kislotalar 1 bosqichli dissotsilanadi.

$HCl \leftrightarrow H^+ + Cl^-$

$HNO_3 \leftrightarrow H^+ + NO_3^-$

Ko‘p negizli kislotalar ko‘p bosqichli dissotsilanadi.

1. $H_2SO_4 \leftrightarrow H^+ + HSO_4^-$
2. $HSO_4^- \leftrightarrow H^+ + SO_4^{2-}$

$H_2SO_4 \leftrightarrow 2H^+ + SO_4^{2-}$

1. $H_3PO_4 \leftrightarrow H^+ + H_2PO_4^-$
2. $H_2PO_4^- \leftrightarrow H^+ + HPO_4^{2-}$
3. $HPO_4^{2-} \leftrightarrow H^+ + PO_4^{3-}$

α $H_3PO_4 \leftrightarrow 3H^+ + PO_4^{3-}$

Ya’ni bosqichli dissotsilanadigan kislota va asoslarda dissotsilanish darajasi dastlabki bosqichlarnikidan keyingisiga kamayadi. Buni quyidagicha ifodalash mumkin.

$H_4P_2O_7 \leftrightarrow H^+ + H_3P_2O_7^-$ α=40%

$H_3P_2O_7^- \leftrightarrow H^+ + H_2P_2O_7^{2-}$ α=10%

$H_2P_2O_7^{2-} \leftrightarrow H^+ + HP_2O_7^{3-}$ α=3%

$HP_2O_7^{3-} \leftrightarrow H^+ + P_2O_7^{4-}$ α=1%

Ya'ni eritmada eng ko'p vodorod ionlari – 54%, keyin trigidropirofasfat – 40%, keyin digidropirofosfat – 10%, keyin gidropirofasfat – 3% va oxirgi bosqichda pirofosfat - 1% atrofida bo'ladi. Kuchsiz kislotalarda oxirgi bosqich deyarli amalga oshmaydi.

Ta'rif: *Dissotsilanganda kation sifatida faqat metall kationlari va anion sifatida kislota qoldig'i ionlarini hosil qiladigan tuzlarga o'rta tuzlar deyiladi.*

O'rta tuzlar bir bosqichda dissotsilanadi.

$$NaCl \leftrightarrow Na^+ + Cl^-$$

$$Al_2(SO_4)_3 \leftrightarrow 2Al^{3+} + 3SO_4^{2-}$$

Ta'rif: *Dissotsilanganda kation sifatida metall ionlari bilan birga vodorod kationlarini, anion sifatida kislota qoldig'i ionlarini hosil qiladigan tuzlarga nordon tuzlar deyiladi.*

Nordon tuzlar bosqichli dissotsilanadi:

1. $NaHSO_4 \leftrightarrow Na^+ + HSO_4^-$
2. $HSO_4^- \leftrightarrow H^+ + SO_4^{2-}$

$NaHSO_4 \leftrightarrow Na^+ + H^+ + SO_4^{2-}$

Ta'rif: *Dissotsilanganda kation sifatida faqat metall ionlarini, anion sifatida kislota qoldiqlari bilan birga gidroksil ionlarini hosil qiladigan tuzlarga asosli tuzlar deyiladi.*

Asosli tuzlar bosqichli dissotsilanadi:

1. $CaOHCl \leftrightarrow CaOH^+ + Cl^-$
2. $CaOH^+ \leftrightarrow Ca^{2+} + OH^-$

$CaOHCl \leftrightarrow Ca^{2+} + OH^- + Cl^-$

yoki, $Fe(OH)_2NO_3 \leftrightarrow Fe(OH)_2^+ + NO_3^-$

Ta'rif: *Dissotsilanganda kation sifatida ikki xil metall kationlarini (asosan 1 va 3 valentli), anion sifatida faqat kislota qoldig'i ionlarini hosil qiladigan tuzlarga qo'sh tuzlar deyiladi.*

Qo'sh tuzlar bir bosqichda dissotsilanadi:

$$KAl(SO_4)_2 \leftrightarrow K^+ + Al^{3+} + 2SO_4^{2-}$$

Ta'rif: *Dissotsilanganda kation sifatida faqat bitta metall kationlarini, anion sifatida ikki xil kislota qoldig'larini hosil qiladigan tuzlarga aralash tuzlar deyiladi.*

Aralash tuzlar bir bosqichli dissotsilanadi:

$$AlSO_4Cl \leftrightarrow Al^{3+} + SO_4^{2-} + Cl^-$$

Ta'rif: *Dissotsilanganda kation yoki anion sifatida murakkab ion – komplekslarni hosil qiladigan tuzlarga kompleks tuzlar deyiladi.*

Kompleks tuzlar bir bosqichli dissotsilanadi.

$$K_4[Fe(CN)_6] \leftrightarrow 4K^+ + [Fe(CN)_6]^{4-}$$

$$[Co(NH_3)_6]Cl_3 \leftrightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$$

Mavzu: Ionli reaksiyalar

Ta'rif: *Eritmada yoki suyuqlanmada ionlar orasida sodir bo'ladigan reaksiyalar ionli reaksiyalar deyiladi.*

1803 yil fransuz olimi Bertolle agar ionli reaksiyalarda reaksiya mahsuloti gaz, cho'kma yoki noelektrolit (suv molekulasi) bo'lsa, oxirigacha borishini aytadi.

Elektrolitlar orasidagi reaksiyalar 2 xil: molekulyar va ionli ko'rinishda tasvirlanadi. Ionli reasiyalarni yozishda kuchsiz elektrolitlar (kuchsiz asos va kislotalar) suv va oksidlar, cho'kma va gaz moddalar faqat molekulyar ko'rinishda yoziladi.

$$Na_2CO_3 + 2HCl = 2NaCl + CO_2\uparrow + H_2O \quad \text{(molekulyar)}$$

$$2Na^+ + CO_3^{2-} + 2H^+ + 2Cl^- = 2Na^+ + 2Cl^- + CO_2\uparrow + H_2O \quad \text{(to'la ionli)}$$

To‘la ionli tenglamalarning chap va o‘ng tomonidagi bir xil ismli ionlar qisqartirilsa, qisqartirilgan ionli reaksiya sodir bo‘ladi.

$$CO_3^{2-}+2H^+ \leftrightarrow CO_2\uparrow+H_2O$$

Qisqartirilgan ionli reaksiyalarni molekulyar holda tasvirlash uchun ayni anionga mos eruvchan kation, ayni kationga eruvchan anion topiladi.

M1. Quyidagi reaksiyaning ionli tenglamasini molekulyar shaklda yozish uchun keltirilgan ion juftlarining qaysilaridan foydalanish mumkin?

$Pb^{2+}+SO_4^{2-}=PbSO_4\downarrow$

NO_3^- va K^+

$Pb(NO_3)_2+K_2SO_4=PbSO_4\downarrow+2KNO_3$

E E

Bunday juftlikni topish uchun:

1. Ishqoriy metallar va NH_4^+ ioninning barcha tuzlari eruvchan bo‘lishiga;
2. NO_3^- - nitrat va CH_3COO^- - sirka kislotaning barcha tuzlari eruvchanligiga;
3. Ag^+, Hg^+, Pb dan boshqa barcha metallarning xloridlari, bromidlari va yodidlari eruvchanligiga;
4. $CaSO_4$, Ag_2SO_4, Hg_2SO_4 kam erishiga $BaSO_4$, $PbSO_4$ va $SrSO_4$ erimasligiga;
5. Ishqoriy metallari, $Ba(OH)_2$ va ammoniy gidroksid yaxshi erishigam $Ca(OH)_2$ va $Sr(OH)_2$ kam erishiga, qolgan barcha asoslar erimasligiga;
6. Ishqoriy metallar va ammoniydan boshqa barcha karbonatlari suvda erimasligiga;
7. Ishqoriy metallar va ammoniydan boshqa barcha sulfidlar suvda erimasligiga e’tibor berish kerak.

Mavzu: Vodorod ko‘rsatkich - pH

Suv nafaqat kuchli qutbli erituvchi, balki ideal amfolit ham hisoblanadi. Ya’ni toza suv kam miqdorda dissotsilanadi:

$$H_2O \leftrightarrow H^+ + OH^-$$

$$K_{H_2O} = \frac{[H^+][OH^-]}{[H_2O]} = 1{,}8 \cdot 10^{-16} \qquad (22°C)$$

1 l (1000g) suvning miqdori 55,56 mol bo‘lganligi uchun

$K_{H_2O} \cdot [H_2O] = [OH^-][H^+]=1{,}8\cdot 10^{-16} \cdot 55{,}56$

$[H^+][OH^-]=10^{-14} = K_W -$ suvning ion ko′paytmasi

Suvda $[H^+]$ va $[OH^-]$ ionlari konsentratsiyasi bir xil;

$[H^+]=[OH^-]=10^{-7}$ mol/l

ya’ni 1 l toza suvda 10^{-7} mol/l dan H^+ va OH^- ionlari bo‘ladi.

Ta’rif: *Eritmadagi vodorod ionlari konsentratsiyasining o‘nli manfiy logarifmi bilan olingan qiymatiga vodorod ko‘rsatkich deyiladi va pH bilan belgilanadi.*

$$pH= - \lg[H^+]$$

Agar toza suvda $[H^+]=10^{-7}$ mol/l

$pH= - \lg 10^{-7} = 7$ muhit neytral

Kislota qo‘shilganda pH<7 (0 - 7)

Ishqor qo‘shilganda pH>7 (7 - 14)

Shuningdek gidroksil ionlarini ifodalash uchun ishqor eritmalarida pOH ham qo‘llaniladi.

$$pOH= - \lg[OH^-]$$

$$pOH+pH=14$$

$$pOH=14 – pH$$

Eritma muhiti shkalasi:

1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}	10^{-13}	10^{-14}
$[H^+]$, mol/l														
10^{-14}	10^{-13}	10^{-12}	10^{-11}	10^{-10}	10^{-9}	10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1
$[OH^-]$, mol/l														

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

kuchli kuchsiz neytral kuchsiz kuchli

Kislotali Ishqoriy

Amalda 0 dan kichik va 14 dan katta pH ga ega erimalar uchramaydi.

M1. Vodorod ionlari konsentratsiyasi 0,001ga teng bo‘lgan eritma pH va pOH ni toping.

$[H^+]=10^{-3}$ $pH= - lg10^{-3}=3$

$pOH=14-3=11$ kuchli kislotali.

M2 $Ba(OH)_2$ ning $5\cdot10^{-4}$ mol/l konsentratsiyali eritmasining pH ini toping.

$C_M(Ba(OH)_2)=5\cdot10^{-4}$ mol/l

$Ba(OH)_2 \leftrightarrow Ba^{2+}+2OH^-$

2

$5\cdot10^{-4}$ - $x=10^{-3}$

$[OH^-]=10^{-3}$ mol/l $pOH= - lg(OH)= - lg\ 10^{-3}=3$

$pH=14-3=11$ kuchli ishqoriy

M3. pH=1 bo‘lgan sulfat kislota eritmasining molyar konsentratsiyasini toping.

$[H^+]=10^{-1}=0,1$ mol/l $H_2SO_4 \leftrightarrow 2H^+ + SO_4^{2-}$

1 - 2

x - 0,1 $x=0,05$ mol/l

Mavzu: Indikatorlar

Ta’rif: *Eritmadagi vodorod ionlarining konsentratsiyasiga qarab rangini o‘zgartiradigan moddalar indikatorlar deyiladi.*

Indikatorlar yordamida eritmaning taxminiy pH i aniqlanadi.

Eng ko‘p qo‘llaniladigan indikatorlar quyidagilar:

		Rangi	
	pH intervali	pH<7	pH>7
Metiloranj	3,1 – 4,4	Qizil	Sariq
Lakmus	5 – 8	Qizil	Ko‘k
Fenolftalein	8 – 10	Rangsiz	To‘q qizil

Ulardan eng qulayi bu universal indikator – lakmus hisoblanadi.

Mavzu: Kislota va asoslar nazariyasi

Arrenius nazariyasiga asoslanib, 1923 yil Brensted va Lourilar kislota va asoslarning proton nazariyasini ishlab chiqishdi.

Unga ko‘ra:

Kislotalar – vodorod kationini beradigan, asoslar – vodorod kationini biriktirib oladigan moddalardir.

$HAc \leftrightarrow H^+ + Ac^-$ $B + H^+ \leftrightarrow HB^+$

Kislota Asos

Bu nazariyasiga ko‘ra kislotalar 3 ga bo‘linadi:

1. Neytral kislotalar - HCl, HNO_3, H_2SO_4

2. Anion holidagi kislotalar – HSO_4^-, $H_2PO_4^-$
3. Musbat zaryadlangan kislotalar – H_3O^+, NH_4^+.

Protolitik nazariyaga ko‘ra ham proton bera oladigan, ham biriktira oladigan moddalar *amfolitlar* deyiladi.

$HCO_3^- \leftrightarrow H^+ + CO_3^{2-}$ $HCO_3^- + H^+ \leftrightarrow H_2CO_3$

XIV BOB. GIDROLIZ

Mavzu: Tuzlar gidrolizi. Qaytar va qaytmas gidroliz

Ta'rif: *Tuz ionlari bilan suv molekulalari orasida boradigan va kuchsiz elektrolitik (kuchsiz asos va kuchsiz kislota) hosil bo'lishiga olib keladigan o'zaro ta'sirlashuv gidroliz deyiladi. ("hydro" – suv, "lysis" - parchalanish).*

Gidrolizning sababi tuzning kationi yoki anionining H^+ va OH^- ionlari bilan bog'lanishidir.

Tuzlar hosil bo'lishiga ko'ra 4 ga bo'linadi:

1. Kuchli asos va kuchli kislotadan hosil bo'lgan tuzlar;
2. Kuchli asos va kuchsiz kislotadan hosil bo'lgan tuzlar;
3. Kuchsiz asos va kuchli kislotadan hosil bo'lgan tuzlar;
4. Kuchsiz asos va kuchsiz kislotadan hosil bo'lgan tuzlar.

1) Kuchli asos va kuchli kislotadan hosil bo'lgan tuzlar gidrolizga uchramaydi. Chunki, bunda ionlar bog'lanmaydi. Ular eritmasida muhit neytral bo'ladi. pH=7

$$K_2SO_4+H_2O\rightarrow X$$

2) Kuchli asos va kuchsiz kislotadan hosil bo'lgan tuzlar kislota anioni hisobiga gidrolizga uchraydi. Muhit ishqoriy bo'ladi. pH>7

$$CH_3COONa+HOH\leftrightarrow CH_3COOH+NaOH$$
$$CH_3COO^-+Na^++HOH\leftrightarrow CH_3COOH+Na^+OH^-$$
$$CH_3COO^-+HOH\leftrightarrow CH_3COOH+OH^-$$

3) Kuchsiz asos va kuchli kislotadan hosil bo'lgan tuzlar asos kationi hisobiga gidrolizga uchraydi. Muhit kislotali bo'ladi. pH<7.

$$NH_4Cl+HOH\leftrightarrow NH_4OH+HCl$$
$$NH_4^++Cl^-+HOH\leftrightarrow NH_4OH+H^++Cl^-$$
$$NH_4^++HOH\leftrightarrow NH_4OH^++H^+$$

4) Kuchsiz asos va kuchsiz kislotadan hosil bo'lgan tuzlar ham kation, ham anion bo'yicha gidrolizga uchraydi. Muhit deyarli neytral bo'ladi. pH=7

$$CH_3COONH_4+HOH\leftrightarrow NH_4OH+CH_3COOH$$
$$CH_3COO^-+NH_4^++HOH\leftrightarrow NH_4OH+CH_3COOH$$

ion yo'q

Gidroliz reaksiyasi aksariyat hollarda qaytardir.

Agar gidroliz jarayonida cho'kma yoki gaz modda ajralsa, gidroliz reaksiyasi oxirigacha boradi, ya'ni qaytmas bo'ladi.

Bunday tuzlarga metallarning nitrid va fosfidlari, Al^{3+}, Cr^{3+} va Fe^{3+} ning sulfidi, sulfiti va karbonati kiradi. Ular eruvchanlik jadvalida (-) belgisi bilan berilgan.

$$Ca_3P_2+6HOH\rightarrow 3Ca(OH)_2+2PH_3\uparrow$$
$$Cr_2S_3+6HOH\rightarrow 2Cr(OH)_3\downarrow+3H_2S\uparrow$$

Shuningdek kuchsiz kislota va kuchsiz asosdan hosil bo'lgan tuzlar ham qaytmas gidrolizga uchraydi.

Gidroliz darajasi

Ta'rif: *Gidrolizlangan tuz molekulalari sonining umumiy erigan molekulalar soniga nisbati gidroliz darajasi deyiladi va h bilan belgilanadi.*

$$h=\frac{N_g}{N_{um}}\cdot 100\%$$

Gidroliz darajasi eritma konsentratsiyasiga, tuz tabiatiga va temperaturaga bog'liq.

Eritma suyultirilganda va temperatura oshirilganda gidroliz darajasi ortadi.

Eng yaxshi gidrolizga kuchsiz asos va kuchsiz kislotadan hosil bo'lgan tuzlar uchraydi.

XV BOB. ELEKTROKIMYO

Mavzu: Metallarning kuchlanishlar qatori

Ta'rif: *Elektr energiyasi ishtirokida sodir bo'ladigan reaksiyalar elektrokimyoviy reaksiyalar deyiladi.*

Elektrokimyoviy reaksiyalar davomida kimyoviy energiya elektr energiyasiga yoki aksincha o'tadi.

Metallarning xususiyati uning qay darajada oksidlanishiga bog'liq. Oson oksidlanadigan metallar nodirmas metallar deyiladi. Qiyin oksidlanadigan metllar nodir metallar hisoblanadi. Masalan: Na, Al va Fe nodirmas, Cu, Ag va Au nodir metallardir.

Agar metallarni oksidlanish xossasi kamayib borish tartibida joylashtirsak, elektrokimyoviy kuchlanishlar qatori hosil bo'ladi.

Eng aktiv metallar	O'rtacha aktivlikdagi metallar	Kamroq aktiv metallar	(H_2)	Nodir metallar
Li, K, Ba, Ca, Na,	Mg, Al, Mn, Zn, Cr, Fe	Cd, Co, Ni, Sn, Pb		Cu, Ag, Pd, Hg, Pt, Au

Aktivlik kamayadi

Bu qatorda quyidagi qonuniyat kuzatiladi:

1. Eritmalarda har qanday metall o'zidan o'ng tomonda turgan metallarni tuzidan siqib chiqaradi:

$Zn^0+Cu^{+2}SO_4 \rightarrow Cu^0+Zn^{+2}SO_4$

$Zn^0-2\bar{e} \rightarrow Zn^{+2}$ Red

$Cu^{+2}+2\bar{e} \rightarrow Cu^0$ Ox

2. Elektrikimyoviy kuchlanishlar qatorida vodoroddan chapda turgan metallar suyultirilgan kislotalardan vodorodni siqib chiqaradi (HNO_3 dan tashqari):

$$Zn+H_2SO_4 \rightarrow ZnSO_4+H_2$$

3. Elektrokimyoviy kuchlanishlar qatorida vodoroddan o'ngda turgan metallar (nodir metallar) suyultirilgan kislotalarda erimaydi va vodorodni siqib chiqara olmaydi:

$$Cu+HCl \rightarrow X$$

4. Oksidlovchi kislotalar kons. H_2SO_4 va har qanday konsentratsiyali HNO_3 deyarli barcha metallarni eritadi. Lekin vodorod ajralib chiqmaydi:

$$Cu+2H_2SO_{4(k)} \xrightarrow{t^\circ C} CuSO_4+SO_2+2H_2O$$

$$Ag+2HNO_{3(k)} \rightarrow AgNO_3+NO_2+H_2O$$

$$4Zn+10HNO_{3(j.s.)} \rightarrow 4Zn(NO_3)_2+NH_4NO_3+3H_2O$$

5. Nodir metallardan faqat Pt va Au biror kislotada erimaydi. Ular zar suvida ($3HCl+HNO_3$) eriydi:

$$Au+3HCl+HNO_3 \rightarrow AuCl_3+NO+2H_2O$$

6. Metallardan faqat ishqoriy va ishqoriy yer metallari odatdagi sharoitida suvdan vodorodni siqib chiqaradi va tegishli asoslarni hosil qiladi:

$$2Na+2HOH \rightarrow 2NaOH+H_2\uparrow$$

$$Ba+2HOH \rightarrow Ba(OH)_2+H_2\uparrow$$

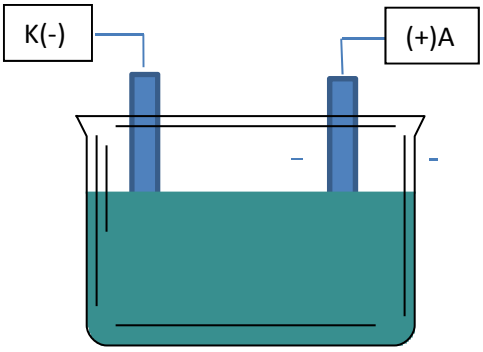
(ilovaga qarang)

Mavzu: Elektroliz

Ta'rif: *Elektrolit suyuqlanmalari yoki eritmalari orqali elektr toki o'tganda elektrodlarda sodir bo'ladigan oksidlanish – qaytarilish reaksiyasi elektroliz deyiladi.*

Elektroliz jarayonida manfiy va musbat ionlar anod va katodga tomon harakat qiladi. Elektroliz elektrolizyorda amalga oshiriladi. U elektrolitik vanna, musbat elektrod –

A^-



anod va manfiy elektrod – katoddan tuzilgan. Elektrolitik vanna elektrolit suyuqlanmasi yoki eritmasi bilan to‘ldiriladi. Elektrolit orqali elektr toki o‘tkazilganda, tartibsiz harakat qilayotgan kationlar va anionlar tegishli elektrodlarga tomon harakat qiladi.

Kationlar katodga borib elektron qabul qiladi, anionlar anodga elektronini berib neytral holga o‘tadi.

(-) Kat: $K^+ + \bar{e} \rightarrow K^0$ Ox *Qaytarilish*

(+) An: $A^- - \bar{e} \rightarrow An^0$ Red *Oksidlnasih*

Ya’ni katodda qaytarilish anodda oksidlanish jarayonlari ro‘y beradi. Natijada elektroliz mahsulotlari erkin holda ajralib chiqadi.

Suyuqlanma va eritma elektrolizi farqlanadi.

Suyuqlanma elektrolizi juda oddiy boradi, ya’ni metallar katodda, metallmaslar anodda erkin holda ajralib chiqadi.

$$MeAc \xrightarrow{El-z} Me + Ac$$

Masalan: NaCl suyuqlanmasi elektrolizi

$$2NaCl \xrightarrow{El-z} 2Na + Cl_2$$

-K: $Na^+ + e^- \rightarrow Na°$

+A: $Cl^- - e^- \rightarrow Cl°$ $\qquad 2Cl^0 \rightarrow Cl_2$

Suyuqlanma elektrolizi ishqoriy va ishqoriy yer metallari, Mg va Al ni olishda ishlatiladi. Metallmaslardan ftor suyuqlanma elektrolizi yordamida olinadi:

$$2Al_2O_{3(s)} \xrightarrow{El-z} 4Al + 3O_2$$

$$CaF_{2(s)} \xrightarrow{El-z} Ca + F_2$$

Agar bir necha metall tuzlari aralashmasi elektroliz qilinsa, ularning ajralib chiqish ketma – ketligi kuchlanishlar qatoriga muvofiq keladi. Ya’ni, avval nodir metall, so‘ngra nodirmas metall ajralib chiqadi.

Masalan: $CuCl_2$, $FeCl_3$ va $CaCl_2$ suyuqlanmalari aralashmasida metallar Cu→Fe→Ca qatorida ajralib chiqadi.

Eritma elektrolizi

Eritma elektrolizi birmuncha murakkabroq sodir bo‘ladi. Chunki, bunda suv molekulalari ham ishtirok etadi.

Katoddagi jarayonlar.

Kationlarning katoddagi holati kuchlanishlar qatoriga muvofiq keladi.

1. Agar kation sifatida ishqoriy va ishqoriy yer metallari (Li^+- Cs^+; Ca^{2+} - Ba^{2+}) kationlari, Mg^{2+}, Al^{3+} va NH_4^+ ionlari ishtirok etsa, ular qaytarilmaydi va eritmada qoladi. Katodda suv molekulalari qaytarilib, vodorod ajralib chiqadi.

-K: Me^{n+}

$2H_2O + 2\bar{e} \rightarrow H_2 + 2OH^-$

2. Agar kation sifatida Mn^{2+}, Zn^{2+}, Cr^{2+}, Fe^{2+}, Fe^{3+}, Cd^{2+}, Co^{2+}, Ni^{2+}, Sn^{2+}, Pb^{2+} ionlar ishtirok etsa, katodda ham metall, ham suv molekulalari qaytarilib, metall va vodorod ajralib chiqadi.

-K: $Me^{n+} + n\bar{e} \rightarrow Me^0$

$2H_2O + 2\bar{e} \rightarrow H_2 + 2OH^-$

3. Agar kation sifatida nodir metall kationlari ishtirok etsa, Cu^{2+}, Ag^{+}, Pd^{2+}, Hg^{2+}, Pt^{2+}, Au^{3+} katodda faqat metall qaytarilib erkin holda ajralib chiqadi.

-K: $Me^{n+}+n\bar{e}\rightarrow Me^{0}$

4. Kislotalar elektroliz qilinganda, katodda vodorod ajralib chiqadi.

-K: $H^{+}+\bar{e}\rightarrow H^{\circ}$ $\quad 2H\rightarrow H_2$

Anoddagi jarayonlar.

Agar anod inert metalldan yoki grafitdan yasalgan bo‘lsa, quyidagicha oksidlanish jarayonlari sodir bo‘ladi. (metallardan Pt, Ir, Au va Ta ham inert hisoblanadi.)

1. Anion sifatida kislorodli kislotalar SO_4^{2-}, SO_3^{2-}, PO_4^{3-},NO_3^{-}, NO_2^{-}, CO_3^{2-}, MnO_4^{-}, MnO_4^{2-}, CrO_4^{2-},$Cr_2O_7^{2-}$, ΓO_4^{-}, ΓO_3^{-}, ΓO_2^{-}, ΓO^{-} va ftorid ioni F^{-} ishtirok etsa, anodda ular oksidlanmaydi. Anodda suv molekulasi oksidlanib, kislorod ajralib chiqadi.

+A: $2H_2O-4\bar{e}\rightarrow O_2\uparrow+4H^{+}$

2. Kislorodsiz kislotalar anion sifatida ishtirok etsa - S^{2-}, Γ^{-} ular anodda oksidlanib, erkin holda metallmas ajralib chiqadi.

+A: $A^{-}-\bar{e}\rightarrow A^{0}$

3. Ishqorlar eritmalari elektroliz qilinganda, gidroksid ionlari oksidlanib, kislorod ajralib chiqadi.

+A: $4OH^{-}-4\bar{e}\rightarrow O_2+2H_2O$

Umuman olganda eritma elektrolizini quyidagicha tasvirlash mumkin.

Katodda

faqat $H_2\uparrow$	$Me+H_2\uparrow$	$H_2\uparrow$	faqat Me
Li^{+} - Cs^{+}, Ca^{2+}-Ba^{2+}, Mg^{2+}, Al^{3+},NH_4^{+}	Mn^{2+}-Pb^{2+}	(k - ta)	Cu^{2+}-Au^{3+}

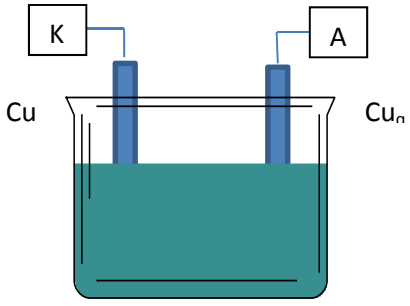
Anodda

Kislorodli kislotalar + F^{-}, OH^{-}	Kislorodsiz kisloatalar
$O_2\uparrow$	Metallmas

Misollar:

1) $2NaCl+2H_2O\xrightarrow{El-z}2NaOH+H_2+Cl_2$
2) $Na_2SO_4+2H_2O\xrightarrow{El-z}Na_2SO_4+2H_2+O_2$
3) $2FeCl_2+2H_2O\xrightarrow{El-z}Fe(OH)_2+Fe+H_2+Cl_2$ (juda kam uchraydi)
4) $FeSO_4+2H_2O\xrightarrow{El-z}H_2SO_4+Fe+H_2+O_2$
5) $CuCl_2+H_2O\xrightarrow{El-z}H_2O+Cu+Cl_2$
6) $2CuSO_4+2H_2O\xrightarrow{El-z}2H_2SO_4+2Cu+O_2$
7) $2HCl+H_2O\xrightarrow{El-z}H_2+Cl_2+H_2O$
8) $H_2SO_4+2H_2O\xrightarrow{El-z}H_2SO_4+2H_2+O_2$
9) $NaOH+2H_2O\xrightarrow{El-z}NaOH+2H_2+O_2$

Mavzu: Eruvchan anodda sodir bo‘ladigan jarayonlar



Eruvchan anod sifatida Cu, Ni, Cd, Al va Zn ishlatiladi. Bunda anod eriydi va eritmadagi metall kationi katodda metallgacha qaytariladi.

Texnikada bu jarayondan metallarni ekektrorafinirlashda foydalaniladi. Bunda anod sifatida qora mis va katod sifatida juda toza mis ishlatiladi.

Anod: $Cu_{(q)} - 2\bar{e} \rightarrow Cu^{2+}$

Katod: $Cu^{2+} + 2\bar{e} \rightarrow Cu°$ (juda toza)

Ya'ni anod oksidlanadi. Anodda O_2 ajralib chiqmaydi.

Shuningdek, bu jarayondan metallik qoplashda foydalaniladi. Bunda anod sifatida qoplanadigan metall va katod sifatida sirti qoplanishi kerak bo'lgan metall ishlatiladi.

Mavzu: Elektroliz qonunlari

Elektrolizda sarflangan tok miqdori va natijada elektrodlarda ajralib chiqadigan moddalar massasi orasidagi bog'liqlik Faradey qonunlari bilan ifodalanadi (1833).

1 Qonun: *Elektroliz davomida elektrodlarda ajralib chiqqan moddalar massasi elektrolitdan o'tgan elektr toki miqdoriga to'g'ri proporsional bo'ladi.*

$$m=k\cdot Q$$

bu yerda: k – moddaning elektrokimyoviy ekvivalenti.

Q – tok miqdori. [Kl]

$$Q=I\cdot t \quad \text{dan} \quad m=k\cdot I\cdot t$$

bu yerda: I – tok kuchi, [A]

t – elektroliz vaqti, [sek.]

Moddaning elektrokimyoviy ekvivalentini topish uchun uning kimyoviy ekvivalentini Faradey soni=96500 ga bo'linishi kerak.

$$k=\frac{E}{F}=\frac{E}{96500}$$

Ta'rif: *1 Kulon tok o'tganda elektrodda ajralib chiqqan modda massasiga elektrokimyoviy ekvivalent deyiladi.*

$$k_{Ag}=\frac{108}{96500}=0{,}00112=1{,}12\text{mg/Kl}$$

ya'ni elektrolitdan 1 Kl tok o'tganda katodda 1,12 mg kumush ajralib chiqadi.

2 Qonun: *Agar turli xil elektrolitlar eritmasi yoki suyuqlanmasi orqali bir xil miqdorda elektr toki o'tkazilsa, elektrodlarda ajralib chiqadigan moddalarning massasi ularning kimyoviy ekvivalentiga proporsional bo'ladi.*

$$m=\frac{E\cdot I\cdot t}{F}$$

bu yerda: E – moddaning kimyoviy ekvivalenti.

I – tok kuchi, [A]

t – elektroliz vaqti, [sek.]

F= 96500 Kl/gr-ekv, Faradey soni.

Masalan, 1 soat davomida turli elektrolit eritmalari orqali tok o'tganda (I=26,8A) katod va anodda ularning ekvivalentlariga mos moddalar ajraladi:

	-K	+A
$NaCl+H_2O\rightarrow$	$1gH_2$	$35{,}5gCl_2$
$Na_2SO_4+H_2O\rightarrow$	$1gH_2$	$8gO_2$
$Fe_2(SO_4)_3+H_2O\rightarrow$	$18{,}67gFe+1gH_2$	$8gO_2$
$AgNO_3+H_2O\rightarrow$	$108gAg$	$8gO_2$
$H_2SO_4+H_2O\rightarrow$	$1gH_2$	$8gO_2$
$KOH+H_2O\rightarrow$	$1gH_2$	$8gO_2$
$CuCl_2+H_2O\rightarrow$	$32gCu$	$35{,}5gCl_2$

Elektrokimyoviy tok unumdorligi quyidagicha hisoblanadi.

$$m=\frac{E\cdot I\cdot t}{F}\cdot\eta$$

Mavzu: Elektroliz masalalari

M1 KOH eritmasi orqali 6A tok kuchi 30 min davomida o‘tkazilganda qancha hajm gaz ajraladi?

I=6A
t=30·60=1800 sek
$V(H_2+O_2)$-?

1 usul

$m(H_2)=\frac{1\cdot6\cdot1800}{96500}=0,112g$

$V(H_2)=\frac{0,112}{2}\cdot22,4=1,25$ l

$m(O_2)=\frac{8\cdot6\cdot1800}{96500}=0,9g$

$V(O_2)=\frac{0,9}{32}\cdot22,4=0,63$ l

$V(H_2+O_2)$=1,25+0,63=1,88 l.

2 usul

KOH eritmasi elektrolizida faqat suv parchalanganligi uchun

$$m(H_2O)=\frac{9\cdot6\cdot1800}{96500}=1,01\ g$$

$2H_2O\xrightarrow{Elektroliz}2H_2+O_2$

36g 67,2 l

1,01g *x*=1,88 l

Agar eritmasi elektrolizi davomida faqat suv parchalansa, Faradey qonuni formulasida suvning ekvivalentini 9g deb olinadi.

Bunday reaksiyalar natijasida eritmada elektrolitning konsentratsiyasi oshadi (suv parchalanishi hisobiga).

M2 KOH eritmasi orqali 80,4 soat davomida 15A tok ishtirokida elektroliz qilindi. Qolgan eritma massasi 195g 30% li KOH ekanligi aniqlansa, boshlang‘ich eritmada ishqor konsentratsiyasini (%) hisoblang.

I=15A
t=80,4·3600sek
m_e=195g
ω_2(KOH)=30%
ω_1(KOH)-?

$m_{H_2O}=\frac{E\cdot I\cdot t}{F}=\frac{9\cdot15\cdot80,4\cdot3600}{96500}=405g$

$m_{KOH}=195\cdot0,3=58,5g$

m_e=195+405=600g

ω(KOH)=$\frac{58,5}{600}$·100%=9,75%

Agar noma’lum metall so‘ralsa, formuladan ekvivalentni topish kerak.

M3 Noma’lum metallning xloridi suyuqlanmasi elektroliz qilinganda 0,5 soat va 11,52A tok kuchida 1,94g metall ajraldi. Qaysi metall tuzi elektroliz qilingan?

I=11,52A
t=0,5·3600sek
m=1,94g
E-?

$m=\frac{E\cdot I\cdot t}{F}$ $E=\frac{m\cdot F}{I\cdot t}$

$E=\frac{1,94\cdot96500}{11,52\cdot1800}=9$ (Al)

Eritma elektrolizi davomida massa kamayishi katodda ajraladigan metall (asosan nodir) va anodda ajraladigan gaz hisobiga aniqlanadi.

M4 $CuSO_4$ ning 400 ml 6% li eritmasining (ρ=1,022g/ml) elektrolizi eritmasi massasi 10g ga kamayguncha davom ettiridi. Eritmada qolgan tuz va hosil bo‘lgan kislotaning massa ulushlarini (%) toping.

V_e=400ml
ρ=1,022g/ml
$\omega_1(CuSO_4)$=6%=0,06
m=(Cu+O_2)=10g
$\omega_2(CuSO_4)$-?
$\omega(H_2SO_4)$-?

$m_e=V_e\cdot\rho$=400·1,022=408,8g

$m(CuSO_4)$=408,8·0,06=24,53g

$CuSO_4+H_2O\rightarrow Cu+{}^1/_2O_2+H_2SO_4$

160g $CuSO_4$ - 40g

x - 10g *x*=20g $CuSO_4$

$m_q(CuSO_4)$=24,53-20=4,53g

98g H_2SO_4 - 80g

y - 10g *y*=12,25g

m_e=408,8 – 10 =398,8g

$\omega(CuSO_4)=\frac{4,53}{398,8}\cdot100\%=1,14\%$

$$\omega(H_2SO_4)=\frac{12,25}{398,8}\cdot 100\% = 3,07\%$$

Agar eritma elektrolizi davomida parchalangan elektrolit massasi kamayishi kerak bo‘lganidan kichik bo‘lsa, 1- elektroliz jarayoni tugab, suvning parchalanishi bo‘yicha hisoblanadi.

M5 Massa ulushi 8,5% bo‘lgan $AgNO_3$ ning 800g eritmasi massasi 50g kamayguncha elektroliz qilindi. Reaksiyada olingan HNO_3 ning massa ulushini va inert elektrodlarda ajralib chiqqan moddalari va ular massasini hisoblang.

$\omega(AgNO_3)=8,5\%=0,085$
$m_e=800g$
$m_{kam}=50g$
$\omega(HNO_3)$-?
m(Ag)-?
$m(O_2)-?$

$m(AgNO_3)=800\cdot 0,085=68g$

1-Elektroliz

$$2AgNO_3 + H_2O \xrightarrow{El-z} 2Ag + \frac{1}{2}O_2 + 2HNO_3$$

340g - 216gAg 16gO_2 126g
68g - *x* *y* *z*

x=43,2gAg
y=3,2gO_2 umumiy 46,4g
z=25,2g HNO_3
qolgan 3,6g kamayish suv parchalanishi hisobidan. $\omega(HNO_3) = \frac{25,2}{750}\cdot 100\% = 3,36\%$

2-Elektroliz $2H_2O = 2H_2 + O_2$
36g - 4g 32g
3,6g - *a* *b*

a=0,4g H_2 *b*=3,2g O_2
umumiy
m(Ag)=43,2g (K)
$m(O_2)$=3,2+3,2=6,4g (A)
$m(H_2)$=0,4g (K)

Agar bir necha elektrolitlar aralashmasi eritmasi elektrolizi berilsa, tok sig‘imi tenglamasidan foydalanish qulayroq:

$$\Phi = \frac{I\cdot t}{F}$$

M6. 1. Suvsiz rux sulfat bilan kadmiy sulfatdan iborat 2,65 g aralashma suvda eritildi. Rux bilan kadmiyni batamom ajratib olish uchun eritmadan 90 minut davomida 0,536 A kuchga ega bo’lgan elektr toki o‘tkazildi. Sulfatlar aralashmasining tarkibini (g) aniqlang.

I=0,536A
t=90·60sek
$m(ZnSO_4, CdSO_4)$=2,65g
$m(ZnSO_4)$-?
$m(CdSO_4)$-?

$$\Phi = \frac{I\cdot t}{F} = \frac{0,536\cdot 5400}{96500} = 0,03F$$

$80,5x+104(0,03-x)=2.65$ x=0,02F
$m(ZnSO_4)=80,5\cdot 0,02=1,61g$
$m(CdSO_4)=104\cdot 0,01=1,04g$

M7. 1. Birinchi elektrolizerda 1,5 mol, ikkinchisida 2,5 mol mis (II) sulfat bo‘lgan eritmalar orqali 5 faradey tok o‘tganda katodlarda ajralib chiqqan moddalar massalarini (g) aniqlang.

1-elektrolizer. 1,5mol $CuSO_4$		1-elektrolizer. 2,5mol $CuSO_4$	
Φ=5F		Φ=5F	
1,5mol $CuSO_4$ ga 3F	2F suvga	1,5mol $CuSO_4$ ga 3F	-
m(Cu)=1.5·64=96g	$m(H_2)$=2·1=2g	m(Cu)=2.5·64=160g	
m_{um}=96+2=98g		m_{um}=160g	

XVI BOB. TERMOKIMYO

Mavzu: Termokimyo

Kimyoviy reaksiyalarning energetik effektlarini o‘rganuvchi bo‘limga termokimyo deyiladi.

Issiqlik chiqishi bilan sodir bo‘ladigan reaksiyalar ekzotermik reaksiya, yutilishi bilan boradigan reaksiyalar endotermik reaksiyalar deyiladi.

Termokimyoda issiqlik miqdori Q bilan, entalpiya o‘zgarishi ΔH bilan belgilanadi.

Ta’rif: *O‘zgarmas bosimdagi reaksiya issiqlik miqdorining manfiy qiymatiga reaksiya entalpiyasi deyiladi.*

$$\Delta H=-Q_P$$

Ekzotermik: $\Delta H<0$ $Q>0$

Endotermik: $\Delta H>0$ $Q<0$

Termokimyoviy tenglamani tuzishda moddalarning agregat holati ko‘rsatiladi. (g) – gaz, (s) – suyuq, (q) – qattiq.

Masalan: $CO_{2(g)}+C_{(q)}\leftrightarrow 2CO_{(g)}$ $\Delta H°=+173$ kJ

$2CO_{(g)}\leftrightarrow CO_{2(g)}+C_{(q)}$ $\Delta H°=-173$ kJ

Odatda standart entalpiya qiymatidan foydalaniladi (P=101,325 kPa; T=298 K) va u $\Delta H°$ bilan belgilanadi.

Oddiy moddalarning standart hosil bo‘lish entalpiyalari 0ga teng.

$$\Delta H^{\circ}_{H_2}=0 \qquad \Delta H^{\circ}_{J_2}=0$$

Murakkab moddalarning hosil bo‘lish entalpiyalari beriladi.

Ta’rif: *Oddiy moddalardan 1 mol murakkab modda hosil bo‘lish reaksiyasi entalpiyasi moddalarning hosil bo‘lish entalpiyasi deyiladi.*

Masalan: $C_{(q)}+O_{2(g)}=CO_{2(g)}$ $\Delta H°=-393$kJ

$2N_{2(g)}+5O_{2(g)}=2N_2O_5$ $\Delta H°=+22$kJ

$\Delta H_{N_2O_5}=22/2=11$kJ ya’ni – 1 mol N_2O_5 hosil bo‘lishi uchun 11 kJ issiqlik yutiladi.

Reaksiya entalpiyasini hisoblash uchun reaksiya mahsulotlari entalpiyalari yig‘indisidan dastlabki moddalar entalpiyalari ayriladi:

$$\Delta H_{R\text{-}ya}=\sum\Delta H_{d.m}-\sum\Delta H_{d.m}$$

Masalan: NH_3 ning katalitik oksidlanish reaksiyasi entalpiyasini topamiz.

$4NH_{3(g)}+5O_{2(g)}=4NO_{(g)}+6H_2O_{(s)}$

4 5 4 6

$\Delta H°$(kJ/mol) – 46 0 +91 -242

$\Delta H°_{R\text{-}ya}=(4\cdot\Delta H°_{NO}+6\cdot\Delta H°_{H_2O})-(4\cdot\Delta H°_{NH_3}+5\Delta H°O_2)=\{4(91)+6(-242)\}-\{4(-46)+5\cdot 0)\}=-904$ kJ.

Reaksiya ekzotermik.

XVII BOB. KOMPLEKS BIRIKMALAR

Mavzu: Kompleks birikmalar va Verner nazariyasi

Ko‘pchilik binary birikmalarda lementlar o‘zining maksimal valentliklarini namoyon qiladi. masalan, BF_3, CH_4, NH_3, H_2O va CO_2. Ular *birinchi tartibli birikmalar* deyiladi.

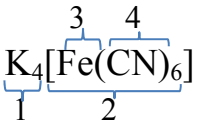
Birinchi tartibli birikmalar o‘zaro qo‘shilib *yuqori tartibli birikmalarni* hosil qiladi. Ularga gidratlar, ammiakatlar, qo‘sh tuzlar va boshqalar kiradi.

Shveysariyalik kimyogar Alfred Verner *komplek birikmalar* tushunchasini fanga kiritgan.

Ta’rif: *Koordinatsion yoki kompleks birikmalar deb eritmada yoki quruq holda ham parchalanib ketmaydigan moddalarga aytiladi.*

1883 yil Verner har qanday element o‘zining asosiy valentliklaridan tashqari qo‘shimcha, ya’ni koordinatsion valentlikni namoyon qilishini aytadi.

Kompleks birikmalarda (KB) *tashqi* va *ichki sfera* farq qiladi.



1) Tashqi sfera;
2) Ichki sfera;
3) Kompleks hosil qiluvchi yoki markaziy atom;
4) Ligand.

Kompleks hosil qiluvchi sifatida ko‘proq o‘tish metallarining (*d*-elementlar) kationlari ishtirok etadi.

Ligandlar sifatida Γ^-, OH^-, CN^-, SCN^-, NO_2^-, $C_2O_4^{2-}$, CO_3^{2-} kabi anionlar, H_2O, NH_3, CO, NO, N_2H_4 kabi meytral molekulalar qatnashadi.

Markaziy atom bilan bog‘langan ligandlar soni *koordinatsion son* yoki *koordinatsion sig‘im* deyiladi. Koordinatsion son 1,2,3,4,5,6,7,8,9,12 bo‘lishi mumkin. Koordinatsion soni (KS) 2.4 yoki 6 ga teng bo‘lgan komplekslar ko‘proq uchraydi.

Agar KS 2 teng bo‘lsa kompleks chiziqli, gibridlanish *sp*;

Agar KS 4 teng bo‘lsa kompleks tetraedr yoki kvadrat, gibridlanish sp^3;

Agar KS 6 teng bo‘lsa kompleks oktaedrik, gibridlanish sp^3d^2 bo‘ladi.

Kompleks hosil qiluvhci qancha katta oksidlanish darajasini namoyon qilsa, uning koordinatsion sig‘imi shuncha katta bo‘ladi. Masalan, $[Ag(NH_3)_2]Cl$, $K[AlCl_4]$, $K_4[Fe(CN)_6]$.

Shuningdek koordinatsion sig‘im ligand tabiatiga bog‘liq. Masalan, alyuminiy Cl^-, Br^- va J^- ionlari bilan 4, F^- ioni bilan 6 ga teng koordinatsion birikmalarni hosil qiladi: $K[A;Cl_4]$, $K_3[AlF_6]$.

Nomlanishi:

Ko‘pchilik KB lar oz’ining tarixiy nomini saqlab qolgan. Masalan, $K_3[Fe(CN)_6]$ – qizil qon tuzi.

IUPAC bo‘yicha KB lar quyidagicha nomlanadi:

1) Dastlab kation, keyin anion aytiladi:
   $[Ag(NH_3)_2]Cl$ – diamminargento(kumush) xlorid
   $K_2[CuCl_3]$ – kaliytrixlorokuprat(mis)(I)
2) Ligandlar quyidagi ketma-ketlikda aytiladi: *anion L<neytral L<kation L*. Bunda dastlab soda ligandlar, kyin organik ligandlar alfavit ketma-ketligida aytiladi:
   $[Co(NH_3)_4Br(H_2O)](NO_3)_2$ – bromoakvotetraamminkobalt(III) nitrat.
3) Neytral ligandlar molekula kabi aytiladi. Lekin, H_2O – *akvo*, NH_3 – *ammin* deb aytiladi. Manfiy ligandlarga “*o*” qo‘shimchasi qo‘shiladi:
   $K_2[CuCl_4]$ – kaliytetraxl*o*romis(II)
4) Ligandlar soni *di-, tri-, tera-, penta-* va *geksa-* deb ko‘rsatiladi:
   $K_2[SnF_6]$ – kaliy*geksa*ftorostannat(IV)

5) Anion komplekslarda "*at*" qo‘shimchasi qo‘shiladi. Neytral va kation komplekslarni nomlashda o‘zgartirish kiritilmaydi:
   $K_4[Fe(CN)_6]$ – kaliygeksasianoferr*at*(II)
   $[Al(H_2O)_6]Cl_3$ – geksaakvoaluminiy xlorid
6) Kompleks hosil qiluvchi (markaziy atom)ning oksidlanish darajasi qavs ichida rim raqamida ko‘rsatiladi:
   $[Cu(NH_3)_2]Cl$- diamminmis(I) xlorid.

KB lar klassifikatsiyasi:

1. KB lar qaysi birikmalar sinfiga kirishiga ko‘ra:
   a) Kompleks kislotalar: $H_2[SiF_6]$, $H[AuCl_4]$;
   b) Kompleks asoslar: $[Ag(NH_3)_2]OH$;
   c) Kompleks tuzlar: $K_4[Fe(CN)_6]$, $[Cr(H_2O)_6]Cl_3$ ga bo‘linadi.
2. Ligandlar tabiatiga ko‘ra akvokomplekslar $[Co(H_2O)_6]SO_4$, ammiakatlar $[Ag(NH_3)_2]Cl$, atsidokomplekslar – kislota qoldig‘i radikali tutgan $K_2[HgJ_4]$, OH^- ligandli komplekslar – gidroksokomplekslar $Na[Al(OH)_4]$ bo‘linadi.
3. Kompleks zaryadiga ko‘ra:
   a) Kation komplekslar $[Co(NH_3)_6]Cl_3$, $[Zn(NH_3)_4]Cl_2$;
   b) Anion komplekslar $Li[AlH_4]$, $K_2[Be(CO_3)_2]$
   c) Neytral komplekslar $[Pt(NH_3)_4Cl_2]$, $[Co(NH_3)_3Cl_3]$ bo‘linadi. Neytral komplekslarda tashqi sfera bo‘lmaydi.

KB larda bog‘lanish:

KB larda markaziy atom bilan ligand orasidagi bog‘ donor-akseptor (koordinatsion) bog‘lanish hisoblanadi. Masalan, $K[AlCl_4]$ da 4 ta donor-akseptor, $K_3[Fe(CN)_6]$ da 6 ta donor-akseptor bog‘lanish mavjud.

Ulardagi bog‘lanish xilma-xilligini quyidagicha tasvirlash mumkin:

$CuSO_4 \cdot 5H_2O$ $[Cu(H_2O)_4]SO_4 \cdot H_2O$ molekulasida

$Cu^{2+} - H_2O$ bog‘lari donor-akseptor;

Koordinatsion ion – SO_4^{2-} ion bog‘;

Bitta H_2O vodorod bog‘lanish orqali bog‘langan bo‘ladi.

Xossalari:

KB lar qo‘sh tuzlardan farq qilib, murakkab ion – komplekslarga dissotsilanadi:

$$K_4[Fe(CN)_6] \leftrightarrow 4K^+ + [Fe(CN)_6]^{4-}$$

$$[Co(NH_3)_6]Cl_3 \leftrightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$$

Qo‘sh tuzlar esa yakka soda ionlarni hosil qiladi:

$$KAl(SO_4)_2 \cdot 12H_2O \leftrightarrow K^+ + Al^{3+} + 2SO_4^{2-} + 12H_2O$$

2-Qism

ANORGANIK KIMYO REAKSIYALARDA

ANORGANIK KIMYO REAKSIYALARDA

Mavzu: Vodorod – H_2

Olinishi:

Laboratoriyada:

1. Suyultirilgan kislotalarga metallar ta'siridan:

$$Zn+2HCl=ZnCl_2+H_2\uparrow$$

2. Amfoter metallarga ishqor ta'sir ettirib:

$$Al+NaOH+3H_2O=Na[Al(OH)_4]+1{,}5H_2\uparrow$$

Sanoatda:

1. Metanni konversiyalab:

$$CH_4+H_2O=CO+3H_2 \quad (t=800°C, kat)$$

2. Suv bug'ini cho'g'langan koksga ta'sir ettirib:

$$C+H_2O=CO+H_2 \qquad CO+H_2O=CO_2+H_2$$

3. Cho'g'langan temirga suv bug'i ta'siridan:

$$3Fe+4H_2O=Fe_3O_4+4H_2\uparrow$$

4. Suvni elektroliz qilib:

$$2H_2O=2H_2+O_2$$

Kimyoviy xossalari:

1. Kislorodda yorqin havorang alanga berib yonadi:

$$2H_2+O_2=2H_2O$$

2. Galogenlar, N_2 va S bilan oson ta'sirlashadi:

$$H_2+Cl_2=2HCl \quad N_2+3H_2=2NH_3 \quad H_2+S=H_2S$$

3. Ko'pchilik metal oksidlarini qaytaradi(vodorodotermiya):

$$CuO+H_2=Cu+H_2O \qquad WO_3+3H_2=W+3H_2O$$

4. Ishqoriy va ishqoriy yer metallari bilan gidridlar hosil qiladi:

$$Ca+H_2=CaH_2 \quad 2Na+H_2=2NaH$$

5. Molekulyar vodorod VIIIB guruh metallariga yaxshi yutiladi. Masalan, 1 hajm Pd 700 hajm vodorodni yutadi.

Mavzu: Gidridlar – EH_x

1. Tuzsimon gidridlar – ishqoriy va ishqoriy-yer metallarining gidridlari: LiH, NaH, KH, CsH, RbH, CaH_2, SrH_2 va BaH_2.
   Ular suv bilan ta'sirlashib vodorodni hosil qiladi:

$$CaH_2+2HOH=Ca(OH)_2+2H_2\uparrow$$

2. Kovalent gidridlar – IVA, VA, VIA va VIIA guruh elementlarining gidridlaridir. CH_4, SiH_4, NH_3, PH_3, H_2O, H_2S, HF, HCl, HBr, HJ, AsH_3, BeH_2 va BH_3.
3. Metal gidridlar – IB-VIIIB guruh elemntlarining gidridlaridir. Masalan, Pd-H_2.
4. Kompleks gidridlar – tuzsimon va kovalent gidridlaridan hosil bo'ladi.

$$NaH+BH_3=Na[BH_4]$$

Mavzu: Suv – H_2O

Kimyoviy xossalari:

1. Suv 1000°C dan yuqorida parchalanadi:

$$2H_2O\rightarrow 2H_2+O_2$$

2. Galogenlar bilan ta'sirlashadi:

$$H_2O+F_2=2HF+O \qquad H_2O+Cl_2=HCl+HClO$$

3. Cho'g'langan ko'mir bilan ta'sirlashadi:

$$C+H_2O=CO+H_2$$

4. Ishqoriy va ishqoriy-yer metallari bilan ta'sirlashadi:

$$2Na+2H_2O=2NaOH+H_2\uparrow$$

5. Asosli va kislotali oksidlar bilan ta'sirlashadi:

$$CaO+H_2O=Ca(OH)_2 \quad SO_3+H_2O=H_2SO_4$$

Mavzu: Ftor – F_2

Minerallari:

CaF_2 – flyuorit(plavik shpat) $Na_3[AlF_6]$ – kriolit $3Ca_3(PO_4)_2\cdot CaF_2$ – ftorappatit

Olinishi:

1. KF ning HF dagi suyuqlanmasini elektroliz qilib olinadi:

$$2KF=2K+F_2\uparrow$$

Kimyoviy xossalari:

1. Ftor juda aktiv metalmas. U faqatgina bevosita kislorod va azot bilan ta'irlashmaydi.

Mavzu: Vodorod ftorid – HF

Olinishi:

Flyuoritga kons.H_2SO_4 ta'siridan olinadi:

$$CaF_2+H_2SO_4=CaSO_4+2HF$$

Kimyoviy xossalari:

1. Plavik kislota shishani yemiradi:

$$SiO_2+4HF=SiF_4+2H_2O \qquad 2HF+SiF_4=H_2[SiF_6]$$

2. AgF suvda yaxshi eriydi.

Mavzu: Xlor – Cl_2

Minerallari:

KCl – silvin $KCl\cdot MgCl_2\cdot 6H_2O$ – karnallit $KCl\cdot MgSO_4\cdot 3H_2O$ – kainit

Olinishi:

Laboratoriyada:

1. Xlorid kislotaga oksidlovchilar ta'sir ettirib olinadi:

$$2KMnO_4+16HCl=2KCl+2MnCl_2+5Cl_2\uparrow+8H_2O$$
$$MnO_2+4HCl=MnCl_2+Cl_2\uparrow+2H_2O$$

Sanoatda:

1. Osh tuzi eritmasini elektroliz qilib olinadi:

$$2NaCl+2H_2O=2NaOH+Cl_2\uparrow+H_2\uparrow$$

Kimyoviy xossalari:

1. Xlor juda kuchli oksidlovchi. U vodorod va metallar bilan kuchli ta'sirlashadi:

$$H_2+Cl_2=2HCl \qquad 2Fe+3Cl_2=2FeCl_3 \qquad 2Sb+3Cl_2=2SbCl_3$$

2. U metalmaslar bilan ham ta'sirlashadi:

$$2P+3Cl_2=2PCl_3$$

3. Xlor suvda erib kislotalar aralashmasini hosil qiladi:

$$Cl_2+H_2O=HCl+HClO$$

4. Xlor sovuq ishqor eritmalari bilan xlorid va gipoxloritlar aralashmasini hosil qiladi:

$$Cl_2+2NaOH=NaCl+NaClO+H_2O$$ (Laborak suvi)

5. Xlor qaynoq ishqor eritmalari bilan xlorid va xloratlar aralashmasini hosil qiladi:

$$3Cl_2+6NaOH=5NaCl+NaClO_3+3H_2O$$

6. Xlor brom va yodni birikmalaridan siqib chiqaradi:

$$Cl_2+2NaBr=2NaCl+Br_2 \qquad Cl_2+2NaJ=2NaCl+J_2$$

Mavzu: Vodorod xlorid – HCl

Olinishi:

1. Sintez usuli bilan olinadi:

$$H_2+Cl_2=2HCl$$

2. Osh tuziga kons.H_2SO_4 ta'sir ettirib olinadi:

$$2NaCl+H_2SO_4=2HCl+Na_2SO_4 \qquad NaCl+H_2SO_4=NaHSO_4+HCl$$

Kimyoviy xossalari:

1. Xlorid kislota kuchli kislota hisoblanadi:

$$Fe+2HCl=FeCl_2+H_2\uparrow$$

2. 3 hajm kons.HCl va 1 hajm kons.HNO_3 aralashmasiga "zar suvi" yoki "podsho arog'i" deyiladi. Unda Au va Pt eriydi:

$$Au+3HCl+HNO_3=AuCl_3+NO\uparrow+2H_2O$$

3. Kuchlanishlar qatorida H_2 dan o'ngda turgan metallar HCl da erimaydi.

Mavzu: Xorning kislorodli birikmlari

Kislorodli kislotalari: HClO, $HClO_2$, $HClO_3$, $HClO_4$

Kimyoviy xossalari:

1. Gipoxlorit kislota juda kuchsiz kislota. Parchalanganda atomar kislorod ajralib chiqqanligi uchun juda kuchli oksidlovchi:

$$HClO=HCl+O$$

2. Gipoxloritlarni olish uchun xlor sovuq ishqor eritmasida eritiladi:

$$2KOH+Cl_2=KCl+KClO+H_2O$$ (Javell suvi)

3. Ohak eritmasiga xlor yuborilsa xlorli ohak hosil bo'ladi:

$$Ca(OH)_2+Cl_2=CaOCl_2+H_2O$$

4. Xlorli ohak havoda va kislotalar ta'siridan parchalanadi:

$$2CaClOCl+CO_2=CaCO_3+0CaCl_2+Cl_2\uparrow \qquad CaClOCl+2HCl=CaCl_2+Cl_2\uparrow+H_2O$$

5. ClO_2 ishqorlarda erib disproporsilanadi:

$$2ClO_2+2KOH=KClO_2+KClO_3+H_2O$$

6. Xlorat kislota quyidagicha hosil qilinadi:

$$Ba(ClO_3)_2+H_2SO_4=BaSO_4+2HClO_3$$

7. Bertolle tuzi katalizatorsiz 400°C da parchalanganda xlorid va perxloratlar hosil bo'ladi:

$$4KClO_3\rightarrow 3KClO_4+KCl$$

8. Bertolle tuzi MnO_2 ishtirokida xlorid va kislorodni hosil qiladi:

$$2KClO_3\rightarrow 2KCl+3O_2\uparrow$$

9. Perxlorat kislota – $HClO_4$ eng kuchli kislorodli kislota hisoblanib, u perxloratlarga kons.H_2SO_4 ta'siridan olinadi:

$$KClO_4+H_2SO_4=KHSO_4+HClO_4$$

10. Perxloratlar oksidlovchilik xossasini namoyon qilmaydi.

Mavzu: Brom va yod – Br_2/J_2

Olinishi:

1. Bromidlarni/yodidlarni xlor bilan siqib chiqarib olinadi:

$$2KBr+Cl_2=2KCl+Br_2$$
$$2KJ+Cl_2=2KCl+J_2$$

2. HBr sintez yoki PBr_3 gidrolizidan olinadi:

$$PBr_3+3H_2O=H_3PO_3+3HBr$$

Kimyoviy xossalari:

1. Brom vodorod bilan qizdirilganda reaksiyaga kirishadi:

$$H_2+Br_2=2HBr$$

2. Brom kuchli oksidlovchi hisoblanadi:

$$SO_2+Br_2+2H_2O=2HBr+H_2SO_4$$

3. Yod ishqorda erib yodid va yodatlar aralashmasini hosil qiladi:

$$J_2+6NaOH=5NaJ+NaJO_3+3H_2O$$

Mavzu: Kislorod – O_2

Olinishi:

1. Parchalash reaksiyalari yordamida olinadi:

$$2KClO_3=2KCl+3O_2\uparrow$$
$$2KNO_3=2KNO_2+O_2\uparrow$$
$$2KMnO_4=K_2MnO_4+MnO_2+O_2\uparrow \text{ (juda toza } O_2\text{)}$$
$$2H_2O_2=2H_2O+O_2\uparrow$$
$$2BaO_2=2BaO+O_2\uparrow$$
$$2HgO=2Hg+O_2\uparrow$$

2. Ishqoriy metallar peroksidlarini CO_2 bilan ta'siridan:

$$2Na_2O_2+2CO_2=2Na_2CO_3+O_2\uparrow \text{ (akvalangda } O_2 \text{ ni regeneratsiya qilish)}$$

3. Sanoatda havoni fraksiyalab, yoki suvni elektroliz qilib:

$$2H_2O=2H_2+O_2$$

Kimyoviy xossalari:

1. Moddalar O_2 da yonganda oksidlar hosil bo'ladi:

$$S+O_2=SO_2 \qquad 4Li+O_2=2Li_2O \qquad 2Cu+O_2=2CuO \qquad 2H_2S+3O_2=2SO_2+2H_2O$$

2. Barcha organik moddalar O_2 da yonadi:

$$CH_4+2O_2=CO_2+2H_2O \qquad C_6H_{12}O_6+6O_2=6CO_2+6H_2O$$

3. Fosfor O_2 da yonganda 2 xil oksid hosil bo'ladi:

$$4P+3O_2=2P_2O_3 \text{ } (O_2 \text{ kam}) \qquad 4P+5O_2=2P_2O_5 \text{ } (O_2 \text{ mo'l})$$

Mavzu: Ozon – O_3

Olinishi:

1. Ozonatorda olinadi:

$$2O_3=3O_2$$

Kimyoviy xossalari:

1. Ozon juda kuchli oksidlovchi:

$$2Ag+O_3=Ag_2O+O_2\uparrow$$
$$3PbS+4O_3=3PbSO_4$$
$$3H_2S+4O_3=3H_2SO_4$$

Sifat reaksiya:

1. KJ eritmasi orqali o‘tkazilganda binafsha rangli yod cho‘kmasi hosil bo‘ladi:

$$2KJ+O_3+H_2O=2KOH+J_2+O_2\uparrow$$

Mavzu: Vodorod peroksid – H_2O_2

Olinishi:

1. BaO_2 ga H_2SO_4 ta’siridan:

$$BaO_2+H_2SO_4=H_2O_2+BaSO_4$$

Kimyoviy xossalari:

1. MnO_2 katalizatori ishtirokida oson parchalanadi:

$$2H_2O_2=2H_2O+O_2\uparrow$$

2. H_2O_2 kuchsiz kislota xossasiga ega. Ishqorlar bilan peroksidlar hosil qiladi:

$$H_2O_2+Ba(OH)_2=BaO_2+2H_2O$$

3. H_2O_2 kuchli oksidlovchi hisoblanadi:

$$2KJ+H_2O_2=J_2+2KOH$$
$$PbS+4H_2O_2=PbSO_4+4H_2O$$

4. H_2O_2 kuchli oksidlovchilar bilan oksidlanadi:

$$2KMnO_4+3H_2SO_4+5H_2O_2=K_2SO_4+MnSO_4+5O_2\uparrow+8H_2O$$

Mavzu: Oltingugurt – S

Minerallari:

FeS – temir sulfid; FeS_2 – pirit; ZnS – rux aldamasi; $CaSO_4\cdot 2H_2O$ – gips; $CaSO_4$ – angidrit; $BaSO_4$ – barit; $Na_2SO_4\cdot 10H_2O$ – Glauber tuzi; $MgSO_4\cdot 7H_2O$ – taxir tuz.

Olinishi:

1. Sanoatda quyidagicha olinadi:

$$2H_2S+3O_2=2SO_2+2H_2O \qquad 2H_2S+SO_2=3S+2H_2O$$

Kimyoviy xossalari:

1. Oltingugurt kislorodda yonib SO_2 ni hosil qiladi:

$$S+O_2=SO_2$$

2. Oltingugurt metallar va vodorod bilan qizdirilgan ta’sirlashadi:

$$S+H_2=H_2S$$
$$Fe+S=FeS$$

3. S qizdirilganda xlor bilan reaksiyaga kirishadi:

$$2S+Cl_2=S_2Cl_2$$

4. S qaynoq ishqorda disproporsialanadi:

$$3S+6NaOH=2Na_2S+Na_2SO_3+3H_2O$$

5. S kons.H_2SO_4 bilan reaksiyaga kirishib SO_2 ni hosil qiladi:

$$2H_2SO_4+S=2SO_2\uparrow+2H_2O$$

Mavzu: Vodorod sulfid – H_2S

Olinishi:

1. FeS ni HCl bilan ta’siridan:

$$FeS+2HCl=FeCl_2+H_2S\uparrow$$

2. Sintez usul bilan:

$$H_2+S=H_2S$$

Kimyoviy xossalari:

1. U to‘la yonganda ko‘kish alanga berib yonadi:

$$2H_2S+3O_2=2H_2O+2SO_2$$

2. U chala yonganda S hosil bo‘ladi:

$$2H_2S+O_2=2S+2H_2O$$

Mavzu: Oltingugurt(IV)oksid - SO_2

Olinishi:

1. S yoki H_2S ning yonishidan:

$$S+O_2=SO_2 \qquad 2H_2S+3O_2=2H_2O+2SO_2$$

2. Sulfid va piritni yoqib olinadi:

$$2ZnS+3O_2=2ZnO+2SO_2\uparrow$$
$$4FeS_2+11O_2=2Fe_2O_3+8SO_2\uparrow$$

3. Misning konsentrlangan sulfat kislota bilan ta'siridan:

$$Cu+2H_2SO_4=CuSO_4+SO_2\uparrow+2H_2O$$

Kimyoviy xossalari:

1. U kislorod ishtirokida yonib SO_3 ni hosil qiladi:

$$2SO_2+O_2=2SO_3$$

2. U suvda erib kuchsiz kislota – sulfit kislotani hosil qiladi:

$$SO_2+H_2O=H_2SO_3$$

Mavzu: Oltingugurt (VI) oksid – SO_3

Olinishi:

1. SO_2 ning oksidlanishidan hosil bo'ladi:

$$2SO_2+O_2=2SO_3 \quad \text{kat } (Pt,V_2O_5)$$

Kimyoviy xossalari:

1. U suv bilan sulfat kislotani hosil qiladi. Bu reaksiya kuchli ekzotermik:

$$SO_3+H_2O=H_2SO_4$$

2. Sulfat kislotada erib oleumni hosil qiladi. Uning asosiy tarkibi pirosulfat kislota hisoblanadi:

$$H_2SO_4+SO_3=H_2S_2O_7$$

$$H_2SO_4+nSO_3=H_2SO_4\cdot nSO_3 \quad \text{(oleum)}$$

Mavzu: Sulfat kislota – H_2SO_4

Olinishi:

1. Nitroza
2. Kontakt. Bu 2 usul bir-biri bilan faqat SO_2 ning oksidlanish jarayonida farq qiladi:

1-bosqich. Sulfid rudalari yoqiladi:

$$4FeS_2+11O_2=2Fe_2O_3+8SO_2\uparrow$$

2-bosqich. Nitroza usulida SO_2 NO katalizatorida oksidlanadi:

$$2SO_2+O_2=2SO_3$$

Kontakt usulida SO_2 V_2O_5 katalizatorida oksidlanadi:

$$2SO_2+O_2=2SO_3$$

3-bosqich. SO_3 kons. sulfat kislotaga yuttiriladi:

$$SO_3+H_2SO_4=H_2S_2O_7$$

Oleum suvga yuttiriladi:

$$H_2S_2O_7+H_2O=2H_2SO_4$$

Kimyoviy xossalari:

1. Sulfat kislota kuchli ikki asosli kislota hisoblanadi:

$$H_2SO_4\leftrightarrow H^+ + HSO_4^- \qquad HSO_4^-\leftrightarrow H^+ + SO_4^{2-}$$

2. U ko'pchilik kislotalarni tuzlaridan siqib chiqaradi:

$$CaF_2+H_2SO_4=CaSO_4+2HF$$

3. Suyultirilgan H_2SO_4 ko'pchilik nodirmas metallar bilan ta'sirlashib vodorod ajralib chiqadi:

$$Fe+H_2SO_{4(s)}=FeSO_4+H_2\uparrow$$

4. Konsentrlangan sulfat kislotadan hech qanday metal vodorodni siqib chiqara olmaydi. Chunki u kuchli oksidlovchi.

$$Cu+2H_2SO_{4(k)}=CuSO_4+SO_2\uparrow+2H_2O$$

$$2Ag+2H_2SO_{4(k)}=Ag_2SO_4+SO_2\uparrow+2H_2O$$

$$3Zn+4H_2SO_{4(k)}=3ZnSO_4+S+4H_2O$$

5. Konsentrlangan sulfat kislota ko'pchilik organik moddalardan suvni tortib oladi:

$$C_{12}H_{22}O_{11}+H_2SO_4=12C+H_2SO_4\cdot H_2O$$

$$HCOOH+H_2SO_4=CO\uparrow+H_2SO_4\cdot H_2O$$

6. U hatto ko'mirni ham oksidlashi mumkin:

$$C+2H_2SO_4=CO_2+2SO_2+2H_2O$$

7. Turli qaytaruvchilar kons.H_2SO_4 ta'sirida oksidlanadi:

$$2HBr+H_2SO_4=Br_2+SO_2\uparrow+2H_2O$$

$$3H_2S+H_2SO_4=4S+4H_2O$$

Mavzu: Tiosulfat kislota – $H_2S_2O_3$

Olinishi:

1. Tiosulfatlar sulfitlarga oltingugurt qo'shib qizdirib olinadi:

$$Na_2SO_3+S=Na_2S_2O_3 \qquad Na_2S_2O_3+2HCl=H_2S_2O_3+2NaCl$$

Kimyoviy xossalari:

1. Tiosulfatlar sulfat kislota ta'siridan eritma loyqalanadi(S hosil bo'lish hisobiga):

$$Na_2S_2O_3+H_2SO_4=Na_2SO_4+S+SO_2\uparrow+H_2O$$

Mavzu: Selenat kislota – H_2SeO_4

Kimyoviy xossalari:

1. Selenat kislota juda kucli oksidlovchi. Unda hatto oltin eriydi:

$$2Au+6H_2SeO_4=Au_2(SeO_4)_3+3SeO_2\uparrow+6H_2O$$

Mavzu: Azot – N_2

Olinishi:

Laboratoriyada.

1. NH_4NO_2 ni parchalab olinadi:

$$NH_4NO_2=N_2\uparrow+2H_2O$$

2. $(NH_4)_2Cr_2O_7$ ni parchalab olinadi:

$$(NH_4)_2Cr_2O_7=N_2\uparrow+Cr_2O_3+4H_2O$$

Sanoatda.

Havoni fraksion kondensatlab va distillab olinadi. Bunda birinchi bo'lib azot haydaladi.

Kimyoviy xossalari:

Azot molekulasi barqarorligi uchun u juda ham inert.

$$N_2\rightarrow 2N - 940\ kJ/mol$$

U passivligi jihatidan inert gazlardan keyin ikkinchi o'rinda turadi:

1. U faqat Li bilan xona sharoitida reaksiyaga kirishadi:

$$6Li+N_2=2Li_3N$$

2. U qolgan aktiv metallar bilan temperatura ta'sirida reaksiyaga kiirshib nitridlar hosil qiladi:

$$3Mg+N_2=Mg_3N_2$$

3. U vodorod va metalmaslar bilan ham yuqori temperaturada reaksiyaga kirishadi:

$$N_2+3H_2=2NH_3 \quad N_2+O_2=2NO$$

Mavzu: Ammiak – NH_3

Olinishi:

1. Laboratoriyada ammoniy tuzlariga kuchli asoslar ta'sir ettirib olinadi:

$$2NH_4Cl+Ca(OH)_2\rightarrow CaCl_2+2NH_3\uparrow+2H_2O$$

2. Nitridlarning parchalanishidan:

$$Mg_3N_2+6H_2O=3Mg(OH)_2+2NH_3\uparrow$$

3. Sanoatda sintez usuli bilan olinadi:

$$N_2+3H_2=2NH_3$$

Kimyoviy xossalari:

1. Suvdagi eritmasi asos xossasiga ega:

$$NH_3+H_2O\leftrightarrow NH_4OH$$

2. Ammiak katalizatorsiz yonganda N_2 hosil bo'ladi:

$$4NH_3+3O_2=2N_2+6H_2O$$

3. U katalizator ishtirokida yonganda NO ni hosil qiladi:

$$4NH_3+5O_2=4NO+6H_2O$$

4. Ammiakning suvli eritmasi xlor ishtirokida oksidlanadi:

$$8NH_3+Cl_2=N_2+6NH_4Cl$$

5. CuO ta'sirida oksidlanadi:

$$2NH_3+3CuO=3Cu+N_2\uparrow+3H_2O$$

6. Aktiv metallar bilan amidlar hosil bo'ladi:

$$2NH_3+2Na=2NaNH_2+H_2\uparrow$$

7. Kislotalar ta'sirida ammoniy tuzlarini hosil qiladi:

$$NH_3+HCl=NH_4Cl \qquad NH_3+HNO_3=NH_4NO_3$$

$$NH_3+H_2SO_4=NH_4HSO_4 \qquad 2NH_3+H_2SO_4=(NH_4)SO_4$$

8. NH_3 *d*-metallar tuzlari bilan ammiakatlar hosil qiladi:

$$AgCl+2NH_3\rightarrow[Ag(NH_3)_2]Cl \text{ eritma}$$

Mavzu: Gidrazin – N_2H_4

Olinishi:

1. NH_3 ni NaOCl bilan oksidlab olinadi:

$$2NH_3+NaOCl\rightarrow N_2H_4+NaCl+H_2O$$

Kimyoviy xossalari:

1. U kislorod va xlor ta'sirida oksidlanadi:

$N_2H_4+O_2=N_2+2H_2O$ $N_2H_4+2Cl_2=N_2+4HCl$

Mavzu: Gidroksilamin – NH_2OH

Olinishi:

1. HNO_3 ning katod qaytarilishidan hosil bo'ladi.

$$HNO_3+6H=NH_2OH+2H_2O$$

Mavzu: Azot (II) oksidi – NO

Olinishi:

1. Laboratoriyada misga suyultirilgan HNO_3 ta'siridan olinadi:

$$3Cu+HNO_{3(s)}=3Cu(NO_3)_2+2NO\uparrow+4H_2O$$

2. Sanoatda NH_3 ni katalitik oksidlanishidan hosil bo'ladi:

$$4NH_3+5O_2=4NO+6H_2O$$

Kimyoviy xossalari:

1. U havoda qo'ng'ir rangli gaz hosil qiladi:

$$2NO+O_2=2NO_2$$

Mavzu: Nitrit kislota – HNO_2

Kimyoviy xossalari:

1. Nitrit kislota kuchli oksidlovchilar ta'siridan oksidlanib nitratlarga o'tadi:

$$5HNO_2+2KMnO_4+3H_2SO_4=K_2SO_4+2MnSO_4+5HNO_3+3H_2O$$

Mavzu: Azot(III)oksid – N_2O_3

Olinishi:

1. NO va NO_2 ning ekvimolyar aralashmasini sovutib olinadi:

$$NO+NO_2=N_2O_3$$

Mavzu: Azot(IV)oksid – NO_2

Olinishi:

1. Cu ni kons.HNO_3 da eritib olinadi:

$$Cu+4HNO_3=Cu(NO_3)_2+2NO_2\uparrow+2H_2O$$

Kimyoviy xossalari:

1. Suvda erib kislotalar aralashmasini hosil qiladi:

$$2NO_2+H_2O=HNO_3+HNO_2$$

2. Agar u issiq suvda erisa faqat bitta kislota hosil qiladi;

$$3NO_2+H_2O=2HNO_3+NO$$

3. Ishqorlarda erib tuzlar aralashmasini hosil qiladi.

$$2NO_2+2KOH=KNO_2+KNO_3+H_2O$$

4. U kislorod ishtirokida suvda erib nitrat kislotani hosil qiladi:

$$4NO_2+O_2+2H_2O=4HNO_3$$

Mavzu: Azot(IV)oksidi dimeri - N_2O_4

Olinishi:

1. NO_2 ning sovushidan hosil bo'ladi. Bunda qo'ng'ir rang yo'qoladi:

$$2NO_2=N_2O_4$$

Mavzu: Azot(V)oksid – N_2O_5

Olinishi:

1. Nitrat kislotani degidratlab olinadi:

$$2HNO_3+P_2O_5=2HPO_3+N_2O_5$$

Kimyoviy xossalari:

1. U suvda erib nitrat kislotani hosil qiladi:

$$N_2O_5+H_2O=2HNO_3$$

Mavzu: Nitrat kislota – HNO_3

Olinishi:

1. Laboratoriyada quruq nitratlarga kons.H_2SO_4 qo'shib qizdirib olinadi:

$$NaNO_3+H_2SO_4=HNO_3+NaHSO_4$$

2. Sanoatda Ostvald usulida olinadi (1915):

$$4NH_3+5O_2=4NO+6H_2O \text{ (kat. Pt, Pd)}$$

U keyin katalitik oksidlanadi:

$$2NO+O_2=2NO_2$$

Hosil bo‘lgan NO_2 va O_2 suvga yuttiriladi:

$$4NO_2+O_2+2H_2O=4HNO_3$$

Kimyoviy xossalari:

Nitrat kislota kuchli oksidlovchi kislota

$HNO_3=H^++NO_3^-$

1. Nitrat kislota deyarli barcha metallar (Au, Pt, Os, Ir, Nb, Ta va W dan tashqari) va metalmaslar bilan ta’sirlashadi;

$$3As+5HNO_3+2H_2O=3H_3AsO_4+5NO\uparrow$$
$$S+6HNO_3=H_2SO_4+6NO_2\uparrow+2H_2O$$

2. Standart elektrod potensial qatorida vodoroddan keyin turgan metallar kons.HNO_3 da erib NO_2 ni hosil qiladi:

$$Cu+4HNO_3=Cu(NO_3)_2+2NO_2\uparrow+2H_2O$$

Agar suyultirilgan nitrat kislota ishlatilsa NO hosil bo‘ladi:

$$3Cu+8HNO_3=3Cu(NO_3)_2+2NO\uparrow+4H_2O$$

3. Zn – Pb qatorida metallar NO ni hosil qiladi:

$$3Fe+8HNO_3=3Fe(NO_3)_3+2NO\uparrow+4H_2O$$

Juda suyultirilganda k-ta bilan NH_4^+ hosil bo‘ladi;

$$4Fe+NO_3^-+10H^+=4Fe^{3+}+NH_4^++3H_2O$$

Kons HNO_3 ta’sirida Fe, Al, Cr passivlashadi:

4. Li – Mg qatoridagi metallar kons. HNO_3 bilan N_2O hosil qiladi:

$$4Mg+10HNO_3=4Mg(NO_3)_2+N_2O\uparrow+5H_2O$$

Juda suyultirilgan HNO_3 bilan NH_4NO_3 ni hosil qiladi

$$4Mg+10HNO_3=4Mg(NO_3)_2+NH_4NO_3+3H_2O$$

Faqat Co erkin azorgacha qaytariladi:

$$5Co+12HNO_3=5Co(NO_3)_2+N_2\uparrow+6H_2O$$

5. 1 mol kons. HNO_3 va 3 mol kons. HCl aralashmasi juda kuchli oksidlovchi hisoblanadi. U “zar suvi” yoki “podsho arog‘i” deyiladi. U hatto Au va Pt ni oksidlaydi;

$$3Pt+4HNO_3+12HCl=3PtCl_4+4NO\uparrow+8H_2O$$

6. Nitrat kislota yorug‘lik ta’sirida parchalanib qo‘ng‘ir rangli gaz ajratadi:

$$4HNO_3\rightarrow 2H_2O+4NO_2+O_2$$

Mavzu: Fosfor – P

Olinishi:

Kalsiy fosfatni qum ishtirokida ko‘mir bilan qizdirib olinadi:

$$Ca_3(PO_4)_2+3SiO_2+5C=3CaSiO_3+2P+5CO\uparrow$$

Kimyoviy xossalari:

1. Uishqoriy va ishqoriy yer metallari bilan ta’sirlashib fosfidlar hosil qiladi:

$$3Ca+2P=Ca_3P_2$$

2. Fosfor metalmaslar bilan ta’sirlashib qaytaruvchilik xossasini namoyon qiladi:

$$4P+3O_2=2P_2O_3 \qquad 4P+5O_2=2P_2O_5$$
$$2P+3Cl_2=2PCl_3 \qquad 2P+5Cl_2=2PCl_5$$
$$2P+3S=P_2S_3 \qquad 2P+5S=P_2S_5$$

3. U kons. HNO_3 bilan ta’sirlashadi:

$$P+5HNO_3=H_3PO_4+5NO_2\uparrow+H_2O$$

Mavzu: Fosfin – PH_3

Olinishi:

1. Kalsiy fosfidni gidroliz qilib olinadi:

$$Ca_3P_2+6H_2O=3Ca(OH)_2+2PH_3\uparrow$$

Kimyoviy xossalari:

1. U NH_3 ga qaraganda kuchsiz asos xossasini namoyon qiladi:

$$PH_3+HCl=PH_4Cl$$ (fosfoniy xlorid)

2. U havoda fosfat kislotagacha oksidlanadi:

$$PH_3+2O_2=H_3PO_4$$

Mavzu: Fosfor (III) xlorid – PCl_3

U gidrolizga uchraydi:

$$PCl_3+3H_2O=H_3PO_3+3HCl$$

Mavzu: Fosfor (V) xlorid – PCl_5

U gidrolizga uchraydi:

$$PCl_5+4H_2O=H_3PO_4+5HCl$$

Mavzu: Fosfor (III) oksidi – P_2O_3

Olinishi:

1. Fosfor kislorod yetishmagan muhitda oksidlanib olinadi:

$$4P+3O_2=2P_2O_3$$

Kimyoviy xossalari:

1. U havoda qizdirilganda oksidlanadi:

$$P_2O_3+O_2=P_2O_5$$

2. U suvda fosfit kislotani hosil qiladi:

$$P_2O_3+3H_2O=2H_3PO_3$$

Mavzu: Fosfit kislota – H_3PO_3

Kimyoviy xossalari:

1. U ishqorlar bilan 2 xil tuzlarni hosil qiladi:

$$P_2O_3+2NaOH+H_2O=2NaH_2PO_3 \text{ (natriy gidrofosfit)}$$

$$P_2O_3+4NaOH=2Na_2HPO_3+H_2O \text{ (natriy fosfit)}$$

$$H_3PO_3+NaOH=NaH_2PO_3+H_2O$$

$$H_3PO_3+2NaOH=Na_2HPO_3+2H_2O$$

2. Fosfit kislota qizdirilganda disproprsilanadi:

$$4H_3PO_3=PH_3\uparrow+3H_3PO_4$$

3. Fosfit kislota oksidlovchilar ta'sirida oksidlanadi:

$$H_3PO_3+Cl_2+H_2O=H_3PO_4+2HCl$$

Mavzu: Fosfor(V)oksid - P_2O_5

Olinishi:

1. Fosforni mo'l kislorodda yoqib olinadi;

$$4P+5O_2=2P_2O_5$$

Kimyoviy xossalari:

1. P_2O_5 soviq suvda eriganda metafosfat kislota hosil bo'ladi:

$$P_2O_5+H_2O=2HPO_3$$

2. P_2O_5 issiq suvda eriganda ortofosfat kislota hosil bo'ladi:

$$P_2O_5+3H_2O=2H_3PO_4$$

3. Bu 2 mol suv bilan ta'sirlashsa difosfat (pirofosfat) kislota hosilbo'ladi;

$$P_2O_5+2H_2O=H_4P_2O_7$$

Mavzu: Ortofosfat kislota - H_3PO_4

Olinishi:

1. Laboratoryada fosfat kislota fosforni 32% li nitrat kislotada eritib olinadi:

$$3P+5HNO_3+2H_2O=3H_3PO_4+5NO\uparrow$$

2. Sanoatda fosfat kislota ekstraksiyon va termik usulda olinadi:

a) Ekstraksiyon usulda maydalangan fosforit sulfat kislotada eritiladi:

$$Ca_3(PO_4)_2+3H_2SO_4=3CaSO_4+2H_3PO_4$$

b) Termik usulda fosforitdan fosfor olinadi. Olingan fosfor kislorodda oksidlantirilib P_2O_5 olinadi. P_2O_5 suvda eritilib fosfat kislota olinadi:

$$Ca_3(PO_4)_2+5C+3SiO_2=3CaSiO_3+5CO\uparrow+2P$$

$$4P+5O_2=2P_2O_5$$

$$P_2O_5+3H_2O=2H_3PO_4$$

Termik usulda olingan fosfat kislota ekstraksiya usulida olingan kislotaga qaraganda tozaligi va yuqori konsentratsiyali bo'lishi bilan ajralib turadi.

3. Kelajakda fosfat kislota chiqindisiz texnologiya asosida olinishi mumkin:

$$P_4+16H_2O=4H_3PO_4+10H_2\uparrow \quad (t=700°C \quad kat=Cu)$$

Kimyoviy xossalari:

1. U uch xil tuzlarni hosil qiladi:

$$NaOH+H_3PO_4=NaH_2PO_4+H_2O \quad \text{digidrofosfat}$$

$$2NaOH+H_3PO_4=Na_2HPO_4+2H_2O \quad \text{gidrofosfat}$$

$$3NaOH+H_3PO_4=Na_3PO_4+3H_2O \quad \text{fosfat}$$

2. U 200°C da qizdirilganda pirofasfat kislota hosil bo'ladi:

$$2H_3PO_4=H_4P_2O_7+H_2O$$

Mavzu: Fosforli o‘g‘itlar

Fosforli o‘g‘itlarga quyidagilar kiradi:

1. Fosforit yoki appatit – $Ca_3(PO_4)_2$ (16-35% P_2O_5)
2. Oddiy superfosfat :

$$Ca_3(PO_4)_2+2H_2SO_4=Ca(H_2PO_4)_2+2CaSO_4 \text{ (20\% } P_2O_5)$$

3. Qo‘sh superfosfat:

$$Ca_3(PO_4)_2+4H_3PO_4=3Ca(H_2PO_4)_2 \text{ (40-50\% } P_2O_5)$$

4. Pretsipitat:

$$2CaCO_3+2H_3PO_4=2CaHPO_4\cdot 2H_2O+2CO_2\uparrow \text{ (30-35\% } P_2O_5)$$

Mavzu: Azot saqlovchi o‘g‘itlar

1. Ammofos- $NH_4H_2PO_4$
2. Diammofos- $(NH_4)_2HPO_4$
3. Karbamid- $CO(NH_2)_2$

   Karbamid yuqori bosimda ammiakni karbonat angidrid bilan reaksiyasidan hosil bo‘ladi:

$$CO_2+2NH_3=CO(NH_2)_2+H_2O$$

Mavzu: Uglerod

Kimyoviy xossalari:

1. Uglerod kislorod yetishmagan muhitda CO ni hosil qiladi.

$$2C+O_2=2CO$$

2. Uglerod kislorodda to‘la yonib CO_2 ni hosil qiladi:

$$C+O_2=CO_2$$

3. U ko‘pchilik metallmaslar bilan ta’sirlashadi:

$$C+H_2O=CO+H_2 \qquad C+S=CS_2 \qquad C+2F_2=CF_4$$

Mavzu: Uglerod(II)oksid – CO

Olinishi:

Laboratoriyada chumoli kislotaga konsentrlangan sulfat kislota ta’siridan olinadi:

$$HCOOH=CO\uparrow+H_2O$$

1. Sanoatda quyidagi usullar bilan olinadi:

$$CO_2+C=2CO+(N_2) \text{ Generator gazi } 2C+O_2+4N_2=2CO+4N_2$$

2. Shuningdek suv gazi ko‘rinishida olinadi:

$$C+H_2O=CO+H_2$$

Kimyoviy xossalari:

1. U havoda ko‘kish alanga berib yonadi:

$$2CO+O_2=2CO_2$$

2. U juda ko‘p metallarning oksidlarini erkin metallargacha qaytaradi(karbotermiya):

$$NiO+CO=CO_2+Ni$$

$$Fe_3O_4+4CO=3Fe+4CO_2$$

3. CO ba’zi d- metallar bilan birikib karbonillar $\{Me(CO)_x\}$ hosil qiladi:

$$Ni+4CO=Ni(CO)_4 \qquad Fe+5CO=Fe(CO)_5$$

4. CO ishqorlar bilan ta’sirlashib formiatlar hosil qiladi.

$$CO+NaOH=HCOONa$$

5. CO xlor va oltingugurt bilan ta’sirlashadi;

$$CO+Cl_2=COCl_2 \qquad CO+S=COS$$

6. U ZnO kat. ishtirokida yuqori bosim va 300°C da vodorod bilan birikib metanolni hosil qiladi:

$$CO+2H_2=CH_3OH$$

Mavzu: Uglerod(IV)oksid – CO_2

Olinishi:

Laboratoriyada $CaCO_3$ ga HCl ta’siridan Kipp apparatida olinadi:

$$CaCO_3+2HCl=CaCl_2+CO_2\uparrow+H_2O$$

1. Sanoatda ohaktosh kuydirilgandda hosil bo‘ladi:

$$CaCO_3=CaO+CO_2\uparrow$$

2. Barcha organik moddalar va ko‘mir yonganda ham CO_2 hosil bo‘ladi:

$$CH_4+2O_2=CO_2+2H_2O \qquad C+O_2=CO_2 \qquad C_6H_{12}O_6+6O_2=6CO_2+6H_2O$$

Kimyoviy xossalari:

1. Uglerod bilan qaytarilganda CO hosil bo‘ladi:

$$CO_2+C=2CO$$

2. Suvda erib kuchsiz kislota karbonat kislotani hosil qiladi:

$$CO_2+H_2O=H_2CO_3$$

3. CO_2 yonishga yordam bermasa ham aktiv metallar unda yonadi:

$$2Mg+CO_2=2MgO+C$$

4. Ishqorlarda erib karbonatlarni hosil qiladi:

$$CO_2+NaOH=NaHCO_3$$
$$CO_2=2NaOH=Na_2CO_3+H_2O$$

Sifat reaksiya:

CO_2 ajralib chiqayotganligi $Ca(OH)_2$ yoki $Ba(OH)_2$ orqali shu gazni o‘tkazib aniqlanadi. Bunda eritma loyqalanadi:

$$CO_2+Ca(OH)_2=CaCO_3\downarrow+H_2O$$

Mavzu: Uglerod disulfid – CS_2

Ko‘mirni oltingugurt bilan qizdirib olinadi:

$$C+2S=CS_2$$

U tez alangalanuvchan modda:

$$CS_2+3O_2=CO_2+2SO_2$$

Mavzu: Galogenidlari – $C\Gamma_4$

$$CH_4+4Cl_2=CCl_4+4HCl \qquad CS_2+2Cl_2=CCl_4+2S$$

Mavzu: Uglerodning azotli birikmalari

1. Disian – C_2N_2

$$Hg(CN)_2\rightarrow Hg+C_2N_2$$

2. Vodorod sianid – HCN

Olinishi:

1. Sianidlarga kislota ta’siridan olinadi:

$$2KCN+H_2SO_4=2HCN=K_2SO_4$$

Boshqa birikmlari:

Sianat kislota – H-O-C≡N Izosianat kislota – H-N=C=O
Tiosianat kislota – H-S-C≡N (Rodanidlar) Izotiosianat kislota – H-N=C=S

Mavzu: Karbidlar

1. Atsetilenidlar – ishqoriy/ishqoriy-yer metallarining karbidlari.
Li_2C_2, Na_2C_2, MgC_2, CaC_2, SrC_2, BaC_2
Ular gidrolizidan atsetilen hosil bo‘ladi:

$$CaC_2+2HOH=Ca(OH)_2+C_2H_2\uparrow$$

2. Metanidlar – Al_4C_3 va Be_2C
Ular gidrolizidan metan hosil bo‘ladi:

$$Al_4C_3+12HOH=4Al(OH)_3+3CH_4\uparrow$$

3. Olmossimon karbidlar – B_3C va SiC. Charxtoshlarda ishlatiladi:
4. Fe_3C – sementit.

Mavzu: Karbonat kislota – H_2CO_3

Olinishi:

1. CO_2 ni suvga yuttirib olinadi;

$$CO_2+H_2O=H_2CO_3$$

Kimyoviy xossalari:

1. Karbonat kislota kuchsiz ikki asosli kislota

Mavzu: Karbonatlar

Kimyoviy xossalari:

1. Li_2CO_3 dan boshqa ishqoriy metallarning karbonatlari parchalanmasdan suyuqlanadi. Qolganlari qizdirilganda parchalanadi:

$$CaCO_3\rightarrow CaO+CO_2\uparrow \qquad Cu(OH)_2\cdot CuCO_3\rightarrow 2CuO+CO_2\uparrow+H_2O$$

2. Gidrokarbonatlar qizdirilganda osonroq parchalanadi:

$$Ca(HCO_3)_2\rightarrow CaCO_3+CO_2\uparrow+H_2O \qquad 2NaHCO_3\rightarrow Na_2CO_3\uparrow+CO_2+H_2O$$

Mavzu: Soda ishlab chiqarish

Na_2CO_3 – soda, kalsinirlangan soda; $NaHCO_3$ – ichimlik soda
$Na_2CO_3\cdot 10H_2O$ – kristall soda

Olinishi:

1. Leblan usuli:

$$Na_2SO_4+2C=Na_2S+2CO_2\uparrow$$

$Na_2S+CaCO_3=Na_2CO_3+CaS$ (toza emas)

2. Solvey usuli (Ammiakli usul)

$NaCl+NH_3+CO_2+H_2O=NaHCO_3+NH_4Cl$

$2NaHCO_3\rightarrow Na_2CO_3+CO_2\uparrow+H_2O$ (toza)

3. Elektrolitik usul:

$NaOH+CO_2=NaHCO_3$

Mavzu: Kremniy - Si

Olinishi:

1. SiF_4 ni K bilan qaytarib olinadi:

$SiF_4+4K=Si+4KF$

2. SiO_2 ni Mg yoki Al bilan qaytarib olinadi:

$SiO_2+2Mg=2MgO+Si$ $3SiO_2+4Al=3Si+2Al_2O_3$

3. Juda toza kremniy $SiCl_4$ ni vodorod bilan qaytarib olinadi:

$SiCl_4+2H_2=Si+4HCl$

Kimyoviy xossalari:

1. Yuqori temperaturada kislorodda yonadi:

$Si+O_2=SiO_2$

2. Faqat ftor bilan odatdagi sharoitda ta'sirlashadi:

$Si+2F_2=SiF_4$

3. Issiq ishqorlarda eriydi:

$Si+2NaOH+H_2O=Na_2SiO_3+2H_2\uparrow$

4. SiO_2 ishqorlarda erib silikatlarni hosil qiladi:

$SiO_2+2NaOH=Na_2SiO_3+H_2O$

5. Uni faqat ftorid kislota eritadi:

$SiO_2+4HF=SiF_4+2H_2O$

Mavzu: Silan – SiH_4

Olinishi:

1. Magniy silitsidga xlorid kislota ta'siridan olinadi:

$Mg_2Si+4HCl=2MgCl_2+SiH_4\uparrow$

Kimyoviy xossalari:

1. Silan havoda o'z-o'zidan alangalanadi:

$SiH_4+2O_2=SiO_2+2H_2O$

2. U suv bilan quyidagicha ta'sirlashadi:

$SiH_4+2H_2O=SiO_2+4H_2$

Mavzu: Kremniyning galogenli birikmalari – $SiГ_4$

Olinishi:

$SiO_2+4HF=SiF_4+2H_2O$

$SiO_2+2Cl_2+2C=SiCl_4+2CO$

Mavzu: Shisha

Olinishi:

$Na_2CO_3+CaCO_3+6SiO_2=Na_2O\cdot CaO\cdot 6SiO_2+2CO_2\uparrow$

$K_2O\cdot CaO\cdot 6SiO_2$ – Eruvchan shisha

Mavzu: Metallarning olinish usullari

Metallarning olinishi 3 ga bo'linadi:

1. Pirometallurgiya – yuqori temperaturada biror qaytaruvchi bilan qaytarish. Qaytaruvchiga ko'ra yana farqlanadi:
   a) Vodorodotermiya – H_2 bilan qaytarish:

$WO_3+3H_2=W+3H_2O$ $MoO_3+3H_2O=Mo+3H_2O$

   b) Karbotermiya – C va CO bilan qaytarish:

$SnO_2+2C=Sn+2CO$ $ZnO+CO=Zn+CO_2$ (bu usulda Fe, Pb, Sn, Cu, Zn, Ni, Cd va Mn olinadi)

   c) Alyumotermiya – Al bilan qaytarish:

$3Mn_3O_4+8Al=9Mn+4Al_2O_3$

Pirometallurgiyada agar metal sulfid holida bo'lsa, avval yoqilib oksid holiga keltiriladi:

$2Zn+3O_2=2ZnO+2SO_2$

2. Gidrometallurgiya – avval metal eruvchan holga keltirilib eritmaga o'tkaziladi, so'ngra biror aktivroq metal bilan qaytariladi:

$$4Au+8NaCN+2H_2O+O_2=4Na[Au(CN)_2]+4NaOH$$
$$Zn+2Na[Au(CN)_2]=Na_2[An(CN)_4]+2Au$$
$$Fe+CuSO_4=Cu+FeSO_4$$

3. Elektrometallurgiya – elektroliz usulida olish:

$$CuSO_4+H_2O=Cu+H_2SO_4+0{,}5O_2\uparrow$$

Ishqoriy metallar, ishqoriy-yer metallar, Mg va Al suyuqlanma elektrolizi yordamida olinadi:

$$2NaCl=2Na+Cl_2\uparrow \qquad 2Al_2O_3=4Al+3O_2\uparrow$$

Mavzu: Ishqoriy metallar

Kimyoviy xossalari:

1. Kislorodda yonib faqat Li oksid hosil qilsa, qolganlari peroksid va nadperoksidlar hosil qiladi:

$$4Li+O_2=2Li_2O \qquad 2Na+O_2=Na_2O_2 \qquad K+O_2=KO_2$$

2. Suv bilan shiddatli ta'sirlashadi:

$$2K+2HOH=2KOH+H_2\uparrow$$

Mavzu: Litiy – Li

Olinishi:

LiCl va KCl suyuqlanmasini elektroliz qilib olinadi:

$$2LiCl=2Li+Cl_2\uparrow$$

Kimyoviy xossalari:

1. Kislorodda yonib oksid hosil qiladi:

$$4Li+O_2=2Li_2O$$

2. Suv bilan odatdagi sharoitda ta'sirlashib H_2 ni siqib chiqaradi:

$$2Li+2H_2O=2LiOH+H_2\uparrow$$

3. Li azot bilan xona temperaturasida ta'sirlashasi:

$$6Li+N_2=2Li_3N$$

4. Li barcha galogenlar, S va H_2 bilan ta'sirlashadi:

$$2Li+Cl_2=2LiCl \qquad 2Li+H_2=2LiH$$

5. Li magniyga diagonal o'xshash element. Uning karbonati, fosfat va fosfiti kam eriydi. Li_2CO_3 qizdirilganda parchalanadi:

$$Li_2CO_3\rightarrow Li_2O+CO_2\uparrow$$

Mavzu: Natriy – Na

Minerallari:

NaCl – tosh tuz $NaCl\cdot KCl$ – silvinit $Na_2SO_4\cdot 10H_2O$ – Glauber tuzi
$Na_3[AlF_6]$ – Kriolit $NaNO_3$ – Chili selitrasi $Na_2B_4O_7\cdot 10H_2O$ – bura

Olinishi:

1. NaOH yoki NaCl suyuqlanmasini elektroliz qilib olinadi:

$$2NaOH=2Na+2H_2O+O_2\uparrow \qquad 2NaCl=2Na+Cl_2\uparrow$$

Kimyoviy xossalari:

1. Kislorod bilan ta'sirlashib peroksid hosil qiladi:

$$2Na+O_2=Na_2O_2$$

2. Suv bilan shiddatli ta'sirlashib vodorodni siqib chiqaradi:

$$2Na+2HOH=2NaOH+H_2\uparrow$$

3. Galogenlar, S va H_2 bilan ta'sirlashadi:

$$2Na+Cl_2=2NaCl \quad 2Na+S=Na_2S \qquad 2Na+H_2=2NaH$$

Mavzu: Kaliy – K

Minerallari:

KCl – silvin $KCl\cdot MgCl_2\cdot 6H_2O$ – karnallit $KCl\cdot MgSO_4\cdot 3H_2O$ – kainit

Olinishi:

1. KOH suyuqlanmasini elektroliz qilib olinadi:

$$2KOH=2K+2H_2O+O_2\uparrow$$

Kimyoviy xossalari:

1. Kislorodda yonib asosan superoksidni hosil qiladi:

$$K+O_2=KO_2$$

2. Suv bian yonish orqali ta'sirlashadi. Galogenlar bilan portlaydi:

$$2K+Br_2=2KBr$$

Mavzu: Berilliy – Be

Olinishi:

1. BeF_2 ni vakuumda Ca bilan qizdirib olinadi:

$$BeF_2+Ca=CaF_2+Be$$

Kimyoviy xossalari:

1. Kislorodda qizdirilganda yonadi:

$$2Be+O_2=2BeO$$

2. Suyultirlgan kislotalarda eriydi:

$$Be+H_2SO_4=BeSO_4+H_2\uparrow$$

3. Ishqorlar bilan berillatlar hosil qiladi:

$$Be+2NaOH=Na_2BeO_2+H_2\uparrow$$

4. Berilliy karbid metanid hisoblanadi;

$$Be_2C+4H_2O=2Be(OH)_2+CH_4\uparrow$$

5. $Be(OH)_2$ amfoterlik xossasini namoyon qiladi;

$$Be(OH)_2+H_2SO_4=BeSO_4+2H_2O$$
$$Be(OH)_2+2NaOH=Na_2[Be(OH)_4]$$

Mavzu: Magniy – Mg

Minerallari:

$MgCO_3$ – magnezit $CaCO_3 \cdot MgCO_3$ – dolomit $KCl \cdot MgCl_2 \cdot 6H_2O$ – karnallit

Olinishi:

1. $MgCl_2$ suyuqlanmasini elektroliz qilib olinadi:

$$MgCl_2=Mg+Cl_2\uparrow$$

Kimyoviy xossalari:

1. Havoda Mg sirti oksid parda bilan qoplanadi;

$$2Mg+O_2=2MgO$$

2. Sovuq suv bilan sekin, issiq suv bilan tez ta'sirlashib, H_2 ni siqib chiqaradi:

$$Mg+2HOH=Mh(OH)_2+H_2\uparrow$$

3. $Mg(OH)_2$ oq kukun, suvda kam eriydi. Ammoniy tuzlari $Mg(OH)_2$ cho'kmsi tushishiga xalaqit beradi:

$$MgSO_4+2NaOH=Mg(OH)_2+Na_2SO_4$$

Mavzu: Kalsiy – Ca

Minerallari:

$CaCO_3$ – bor, ohaktosh, marmar, kalsit $CaCO_3 \cdot MgCO_3$ – dolomit $CaSO_4 \cdot 2H_2O$ – gips CaF_2 – flyuorit, plavik shpat $Ca_3(PO_4)_2$ – fosforit

Olinishi:

1. $CaCl_2$ suyuqlanmasini elektroliz qilib olinadi:

$$CaCl_2=Ca+Cl_2\uparrow$$

Kimyoviy xossalari:

1. Kislorodda yonib oksid hosil qiladi:

$$2Ca+O_2=2CaO$$

2. Suv bilan shiddatli ta'sirlashib ohakli suvni hosil qiladi:

$$Ca+2H_2O=Ca(OH)_2+H_2\uparrow$$

3. Azot ta'sirida nitrid hosil qiladi:

$$3Ca+N_2=Ca_3N_2$$

Mavzu: Kalsiy birikmalari

Olinishi:

1. CaO ohaktoshni parchalab olinadi:

$$CaCO_3\rightarrow CaO+CO_2\uparrow$$

Kimyoviy xossalari:

1. CaO – so'ndirilmagan ohak. U suvda erib $Ca(OH)_2$ – so'ndirilgan ohakni hsoil qiladi:

$$CaO+H_2O=Ca(OH)_2$$

2. $Ca(OH)_2$ CO_2 ta'sirida loyqalanadi:

$$Ca(OH)_2+CO_2=CaCO_3+H_2O$$

3. $CaCO_3$ suspenziyasi orqali CO_2 o'tkazilsa eritma holiga o'tadi va tiniqlashadi:

$$CaCO_3+CO_2+H_2O=Ca(HCO_3)_2$$

4. CaC_2 atsetilenid hisoblanadi:

$$CaC_2+2HOH=Ca(OH)_2+C_2H_2\uparrow$$

Mavzu: Suvning qattiqligi va uni yo‘qotish usullari

Vaqtinchalik qattiqlikni yo‘qotish:

1. Qaynatib yo‘qotiladi:

$$Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2\uparrow + H_2O$$

2. Ohak qo‘shib yo‘qotiladi:

$$Ca(HCO_3)_2 + Ca(OH)_2 = 2CaCO_3 + 2H_2O$$

Doimiy qattiqlikni yo‘qotish:

1. Soda yoki natriy fosfat qo‘shib:

$$3CaSO_4 + 2Na_3PO_4 = Ca_3(PO_4)_2 + 3Na_2SO_4$$
$$MgSO_4 + Na_2CO_3 = MgCO_3 + Na_2SO_4$$

2. Kationit yoki anionitdan foydalaniladi.

Mavzu: Bor – B

Olinishi:

$$B_2O_3 + 3Mg = 2B + 3MgO$$

Kimyoviy xossalari:

1. Bor suyultilgan kislotalarda erimaydi. U konsentrlangan nitrat kislotada eriydi:

$$B + 3HNO_3 = B(OH)_3 + 3NO_2$$

2. Diboran B_2H_6 gidrolizdan vodorod ajraladi:

$$B_2H_6 + 6H_2O = 2B(OH)_3 + 6H_2\uparrow$$

3. BF_3 gidrolizidan tetraftorborat kislota, qolganlaridan galogenovodorodlar hosil bo‘ladi:

$$4BF_3 + 3H_2O = B(OH)_3 + 3H[BF_4]$$
$$BCl_3 + 3H_2O = B(OH)_3 + 3HCl$$

Mavzu: Alyuminiy – Al

Minerallari:

$Na_3[AlF_6]$ – kriolit Al_2O_3 – korund $Al_2O_3 \cdot 2H_2O$ – boksit

Olinishi:

1. Al_2O_3 ning kriolitdagi suyuqlanmasini elektroliz qilib olinadi:

$$2Al_2O_3 = 4Al + 3O_2\uparrow$$

Kimyoviy xossalari:

1. Al havoda yupqa oksid parda bilan qoplanadi:

$$4Al + 3O_2 = 2Al_2O_3$$

2. Suyultirilgan kislotalarda eriydi:

$$2Al + 6HCl = 2AlCl_3 + 3H_2\uparrow$$

3. Ishqorlarda oson eriydi:

$$2Al + 2NaOH + 6H_2O = 2Na[Al(OH)_4] + 3H_2\uparrow$$

4. Kons. HNO_3 da erimaydi;
5. $Al(OH)_3$ tuzlariga ishqor ta’sir ettirib olinadi:

$$Al_2(SO_4)_3 + 6NaOH = 2Al(OH)_3 + 3Na_2SO_4$$

6. $Al(OH)_3$ amfoter;

$$Al(OH)_3 + 3HCl = AlCl_3 + 3H_2O$$
$$Al(OH)_3 + NaOH = Na[Al(OH)_4]$$

7. Granula holidagi Al metallarni payvandlashda ishlatiladi(termit reaksiyasi):

$$3Fe_3O_4 + 8Al = 4Al_2O_3 + 9Fe$$

Mavzu: Germaniy – Ge

Kimyoviy xossalari:

1. Ge kislorodda yonganda (IV) oksid hosil qiladi:

$$Ge + O_2 = GeO_2$$

Mavzu: Qalay – Sn

Olinishi:

1. SnO_2 ni 1000°C ko‘mir bilan qaytarib olinadi:

$$SnO_2 + 2C = Sn + 2CO\uparrow$$

Kimyoviy xossalari:

1. Sn kislorodda yonganda (IV) oksid hosil qiladi:

$$Sn + O_2 = SnO_2$$

2. Suyultirilgan kislotalarda erib Sn(II) birikmalarini hsoil qiladi:

$$Sn + 2HCl = SnCl_2 + H_2\uparrow$$

3. Kons. sulfat kislotada erib Sn(IV) birikmalarini hsoil qiladi:

$$Sn+4H_2SO_4=Sn(SO_4)_2+2SO_2\uparrow+4H_2O$$

Mavzu: Qo‘rg‘oshin – Pb

Olinishi:

1. Asosan pirometallurgiya usulida olinadi:

$$2PbS+3O_2=2PbO+2SO_2$$
$$PbO+CO=Pb+CO_2$$

Kimyoviy xossalari:

1. Havoda oksidlanganda PbO_2 ni hosil qiladi:

$$Pb+O_2=PbO_2$$

2. Nitrat kislotada oson eriydi:

$$3Pb+8HNO_3=3Pb(NO_3)_2+2NO\uparrow+4H_2O$$

3. Suyultirilgan kislotalarda, masalan sirka kislotada yaxshi eriydi:

$$Pb+2CH_3COOH=(CH_3COO)_2Pb+H_2\uparrow$$

Mavzu: Surma va vismut – Sb va Bi

Olinishi:

1. Pirometallurguya usuli bilan olinadi:

$$Sb_2S_3+3Fe=2Sb+3FeS \qquad Bi_2O_3+3C=2Bi+3CO$$

Kimyoviy xossalari:

1. Sb va Bi kislorodda yonadi:

$$4Sb+3O_2=2Sb_2O_3 \qquad 4Bi+3O_2=2Bi_2O_3$$

2. Sb va Bi elektrod potensiallar qatorida H_2 dan o‘ngda joylashganligi uchun suyultirilgan kislotalarda erimaydi.
3. Sb va Bi kons. nitrat va kons.sulfat kislotalarda eriydi:

$$2Sb+6H_2SO_4=Sb_2(SO_4)_3+3SO_2\uparrow+6H_2O$$
$$Bi+4HNO_3=Bi(NO_3)_3+NO\uparrow+2H_2O$$

4. Sb va Bi ning galogenidlari gidrolizga uchraydi:

$$SbCl_3+H_2O=SbOCl+2HCl \qquad BiCl_3+H_2O=BiOCl+2HCl$$

Mavzu: Temir – Fe

Minerallari:

Fe_3O_4 – magnetit, magnitli temirtosh Fe_2O_3 – gematit, qizil temirtosh
$FeCO_3$ – siderit FeS_2 – pirit, temir kolchedani FeS – temir sulfidi

Olinishi:

1. Asosan pirometallurgiya usulida olinadi:

$$Fe_2O_3+2Al=2Fe+Al_2O_3 \qquad Fe_2O_3+3H_2=2Fe+3H_2O$$

2. Juda toza temir karbonillardan olinadi:

$$Fe(CO)_5\rightarrow Fe+5CO$$

Kimyoviy xossalari:

1. Temir havoda oksidlanadi:

$$3Fe+2O_2=Fe_3O_4$$

2. Temir yuoqri temperaturada suv bug‘lari bilan ta’sirlashadi:

$$3Fe+4H_2O=Fe_3O_4+4H_2$$

3. Xlor va S bilan reaksiyaga kirishadi:

$$2Fe+3Cl_2=2FeCl_3 \qquad Fe+S=FeS$$

4. Suyultirilgan kislotalarda erib Fe(II) birikmalarini hosil qiladi:

$$Fe+2HCl=FeCl_2+H_2\uparrow \qquad Fe+H_2SO_4=FeSO_4+H_2\uparrow$$

5. Temirning oksidlari quyidagi reaksiyalar asosida olinadi:

$$2Fe(OH)_3\rightarrow Fe_2O_3+3H_2O \qquad Fe(OH)_2\rightarrow FeO+H_2O$$

6. Gidrokdilari tegishli tuzlariga ishqor ta’sir ettirib olinadi:

$$FeCl_2+2NaOH=Fe(OH)_2+2NaCl \qquad FeCl_3+3NaOH=Fe(OH)_3+3NaCl$$

7. $Fe(OH)_2$ oson oksidlanib Fe(III) birikmalariga o‘tadi:

$$4Fe(OH)_2+2H_2O+O_2=4Fe(OH)_3$$

8. Temirning sulfatlari quyidagicha olinadi:

$$Fe+H_2SO_{4(s)}=FeSO_4+H_2\uparrow \qquad Fe_2O_3+3H_2SO_4=Fe_2(SO_4)_3+3H_2O$$

9. Temirning (+VI) birikmlari temir birikmalarini ishqoriy muhitda oksidlanishidan hosil bo‘ladi:

$$Fe_2O_3+3KNO_3+4KOH=2K_2FeO_4+3KNO_2+2H_2O$$

$$2Fe(OH)_3+10KOH+3Br_2=2K_2FeO_4+6KBr+8H_2O$$

10. Sariq qon tuzi va qizil qon tuzi quyidagi reaksiyalar asosida olinadi:

$$Fe(CN)_2+4KCN=K_4[Fe(CN)_6] \qquad 2K_4[Fe(CN)_6]+Br_2=2K_3[Fe(CN)_6]+2KBr$$

11. Sariq qon tuzi va qizil qon tuzi Fe^{3+} va Fe^{2+} ionlarini aniqlashda ishlatiladi:

$$4FeCl_3+3K_4[Fe(CN)_6]=Fe_4[Fe(CN)_6]_3+12KCl \quad \text{(Berlin lazuri)}$$

$$3FeCl_2+2K_3[Fe(CN)_6]=Fe_3[Fe(CN)_6]_2+6KCl \quad \text{(Turnbul ko‘ki)}$$

Mavzu: Xrom – Cr

Minerallari:

$Cr_2O_3{\cdot}FeO$ – xromit, xromli temirtosh $PbCrO_4$ – krokoit

Olinishi:

1. Alyumotermiya usulida olinadi:

$$Cr_2O_3+2Al=2Cr+Al_2O_3$$

Kimyoviy xossalari:

1. Oksidlanganda Cr_2O_3 hosil bo‘ladi:

$$4Cr+3O_2=2Cr_2O_3$$

2. Suyultirilgan kislotarlarda erib Cr(II) birikmalarini hosil qiladi:

$$Cr+2HCl=CrCl_2+H_2\uparrow$$

3. Sovuq kons.HNO_3 da erimaydi. Chunki passivlashadi.
4. Cr_2O_3 ammoniy bixromat parchalanganda hosil bo‘ladi:

$$(NH_4)_2Cr_2O_7\rightarrow N_2\uparrow+Cr_2O_3+4H_2O$$

5. $Cr(OH)_3$ xrom(III) tuzlariga ishqor ta’sir ettirib olinadi:

$$Cr_2(SO_4)_3+6NH_4OH=2Cr(OH)_3+3(NH_4)_2SO_4$$

6. $Cr(OH)_3$ amfoter hisoblanadi:

$$Cr(OH)_3+3HCl=CrCl_3+3H_2O$$

$$Cr(OH)_3+3NaOH=Na_3[Cr(OH)_6]$$

7. Xrom(II) birikmalari beqaror. CrO $Cr(OH)_2$ parchalanganda hosil bo‘ladi:

$$CrCl_2+2KOH=Cr(OH)_2+2KCl \qquad Cr(OH)_2\rightarrow CrO+H_2O$$

8. Xrom(VI) oksid kaliy bixromat eritmasiga kons.H_2SO_4 ta’siridan yorqin qizil ignasimon kristall holida cho‘kadi:

$$K_2Cr_2O_7+H_2SO_4=K_2SO_4+2CrO_3+H_2O$$

9. H_2CrO_4 – xromat kislota. O‘rtacha kuchdagi ikki asosli kislota.
10. $H_2Cr_2O_7$ – bixromat kislota. Kuchli ikki asosli kislota.
11. Xromatlar ishqoriy va neytral muhitda barqaror. Kislotali muhitda bixromatlarga o‘tadi:

$$2CrO_4^{2-}+2H^+\leftrightarrow Cr_2O_7^{2-}+H_2O \quad 2K_2CrO_4+H_2SO_4=K_2Cr_2O_7+K_2SO_4+H_2O$$

$$K_2Cr_2O_7+2KOH=2K_2CrO_4+H_2O$$

12. Xromatlar kuchli oksidlovchilar hisoblanadi. Kislotali muhitda Cr(III) birikmalariga qaytariladi:

$$K_2Cr_2O_7+14HCl=2KCl+2CrCl_3+3Cl_2\uparrow+7H_2O$$

Mavzu: Molibden – Mo

Olinishi:

1. Alyumotermiya yoki vodorodotermiya usulida olinadi:

$$MoO_3+2Al=Mo+Al_2O_3 \qquad MoO_3+3H_2=Mo+3H_2O$$

Kimyoviy xossalari:

1. Yuqori temperaturada kislorod bilan ta’sirlashadi:

$$2Mo+3O_2=2MoO_3$$

Mavzu: Volfram – W

Olinishi:

1. Vodorodotermiya usulida olinadi:

$$MoO_3+3H_2=Mo+3H_2O$$

Kimyoviy xossalari:

1. Juda yuqori temperaturada kislorod bilan ta’sirlashadi:

$$2W+3O_2=2WO_3$$

2. Deyarli hech qaysi kislotada erimaydi.

Mavzu: Marganets – Mn

Minerallari:

MnO_2 – pirolyuzit Mn_3O_4 – gausmanit MnS – marganets aldamasi

Olinishi:

1. Alyumotermiya usulida olinadi:

$$3Mn_3O_4+8Al=9Mn=4Al_2O_3$$

Kimyoviy xossalari:

1. Havoda yonganda Mn_3O_4 hosil bo‘ladi:

$$3Mn+2O_2=Mn_3O_4$$

2. Suyultirilgan kislotalarda erib Mn(II) birikmalarini hosil qiladi:

$$Mn+2HCl=MnCl_2+H_2\uparrow$$

3. Suyultirilgan nitrat kislotada eriydi:

$$3Mn+8HNO_3=3Mn(NO_3)_2+2NO\uparrow+4H_2O$$

4. Mn(II) birikmlari asos xossaga ega. $Mn(OH)_2$ suvda yaxshi erimasa ham kuchli asos hisoblanadi:

$$MnCl_2+2NaOH=Mn(OH)_2+2NaCl$$

5. MnO_2 oksidlovchilik xossasini namoyon qiladi:

$$MnO_2+4HCl=MnCl_2+Cl_2\uparrow+2H_2O$$

6. MnO_2 amfoterlik xossasini namoyon qiladi:

$$MnO_2+Ca(OH)_2=CaMnO_3+H_2O$$

7. Mn(VI) birikmalari quyi birikmlarini oksidlanishidan hosil bo‘ladi:

$$MnCl_2+2KNO_3+2Na_2CO_3=Na_2MnO_4+2KNO_2+2CO_2\uparrow+2NaCl$$

8. Mn(VII) birikmalari uning quyi birikmalarining oksidlanishidan hosil bo‘ladi:

$$2K_2MnO_4+Cl_2=2KMnO_4+2KCl$$

9. $KMnO_4$ kuchli oksidlovchi hisoblanadi. Kislotali muhitda Mn^{2+}(*rangsiz*), neytral muhitda MnO_2(*qo‘ng‘ir cho‘kma*) va kislotali muhitda MnO_4^{2-}(*to‘q yashil*) gacha qaytariladi:

$$KMnO_4(pH<7)Mn^{2+} \qquad KMnO_4(pH=7)MnO_2 \qquad KMnO_4(pH>7)K_2MnO_4$$

10. $KMnO_4$ qizdirilganda parchalanadi:

$$2KMnO_4\rightarrow K_2MnO_4+MnO_2+O_2\uparrow$$

Mavzu: Texnetsiy va Reniy – Tc va Re

Kimyoviy xossalari:

1. Kislorodda yonganda +7 birikmlarini hsoil qiladi:

$$4Tc+7O_2=2Tc_2O_7$$

2. Reniy elektrod potensiallar qatorida H_2 dan o‘ngda turadi. Shuning uchun suyultirilgan kislotalarda erimaydi:

$$3Re+7HNO_3=3HReO_4+7NO\uparrow+2H_2O$$

3. $HReO_4$ kuchli kislota.

Mavzu: Rux – Zn

Olinishi:

1. Ikki xil usulda: quruq va eritmada olinadi:

Quruq:

$$2ZnS+3O_2=2ZnO+2SO_2 \qquad ZnO+CO=Zn+CO_2$$

Eritmada:

$ZnO+H_2SO_4=ZnSO_4+H_2O$ keyin elektroliz qilinadi.

Kimyoviy xossalari:

1. Kislorodda oksidlanadi:

$$2Zn+O_2=2ZnO$$

2. Suyultirilgan kislotalarda tez eriydi:

$$Zn+2HCl=ZnCl_2+H_2\uparrow \qquad Zn+H_2SO_4=ZnSO_4+H_2\uparrow$$

3. Rux amfoter bo‘lganligi uchun ishqorlarda eriydi:

$$Zn+2NaOH+2H_2O=Na_2[Zn(OH)_4]+H_2\uparrow$$

4. Konsentrlangan sulfat kislotada eriganda cho‘kma va gazlar aralshmasi hosil bo‘ladi:

$$8Zn+11H_2SO_4=8ZnSO_4+H_2S\uparrow+S+SO_2\uparrow+10H_2O$$

Mavzu: Simob – Hg

Olinishi:

1. Kinovarni yoqib olinadi:

$$HgS+O_2=Hg+SO_2$$

Mavzu: Mis – Cu

Minerallari:

$CuFeS_2$ – xalkopirit Cu_2S – xalkozin, mis yaltirog‘I $CuCO_3\cdot Cu(OH)_2$ – malaxit

Olinishi:

1. Sulfid rudalarini yoqib olinadi:

$$Cu_2S+O_2=2Cu+SO_2$$

2. Mis tuzlarini eritmada Fe yoki Zn bilan qaytarib olinadi:

$$CuSO_4+Zn=Cu+ZnSO_4$$

3. Toza mis eritma elekrtolizidan (rafinirlash) yo‘li bilan olinadi:

$$Cu_{q(Anod)}+CuSO_4+H_2O=Cu_{t(Katodda)}+CuSO_4+H_2O$$

Kimyoviy xossalari:

1. Havoda qizdirilganda qorayib CuO ni hosil qiladi:

$$2Cu+O_2=2CuO$$

2. Standart elektrod potensiallar qatorida H_2 dan o‘ngda turganligi uchun suyultirilgan kislotalarda erimaydi.
3. Har qanday konsentratsiyali nitrat kislotada eriydi:

$$3Cu+8HNO_{3(s)}=3Cu(NO_3)_2+2NO\uparrow+4H_2O$$
$$Cu+4HNO_{3(k)}=Cu(NO_3)_2+2NO_2\uparrow+2H_2O$$

4. $Cu(OH)_2$ ko‘k paxtasimon chokma holida cho‘kadi:

$$Cu(NO_3)_2+2KOH=Cu(OH)_2+2KNO_3$$

Mavzu: Kumush – Ag

Olinishi:

1. Sulfid rudalaridan siyanidli usul yordamida olinadi:

$$4Ag+8KCN+2H_2O+O_2=4K[Ag(CN)_2]+4KOH$$
$$2K[Ag(CN)_2]+Zn=2Ag+K_2[Zn(CN)_4]$$

Kimyoviy xossalari:

1. Ag nodir metal hisoblanadi. H_2S bilan kislorod ishtirokida ta’sirlashadi:

$$4Ag+2H_2S+O_2=2Ag_2S+2H_2O$$

2. Har qanday konsentratsiyali HNO_3 da eriydi:

$$Ag+2HNO_{3(k)}=AgNO_3+NO_2\uparrow+H_2O$$

Mavzu: Oltin – Au

Olinishi:

1. Siyanidli usul yordamida olinadi:

$$4Au+8KCN+2H_2O+O_2=4K[Au(CN)_2]+4KOH$$
$$2K[Au(CN)_2]+Zn=2Au+K_2[Zn(CN)_4]$$

Kimyoviy xossalari:

1. Oltin eng nodir metal hisoblanadi. U havo, kislota va ishqorlar ta’siriga chidamli. Zar suvida eriydi:

$$Au+HNO_3+3HCl=AuCl_3+NO\uparrow+2H_2O$$
$$Au+HNO_3+4HCl=H[AuCl_4]+NO\uparrow+2H_2O$$

Mavzu: Titan – Ti

Olinishi:

1. Titan quyidagicha olinadi:

$$TiO_2+2C+2Cl_2=TiCl_4+2CO \qquad TiCl_4+2Mg=Ti+2MgCl_2$$

Kimyoviy xossalari:

1. Titan suv va mineral kislotalar ta’siriga chidamli. Yuqori temperaturada kislorod bilan ta’sirlashadi:

$$Ti+O_2=TiO_2$$

2. Yuqori temperaturada azot bilan nitrid hosil qiladi:

$$2Ti+N_2=2TiN$$

3. Granula holida HNO_3 da eriydi:

$$3Ti+4HNO_3+H_2O=3H_2TiO_3+4NO\uparrow$$

4. Granula holida issiq sulfat kislotada eriydi:

$$Ti+3H_2SO_4=TiSO_4+Ti(SO_4)_2+3H_2\uparrow$$

5. Kons.H_2SO_4 bilan qizdirilganda reaksiyaga kirishadi:

$$2Ti+6H_2SO_4=Ti_2(SO_4)_3+3SO_2\uparrow+6H_2O$$

3-Qism

ORGANIK KIMYO

* Nazariy ma'lumot

*Ma'lumotlar

I BOB. ORGANIK BIRIKMALAR TUZILISHI NAZARIYASI VA ORGANIK REAKSIYALARNING TURLARI

Mavzu: Organik kimyo faniga kirish

"Organik kimyo" fani termini 1808 yil shved olimi Bersellius tomonidan fanga kiritilgan.

XVIII asr o‘rtalarida juda kam organik moddalar o‘rganilgan. Masalan, sirka chumoli, benzoy va qahrabo kislotalar, Sheele tabiiy moddalardan vino, sut, limon, olma kislotalarni va glitserinni ajratib olgan.

Dastlabki organik sintezlar quyidagilar:

1824 yil Vyoler ditsiandan oksalat kislotani sintez qildi, 1828 yil ammoniy sianatdan mochevinani sintez qildi.

1845 yil Kolbe sirka kislotani, Bertlo chumoli kislotani, etil spirt, C_2H_2, benzol, metan va yog‘ni sintez qildi.

Ta'rif: *"Organik kimyo – uglerod brikmalarining kimyosidir".*

1861 yil rus olimi A.M. Butlerov "organik birikmalar tuzilishi nazariyasini" e'lon qiladi. Uning asosiy hollari quyidagilar:

1. Organik birikmalarda uglerod atomlari o‘zaro ma'lum tartibga ko‘ra birikadi.
2. Moddaning kimyoviy xossasi uning miqdoriy va sifat tarkibiga bog‘liq.
3. Agar bitta molekula bir xil miqdordagi va bir xil molekulyar massaga ega bo‘lgani bilan, tuzilishi har xil bo‘lsa, u holda *izomeriya* hodisasi kuzatiladi.
4. Moddaning kimyoviy xossasi modda molekulasi tarkibidagi atomlar guruhi o‘zaro ta'siriga bog‘liq.

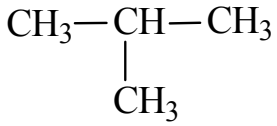
Ta'rif: *Tarkibi va molekulyar massasi bir xil, tuzulishi va xossalari har xil bo‘lgan moddalar izomerlar deyiladi.*

$CH_3 – CH_2 – OH$ $\quad C_2H_6O \quad$ $CH_3 – O – CH_3$

etanol – spirt dimetil efir – oddiy efir

Izomeryaning bir qancha turlari bor:

1) *Uglerod skeleti bo‘yicha izomeriya*:

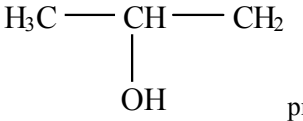


$CH_3 – CH_2 – CH_2 – CH_3$

n-butan (tarmoqlanmagan) izobutan (tarmoqlangan)

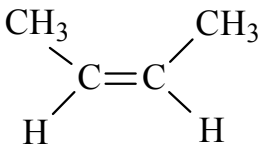
2) *Holat izomeriya, funksional guruh holatiga ko‘ra izomeriya:*

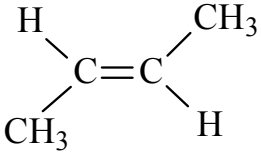
$CH_3 – CH_2 – CH_2 – OH$



propanol -1 propanol -2

3) *Geometrik izomeriya (sis-, trans - izomeriya),* qo‘shbog‘ tutgan organik birikmalarda kuzatiladi:





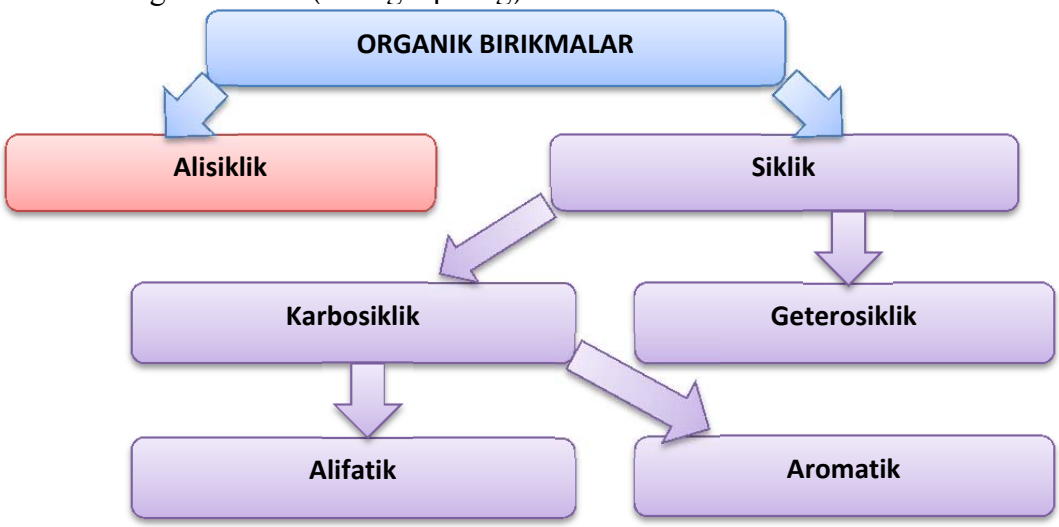
sis – buten – 2 trans – buten – 2

4) *Optik izomeriya* – ular qutblangan yorug‘lik nuruni o‘ng yoki chap tomoniga buradi. Agar o‘ngga bursa – D, chapga bursa – L izomer deyiladi.

Mavzu: Organik birirkmalarning klassifikatsiyasi.

Organik birikmalar turlicha klassifikatsiyalanadi.

1. Alisiklik – siklik bo‘lmagan birikmalar.
2. Siklik birikmalarga bo‘linadi (ilovaga qarang).



Mavzu: Organik reakiyalarning turlari

Reaksiyalarni klassifikatsiyalashda kimyoviy o‘zgarish va ayni molekuladagi bog‘ uzilishi hisobga olinadi.

Kimyoviy o‘zgarishlarga ko‘ra reaksiyalar quyidagicha bo‘linadi:

1) Birikish – *A*.
2) Ajralish – *E*.
3) O‘rin olish.- *S*.
4) Qayta guruhlanish reaaksiyasi.
5) Oksidlanish-qaytarilish reaksiyasi.

Birikish reaksiyalarida asosan to‘yinmagan ya’ni karrali bog‘ga ega molekulalar ishtirok etadi va qo‘shbog‘ yoki uchbog‘ uziladi. Bunday reaksiyalar ***A*** (*Addition*) harfi bilan belgilanadi.

Bunday reaksiyalarning bir qancha turlari bor:

a) *Gidrogenlanish* – ya’ni Ni, Pt yoki Pd katalizatori ishtirokida vodorod birikish reaksiyasi:

$$CH_2{=}CH_2 + H_2 \rightarrow CH_3{-}CH_3$$

b) *Gidratlanish* – suv molekulalarining birikishi. Masalan, etilen gidratlanganda etanol hosil bo‘ladi:

$$CH_2{=}CH_2 + H_2O \rightarrow CH_3{-}CH_2{-}OH$$

c) *Galogenovodorod* birikish reaksiyalari – HF, HCl, HBr va HJ birikishi:

$$CH_2{=}CH{-}CH_3 + HCl \longrightarrow CH_3{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}{-}CH_3$$

d) *Galogenlanish* – F_2, Cl_2, Br_2 va J_2 birikishi:

$$CH_2{=}CH_2 + Cl_2 \longrightarrow \underset{\displaystyle Cl}{\underset{|}{CH_2}}{-}\underset{\displaystyle Cl}{\underset{|}{CH_2}}$$

e) *Polimerlanish* reaksiyasi – ya’ni kichik molekulyar massali to‘yinmagan molekulalardan yuqori molekulyar birikmalar (YuMB) hosil bo‘lish reaksiyalari:

$$n\,CH_3{-}CH{=}CH_2 \longrightarrow \left(\underset{\displaystyle CH_3}{\underset{|}{CH}}{-}CH_2{-}\right)_n$$

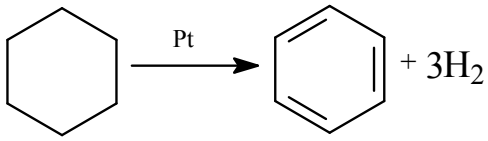
propilen polipropilen

f) *Siklobirikish* reaksiyasi – masalan, Dills-Alder reaksiyasi.

Ajralish reaksiyalarida atom yoki atomlar guruhi ajralib chiqadi va karrali bog‘lar hosil bo‘ladi. Bunday reaksiyalar ***E*** (*Elimination*) harfi bilan belgilanadi.

Ajralash reaksiyalarining bir qancha turlari bor:

a) *Degidrogenlanish* – ya’ni vodorod ajralish reaksiyasi:



b) *Degidratlanish* – ya’ni suv ajralib chiqish reaksiyasi:

$$CH_3 - CH_2 - OH \xrightarrow[t°C]{t > 170°C} CH_2 = CH_2 + H_2O$$

c) *Degidrogalogenlanish* – ya’ni galogenovodorod ajralish reaksiyasi:

$$CH_2Br–CHBr–CH_3 \xrightarrow{KOH,\ spirt} CH{\equiv}C–CH_3 + 2HBr$$

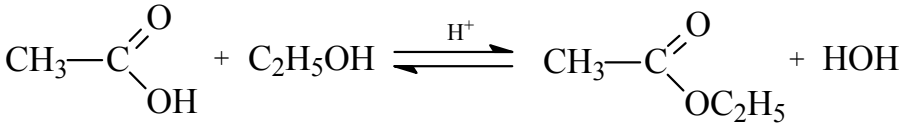
O‘rin olish reaksiyalarida molekuladagi atom yoki atomlar guruhi boshqasiga almashinadi. Bunday reaksiyalar ***S*** (*Substitution*) harfi bilan belgilanadi.

O‘rin olish reaksiyalari organik kimyoda muhim o‘rin tutadi.

a) *Galogen almashinish* reaksiyasi, ya’ni vodorodning galogenga almashinishi:

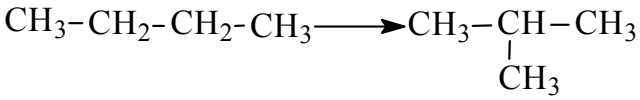
$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

b) *Kondensatsiya* reaksiyasi – quyi molekulyar birikma ajralishi bilan amalga oshadigan reaksiyalar. Masalan, eterifikatsiya reaksiyasi:



c) *Polikondensatsiya* reaksiyasi – polimerlanishdan farq qilib, quyi molekulyar birikmlar ta’siridan polimer hosil bo‘lishi bilan birga past molekulyar massali modda qo‘shimcha sifatida hosil bo‘ladi. Masalan, fenolformaldegid smolasi, kapron va h.k.lar.

Yuqoridagi 3 ta reaksiyadan tashqari qayta guruhlansih va izomerlanish reaksiya ham uchraydi.



Bog‘ning uzilishi va qayta hosil bo‘lishiga ko‘ra reaksiyalar 2 ga bo‘linadi:

Organik kimyoda reaksiyaga kirishadigan asosiy organik modda “*substrat*”, ikkinchisi esa “*reagent*” deb nomlanadi.

1) *Gomogen* uzilish (erkin radikal mexanizmi):

$$A : B \leftrightarrow A^{\bullet} + B^{\bullet}$$

Bunday reaksiyalar S_R bilan belgilanib, yorug‘lik va temperatura ta’sirida amalga oshadi

2) *Geterogen* uzilish (ion mexanizm)

$$A : B \leftrightarrow [A :]^- + [B]^+$$

Ionlarning zaryadiga ko‘ra geterolitik reaksiyalar 2 ga bo‘linadi:

Organik reaksiyalarda nukleofil va elektrofil reagentlar farq qiladi. Umuman olganda nukleofillar taqsimlanmagan elektron juftiga yoki π-bog‘ga ega bo‘lsa, elektrofillar elektron yetishmagan guruhlarga ega bo‘ladi.

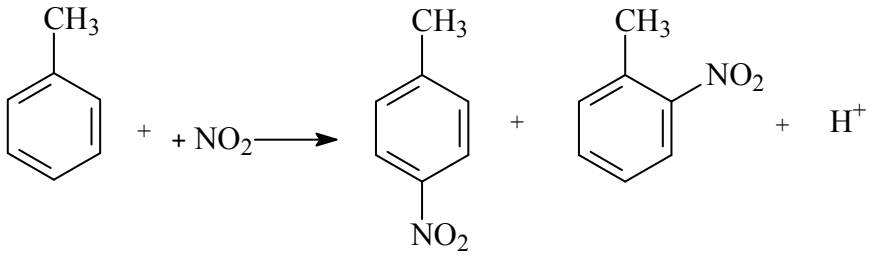
Nukleofil reagentlarga $RCOO^-$, RO^-, ROR, RNH_2, CN^-, I^- va boshqalar kiradi. Agar reaksiyani boshlovchi reagent manfiy zaryadli bo‘lsa (nukleofil), jarayon nukleofil o‘rin olish reaksiyasi (S_N) deyiladi:

$$R{-}X + Nu: \rightarrow R{-}Nu: + :X^-$$

$$CH_3{-}CH_2{-}Br + OH^- \rightarrow CH_3{-}CH_2{-}OH + Br^-$$

Elektrofil reagentlarga $^{+}NO_2$, $[Ar{-}N^{+}{\equiv}N]$, H_3O^{+}, $R_3{}^{+}C$ va boshqalar kiradi va ular ishtirokidagi reaksiyalar S_E bilan belgilanadi:

$$R{-}Y + E^{+} \rightarrow R{-}E + Y^{+}$$



II BOB. UGLEVODORODLAR

Mavzu: Uglevodorodlar

Ta'rif: *Tarkibida faqat uglerod va vodorod atomlari tutgan organik moddalarga uglevodorodlar deyiladi.*

Uglevodorodlar 2 ga bo'linadi

1. To'yingan uglevodorodlar – a) alkanlar b) sikloalkanlar
2. To'yinmagan uglevodorodlar – a) alkenlar b) alkinlar c) alkadiyenlar d) poliyenlar e) arenlar.

Mavzu: Alkanlar

Ta'rif: *Tarkibida faqat σ – bog'lar tutgan uglevodorodlarga alkanlar deyiladi.*

Ularning umumiy formulasi C_nH_{2n+2}.

Gibridlanishi – sp^3.

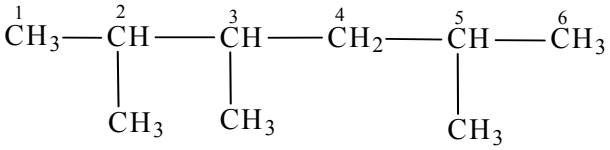
Ta'rif: *Uglerod soni ortishi bilan bir yoki bir necha – CH_2 guruhiga farq qiladigan va xossalari o'xshash moddalarga gomologlar deyiladi.*

Alkanlarning gomologik qatori

Formulasi	Nomi	Agregat holati	Formulasi	Nomi	Agregat holati
CH_4	metan	Gaz	C_8H_{18}	oktan	Suyuq
C_2H_6	etan		C_9H_{20}	nonan	
C_3H_8	propan		$C_{10}H_{22}$	dekan	
C_4H_{10}	butan		$C_{15}H_{32}$	pentadekan	
C_5H_{12}	pentan	Suyuq	$C_{20}H_{42}$	eykozan	Qattiq
C_6H_{14}	geksan		$C_{100}H_{202}$	gektan	
C_7H_{16}	geptan				

Izomeriyasi va nomenklaturasi: alkanlarni IUPAC bo'yicha nomlashda quyidagiga e'tibor beriladi:

1) Eng uzun uglerod zanjiri tanlanadi.
2) Tarmoqqa yaqin tomondan raqamlanadi va radikal nomi ko'rsatiladi.
3) Dastlab kichik radikal, keyin kattarog'i aytiladi.



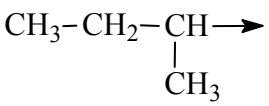
2,3,5-trimetilgeksan

Radikallar bu alkandan vodorod yo'qolganda qolgan qoldiq hisoblanadi va C_nH_{2n+1} formulaga muvofiq keladi.

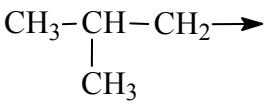
$CH_3 \rightarrow$ metil

$CH_3\text{-}CH_2 \rightarrow$ etil

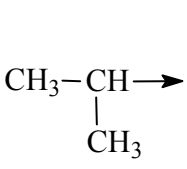
$CH_3 - CH_2 - CH_2 \rightarrow$ propil



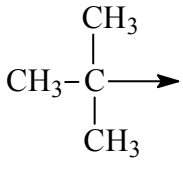
ikkilamchi butil



izobutil



izopropil



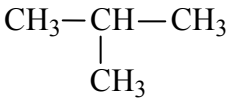
uchlamchi butil

$CH_3 – CH_2 – CH_2 – CH_2 \rightarrow$ butil

Tarmoqlanmagan zanjirga ega alkanlar *normal alkanlar,* tarmoqlanganlari *izo – alkanlar* deyiladi.

Alkanlarda izomeriya – tuzulishi izomeriasi (zanjir) hisoblanadi. Izomeriya butandan boshlanadi.

$CH_3 – CH_2 – CH_2 – CH_3$ n-butan



2 – metil propan (izobutan)

Uglerod soni ortishi bilan izomerlar soni ortadi. Masalan pentanda 3 ta, geptanda 9 ta, oktanda – 18, dekanda – 75.

Tabiatda uchrashi:

Alkanlarning asosiy manbai – tabiiy gaz va neft hisoblanadi.

Olinishi:

1) Uglerodni gidrogenlab (H_2 qo‘shib):

$$C+2H_2=CH_4$$

2) CO_2 va CO ni katalitik gidrogenlab olinadi:

$$CO_2+4H_2 \xrightarrow{400°C,\ Ni} CH_4+2H_2O$$

3) 1856 yil Bertolle birinchi marta metanni quyidagicha sintez qildi:

$$CS_2 + 2H_2S + 8Cu \rightarrow CH_4 + 4Cu_2S$$

4) Al_4C_3 ni gidrolizlab:

$$Al_4C_3+12H_2O=4Al(OH)_3+3CH_4$$

5) Vyurs reaksiyasi, ya’ni galogenalkenlarga Na ta’siridan olinadi.

$$2R – Br + 2Na \rightarrow R – R+2NaBr$$

$$CH_3Br+2Na +CH_3Br\rightarrow \underset{\text{etan}}{CH_3 – CH_3} +2NaBr$$

brommetan

$$3CH_3Cl+6Na+3CH_3\text{- } CH_2\text{-}Cl\rightarrow \underset{\text{etan}}{C_2H_6} + \underset{\text{propan}}{C_3H_8} + \underset{\text{butan}}{C_4H_{10}}+6NaCl$$

6) Karbon kislota tuzlarini ishqor qo‘shilib qizdirib olinadi.

$$CH_3 – COONa + NaOH \xrightarrow{t°C} CH_4 + Na_2CO_3$$

$$R – COONa+NaOH \xrightarrow{t°C} R – H + Na_2CO_3$$

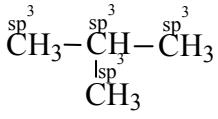
7) To‘yinmagan uglevodorodlarni gidrogenlab olinadi.

$$\underset{\text{eten}}{CH_2=CH_2}+H_2\xrightarrow{Ni}\underset{\text{etan}}{C_2H_6}$$

Fizikaviy xossalari:

Alkanlarda uglerod soni ortishi bilan suyuqlanish va qaynash temperaturasi ortadi. Tarmoqlanmagan alkanlar tarmoqlangan alkanlarga qaraganda yuqori suyuqlanish va qaynash temperaturasiga ega. Alkanlar suvda erimaydi.

Molekula tuzulishi:



Alkanlarda uglerod atomlari faqat sp^3 gibridlangan holda bo‘ladi.

1) sp^3 – 4x4=16 ta 2) s – 10 ta

valent burchagi 109°28’ ga teng.

Kimyoviy xossalari:

Alkanlar “parafin” lar ham deyiladi va ancha inert hisoblanadi. Alkanlarda barcha uglerod atomlari vodorod atomlari vododrod atomi bilan to‘yinganligi uchun birikish reaksiyalariga kirishmaydi.

1) Alkanlar galogenlar bilan oson ta’sirlashadi:

$$CH_4+Cl_2 \xrightarrow{hv} CH_3Cl+HCl$$

2) Reaksiya zanjir mexanizmi asosida boradi va buni Semyonov ochgan.

$$CH_4+Cl_2 \xrightarrow[-HCl]{hv} CH_3Cl \xrightarrow[-HCl]{+Cl_2} CH_2Cl_2 \xrightarrow[-HCl]{+Cl_2} CHCl_3 \xrightarrow[-HCl]{+Cl_2} CCl_4$$

metan — xlormetan — dixlormetan — trixlormetan (xloroform) — tetraxlormetan (uglerodtetraxlorid)

3) Alkanlar nitrat kislota bilan reaksiyaga kirishadi:

$$R–H + HNO_3 \xrightarrow{t°C} R–NO_2+HOH$$

$$CH_4 + HNO_3 \xrightarrow{t°C} \underset{\text{nitrometan}}{CH_3–NO_2} + HOH$$

bu reaksiyaga Konovalov reaksiyasi (1888) deyiladi.

4) Alkanlar kislorod ta’sirida oson yonadi. Bunda karbonat angidrid va suv hosil bo‘ladi:

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$

$$C_nH_{2n+2} + 1{,}5n+0{,}5O_2 = nCO_2 + n+1H_2O$$

5) Alkanlar yuqori temperaturada degidrogenlanadi (H_2 molekulasi ajralib chiqib karrali bog‘lar hosil bo‘ladi):

$$CH_3–CH_3 \xrightarrow{t°C} CH_2=CH_2 + H_2$$

$$2CH_4 \xrightarrow{1500°C} CH\equiv CH + 3H_2$$

6) Alkanlar $AlCl_3$ yoki $AlBr_3$ ishtirokida qizdirilganda izomerlanadi. Bunda zanjir tarmoqlanadi:

7) n-Alkan $\xrightarrow{AlCl_3}$ Izoalkan

$$CH_3-CH_2-CH_2-CH_3 \longrightarrow CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$$

n-butan — izobutan

8) Sulfoxlorlash reaksiyasi – SO_2+Cl_2 UB nurlar ishtirokida alkansulfoxloridlar hosil qiladi:

$$CH_3(CH_2)_{10}CH_3 \xrightarrow{SO_2+Cl_2} CH_3(CH_2)_{10}CH_2SO_2Cl + HCl$$

$$CH_3(CH_2)_{10}CH_2SO_2Cl \xrightarrow{2NaOH} CH_3(CH_2)_{10}CH_2SO_2Na + NaCl$$

Hosil bo‘lgan tuzlar sulfonatlar deyilib, sintetik yuvish vositalari sifatida ishlatiladi.

Ishlatilishi:

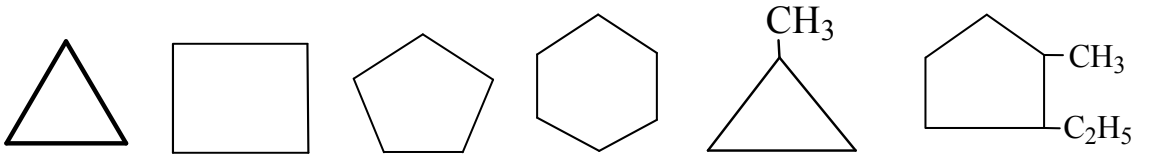
Alkanlar eng asosiysi yoqilg‘ilardan biri hisoblanadi. Masalan, CH_4 tabiiy gazning 90-95% gacha qismini tashkil qiladi. Geksan va xloroform qutbsiz erituvchi sifatida, CCl_4 o‘t o‘chirishda ishlatiladi.

Mavzu: Sikloalkanlar

Ta’rif: *Uglerod atomlari o‘zaro faqat σ-bo‘lgan bilan bog‘langan, yopiq xalqali uglevodorodlarga sikloalkanlar deyiladi.*

Ularning umumiy formulasi: C_nH_{2n}. Gibridlanishi – sp^3

Nomlanishi: Sikloalkanlarni nomlashda zanjirdagi uglerod soniga “*siklo*” – so‘zi qo‘shiladi.



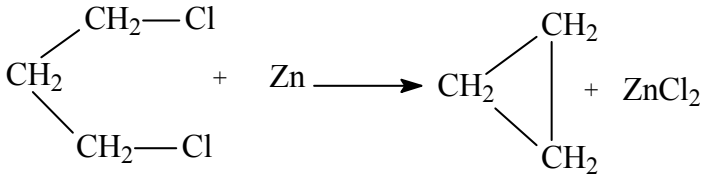
siklopropan siklobutan siklopentan siklogeksan metilsikopropan 1-metil-2- etilsiklopentan

Tabiatda uchrashi:

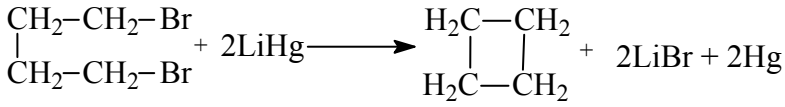
Sikloalkanlar va ularning hosilalari neft va o‘simliklar tarkibida uchraydi. Rus olimi V.V.Markovnikov neftdan C_5H_{10} va C_6H_{12} larni ajratib oldi va bu sinfni kashf qiladi.

Olinishi:

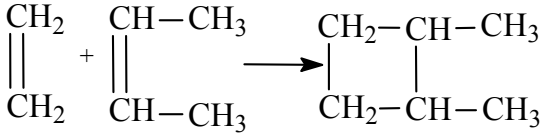
1) Ajratilgan digalogenli hosilalarga Zn ta’siridan olinadi (Gustavson G.G.)



2) Siklobutan olish uchun Zn o‘rniga LiHg ishlatiladi:

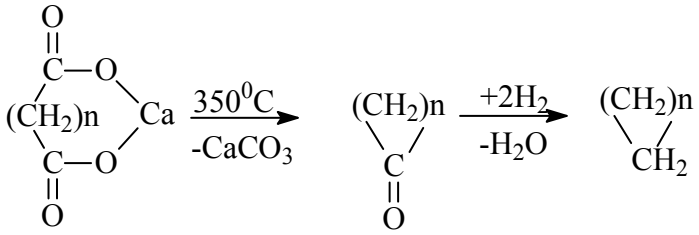


3) Alkenlarni dimerlab olinadi:

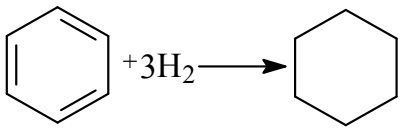


1,2 -dimetilsiklobutan

4) Ikki asosli karbon kislotalarning kalsiyli tuzlarini qizdirib va siklik ketonni qaytarib olinadi:



5) Benzolni gidrogenlab olinadi:



benzol siklogeksan

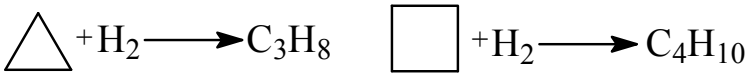
Fizikaviy xossalari:

C_3H_6, C_4H_8 va C_5H_{10} rangsiz gazlar, C_6H_{12} suyuqlik hisoblanadi.

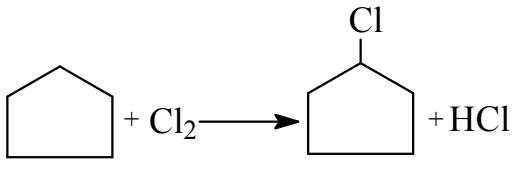
Kimyoviy xossalari:

Sikloalkanlarning dastlabki vakillari bo‘lgan siklopropan va siklobutan birikish reaksiyalariga oson kirishadi. Bunda zanjir ochiladi. (Bayer nazariyasi)

1) Sikloalkanlar gidrogenlanganda alkanlar hosil bo‘ladi.

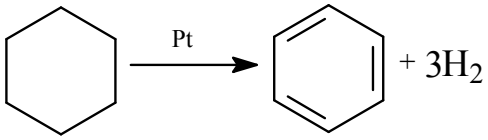


2) Siklopentan va siklogeksan ko‘proq to‘yinganlik xossasini nomoyon qiladi. Shuning uchun o‘rin olish reaksiyalariga oson kirishadi:



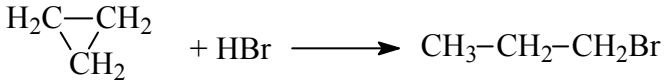
xlorsiklopentan

3) Siklogeksan 300°C da Pt katalizatorida benzolni hosil qiladi:

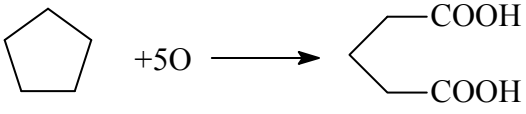


benzol

4) Galogenovodorodlar ham xuddi Γ_2 va H_2 birikkandagi kabi birikadi:



5) Oksidlovchilar ta’siriga sikloalkanlar chidamli. $KMnO_4$ eritmasida faqatgina sikloalkan va gomologlarigina oksidlanadi. Ular to‘yingan uglevodorodlar kabi yuqori temperaturada oksidlanib, ikki asosli kislotalar hosil qiladi:



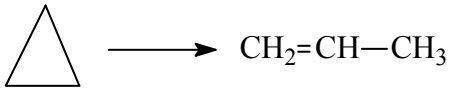
glutar kislota

6) Sikloalkanlar yonganda suv va karbonat angidrid hosil bo‘ladi:

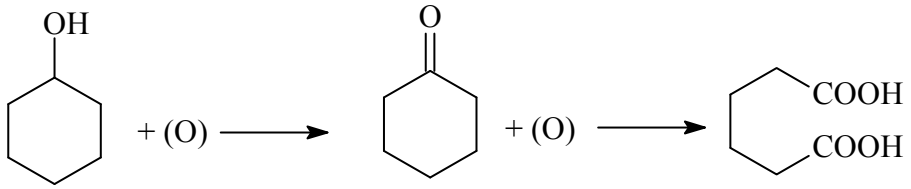
$$C_6H_{12} + 9O_2 = 6CO_2 + 6H_2O$$

$$C_nH_{2n} + 1{,}5nO_2 = nCO_2 + nH_2O$$

7) Siklopropan yuqori temperaturada propenga aylanadi:



8) Siklogeksanol oksidlanganda oxirgi mahsulot adipin kislota hosil bo‘ladi:



siklogeksanol siklogeksanon adipin kislota

Ishlatilishi:

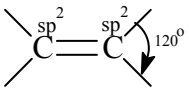
Siklopropan meditsinada og‘riqni qoldirish uchun, siklobutan va siklopentan organik sintezda, siklogeksan qutbsiz erituvchi sifatida ishlatiladi. $C_6H_6Cl_6$ – geksaxlorsiklogeksan qishloq xo‘jaligida insektitsid sifatida ishlatiladi. Siklopropan narkoz sifatida ishlatiladi.

Mavzu: Alkenlar

Ta’rif: *Tarkibida bitta qo‘shbog‘ tutgan to‘yinmagan uglevodorodlarga alkenlar deyiladi.*

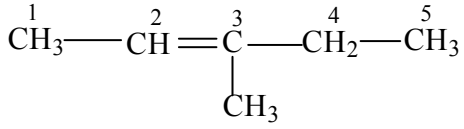
Ularning umumiy formulasi: C_nH_{2n}

Gibridlanishi



Nomlanishi:

Alkenlarni nomlash uchun tarkibida qo‘shbog‘ tutgan eng uzun uglevodorod zanjiri tanlanib, qo‘shbog‘ yaqin tomondan raqamlanadi va uglevodorod nomiga *–en* qo‘shimchasi qo‘shiladi.

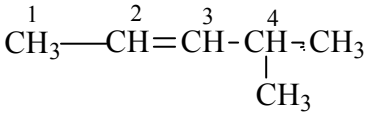


3 – metilpenten - 2

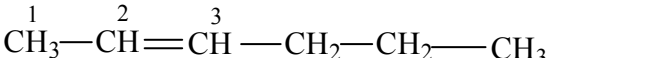
Izomeriyasi:

Alkenlar uchun zanjir izomeriyasi, qo‘shbog‘ning holat izomeriyasi, shuningdek geometrik izomeriya o‘rinli.

1) Zanjir izomeriya



4 – metilpenten -2



geksen -2

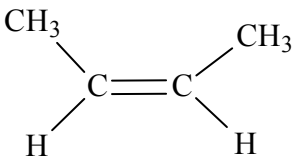
2) Qo‘shbog‘ning holat izomeriyasi

$CH_2=CH—CH_2—CH_3$ buten – 1

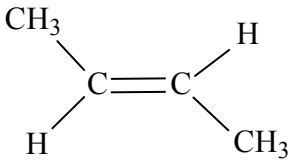
$CH_3—CH=CH—CH_3$ buten – 2

3) Geometrik izomeriyada qo‘shbog‘da turli o‘rinbosarlar joylashganda qo‘shbog‘ 1 – o‘rinda joylashganda yuzaga keladi.

$CH_3—CH=CH—CH_3$ buten – 2



sis – buten – 2



trans – buten – 2

Olinishi:

1) Alkanlarni degidrogenlab olinadi:

$$CH_3 – CH_2 – CH_2 – CH_3 \xrightarrow[450°C]{Cr_2O_3} CH_3 – CH = CH – CH_3 + H_2$$

2) Spirtlarni degidratlab olinadi:

$$CH_3 – CH_2 - OH \xrightarrow[t°C]{t > 170°C} CH_2 = CH_2 + H_2O$$

3) Galogenalkanlarga ishqorning spirtdagi eritmasi ta’sir ettirib olinadi:

$$NaOH + CH_3 – CH_2 – CH_2 – Cl \xrightarrow{t°C} CH_3 – CH = CH_2 + NaCl + H_2O$$

$$CH_3 – CH_2 – CH – CH_3 + NaOH \xrightarrow{spirt} CH_3 – CH = CH – CH_3 + NaCl + H_2O$$

4) Diyenlar va alkinlarni Ni yoki Pd katalizatori ishtirokida gidrogenlab olinadi:

$$CH_2 = CH – CH = CH_2 + H_2 \xrightarrow{Ni} CH_3 – CH = CH – CH_3$$

5) Alkenlarni olishning laboratoriyada keng tarqalgan usuli sirka kislota efirlarini piroliz qilishdir:

$$CH_3COOC_nH_{2n+1} \rightarrow C_nH_{2n} + CH_3COOH$$

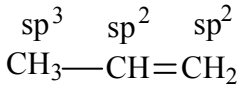
6) Vitsinal digalogenli uglevodorodlarga Zn ta’siridan olinadi:

$$CH_2Br – CH_2Br + Zn \rightarrow CH_2 = CH_2 + ZnBr_2$$

Fizikaviy xossalari:

$C_2H_4 – C_4H_8$ – gaz, undan yuqori vakillari suyuqliklardir. Etilen va propilen kuchsiz hidga ega.

Molekulada tuzulishi:



1) sp^3 – 4ta
2) sp^2 – 2x3=6ta
3) s – 6ta
4) p – 2ta

Kimyoviy xossalari:

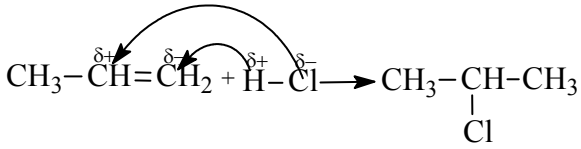
Alkenlarda bitta qo‘shbog‘ bo‘lganligi uchun ular to‘yinmaganlik xossasini namoyon qiladi va birikish reaksiyalariga oson kirishadi.

1) Alkenlar Ni katalizatori ishtirokida gidrogenlanadi.

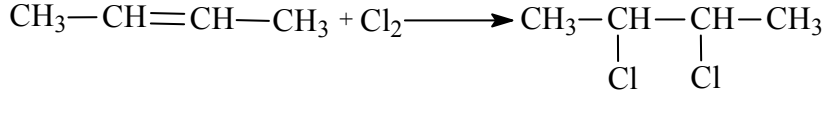
$$\underset{\text{alken}}{CH_3-CH=CH_2} + H_2 \xrightarrow{Ni} \underset{\text{alkan}}{CH_3-CH_2-CH_3}$$

2) Alkenlar vodorod galogenlar bilan ta’sirlashadi. Bunda Markovnikov qoidasiga binoan reaksiya sodir bo‘ladi.

Ta’rif: *Vodorod ko‘p gidrogenlangan uglerodga, galogen kam gidrogenlangan uglerodga birikadi.*

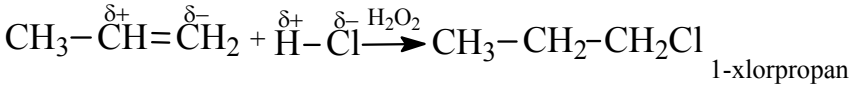


3) Alkenlar galogenlanish reaksiyalariga oson kirishadi. Ular bromli suvni rangsizlantiradi:



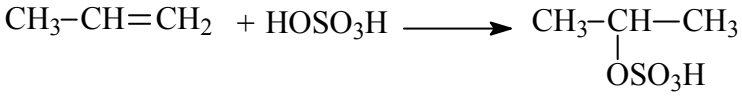
2,3-dixlorbutan

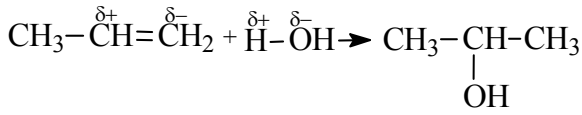
4) Alkenlarga vodorod galogenidlar H_2O_2 ishtirokida biriksa, bunda Markovnikov qoidasiga teskari birikish kuzatiladi. Bu radikal mexanizmi asosida amalga oshadi.



1-xlorpropan

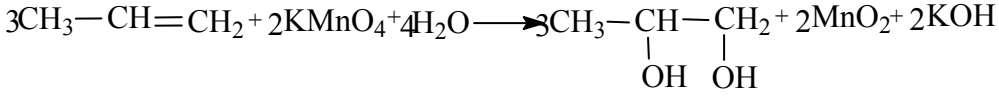
5) Alkenlar H_2SO_4 ishtirokida suv bilan birikib spirtlarni hosil qiladi. Bunda avval alkilsulfat kislota hosil bo‘ladi:





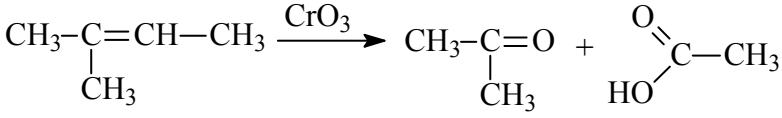
propanol-2

6) Alkenlar $KMnO_4$ eritmasi bilan oksidlanganda ikki atomli spirtlar hosil bo‘ladi. Bunda eritma rangsizlanadi(Vagner reaksiyasi):



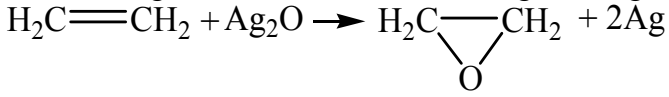
propandiol – 1,2

7) Alkenlar qattiq sharoitda oksidlanganda ($K_2Cr_2O_7$, H_2CrO_4, CrO_3, HNO_3), ularning qo‘shbog‘i uziladi va tegishli kislota(ikkilamchi qo‘shbog‘ uglerodidan)/ketonlar (uchlamchi qo‘shbog‘ uglerodidan) hosil bo‘ladi:



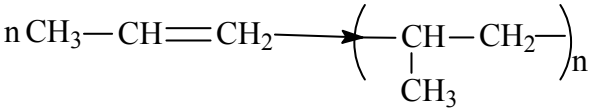
Ushbu reaksiyadan molekuladagi qo‘shbog‘ning o‘rnini aniqlashda foydalaniladi.

8) Alkenlar Ag tuzlari ishtirokida oksidlanganda organik oksidlar hosil bo‘ladi:



etilenoksid

9) Alkenlar polimerlanish reaksiyalariga kirishib yuqori molekulyar birikmalarni hosil qiladi:



polipropilen

Ishlatilishi:

Etilen etanol olishda, polietilen, polivinelxlorid, etilenglikol olishda; propilen polipropilen olishda, fenol va atseton olishda, glitserin olishda ishlatiladi. Buten kauchik ishlab chiqarishda ishlatiladi.

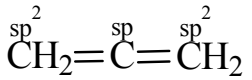
Mavzu: Alkadiyenlar. Diyen uglevodorodlari

Ta’rif: *Tarkibida 2 ta qo‘shbog‘ bo‘lgan ochiq zanjirli uglevodorodlar sinfiga alkadiyenlar deyiladi.*

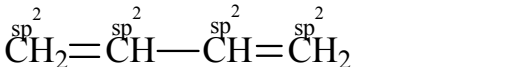
Ularning umumiy formulasi: C_nH_{2n-2}; Gibridlanishi – sp^2

Shuningdek ular alkinlarga izomer hisoblanadi.

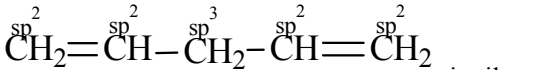
Alkadiyenlar molekulasida ikkita qo‘shbog‘ ajratilmagan yoki ajratilgan bo‘lishi.



kumulirlangan



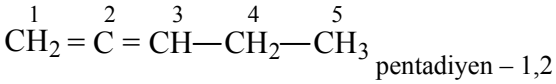
konyugirlangan



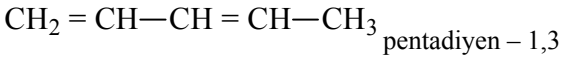
ajratilgan

Nomlanishi va izomeriyasi:

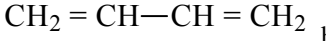
Alkadiyenlar nomlash uchun 2 ta qo‘shbog‘ tutgan eng uzun uglevodorod zanjiri tanlanib qo‘shbog‘ raqami ko‘rsatiladi va asosiy uglevodorod nomiga *-diyen* qo‘shimchasi qo‘shiladi.



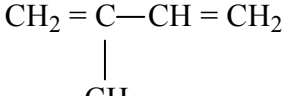
pentadiyen – 1,2



pentadiyen – 1,3



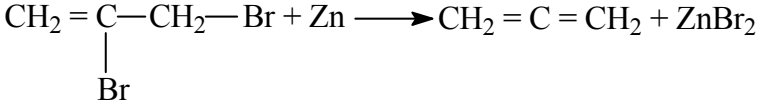
butadiyen-1,3, divinil



2-metilbutadiyen-1,3, izopren

Olinishi:

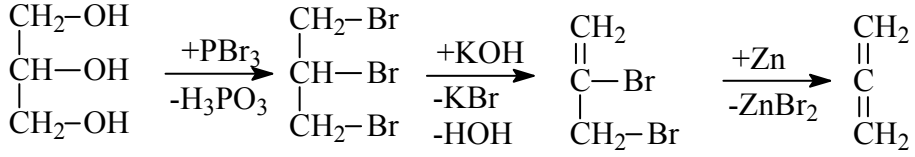
1) Alkadiyenlarni digalogenalkenlarga Zn ta’siridan olish mumkin:



2) Butadiyen – 1,3 etil spirtni Al_2O_3+ZnO katalizatorida qizdirib olinadi. Buni 1927 yil S.V. Lebedev taklif qilgan:

$$2CH_3 - CH_2 - OH \xrightarrow{kat} CH_2 = CH - CH = CH_2 + 2H_2O + H_2$$

3) Allen quyidagicha olinadi:



glitserin 1,2,3-tribrompropan 2,3-dibrompropen allen

4) Ajratilgan qo‘shbog‘li alkadienlar P.P.Shorigin usuli bilan olinadi:

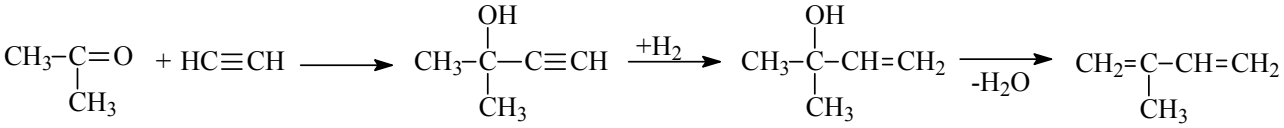
$$2CH_2{=}CH{-}CH_2Br + 2Na \rightarrow CH_2{=}CH{-}CH_2{-}CH_2{-}CH{=}CH_2 + 2NaBr$$

5) Buten yoki butenni digedrogenlab olinadi:

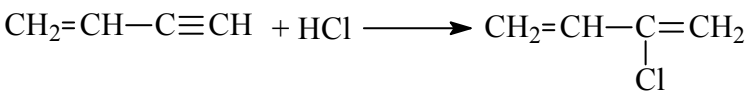
$$CH_3 - CH_2 - CH_2 - CH_3 \xrightarrow[650°C]{Cr_2O_3} CH_2 = CH - CH = CH_2 + 2H_2$$

$$CH_3 - CH = CH - CH_3 \xrightarrow[650°C]{Cr_2O_3} CH_2 = CH - CH = CH_2 + H_2$$

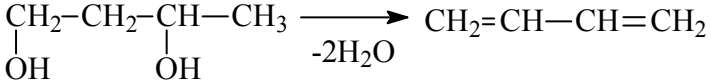
6) Izoprenni quyidagicha olish mumkin:



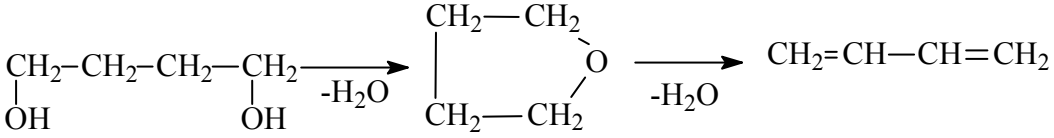
7) Xloropren vinilatsetilendan olinadi:



8) Glikollarning degidratlanishidan divinil olinadi:

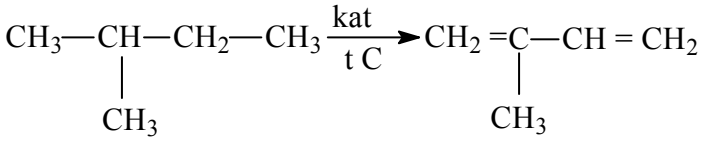


butandiol-1,3 butadiyen-1,3



butandiol-1,4 tetragidrofuran butadiyen-1,3

9) Izopren izopentenni yoki 2 – metil butanni degidrogenlab olinadi.

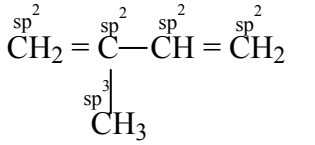


2 – metilbutadiyen – 1,3

Fizikaviy xossalari:

Alkadiyenlarning dastlabki vakillari gaz yoki suyuqliklardir.

Molekula tuzulishi:



1) sp^3 – 4ta
2) sp^2 – 4,3 = 12ta
3) s – 8ta
4) p – 4ta

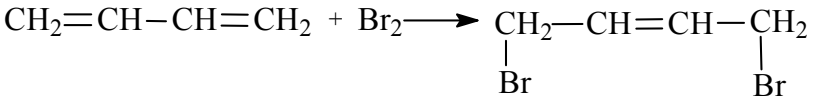
Kimyoviy xossalari:

Alkadiyenlarda 2 ta qo‘shbog‘ bo‘lganligi uchun ular to‘yinmaganlik xossasini namoyon qiladi va birikish reaksiyalariga oson kirishadi.

1) Alkadiyenlar gidrogenlanganda alken yoki alkanlar hosil bo‘ladi:

$$C_4H_6 + H_2 \xrightarrow{Ni} C_4H_8 + H_2 \xrightarrow{Ni} C_4H_{10}$$

2) Alkadiyenlar bromlanganda 1,4 birikish amalga oshadi va qo‘shbog‘ o‘rtaga ko‘chadi.

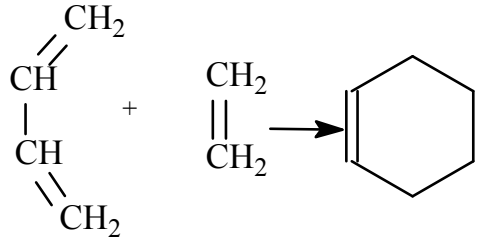


3) Galogenvodorodlar ham 1,4 birikadi:

$CH_2 = CH - CH = CH_2 + H - Cl \rightarrow CH_3 - CH = CH - CH_2Cl$

1–xlorbuten–2

4) Alkenlar bilan birikib sikloalkanlar hosil qiladi. Bunga Dills–Alder reaksiyasi deyiladi:



siklogeksen

5) Alkadiyenlar yonganda suv va karbonat angidrid hosil bo‘ladi:

$$C_4H_6 + 5{,}5O_2 \rightarrow 4CO_2 + 3H_2O$$

$$C_nH_{2n-2} + 1{,}5n - 0{,}5O_2 \rightarrow nCO_2 + n - 1H_2O$$

6) Alkadiyenlar polimerlanish reaksiyasiga kirishib yuqori molekulyar birikmalarni hosil qiladi:

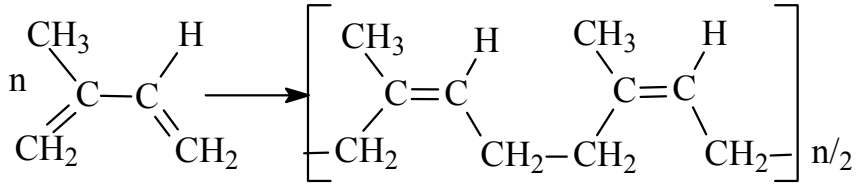
$nCH_2=CH - CH = CH_2 \rightarrow (- CH_2 - CH = CH - CH_2 -)_n$

divinil — divinil kauchuk

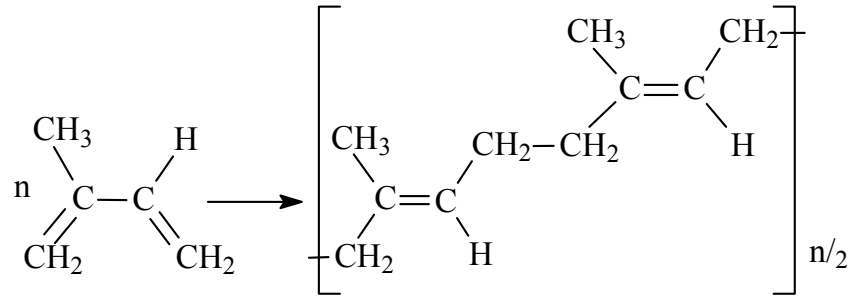
Ishlatilishi:

Ularning polimerlari kauchuk sifatida ishlatiladi. Kauchukning bir necha turlari bor.

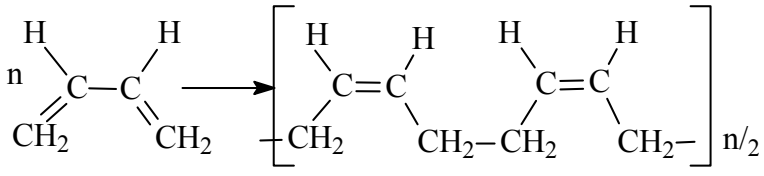
1) Tabiiy kauchuk, ya’ni sis – izopren kauchuk:



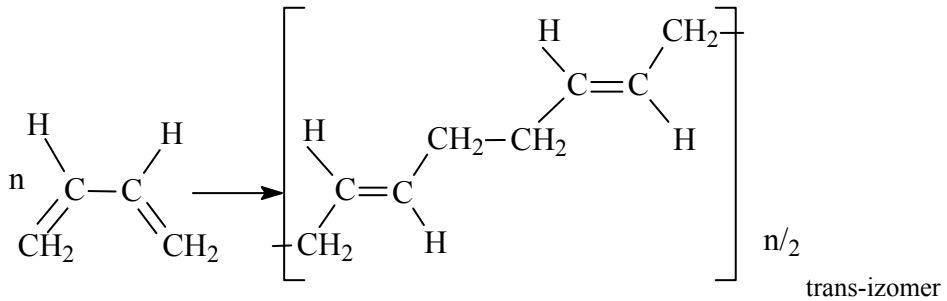
2) Trans-izopren kauchuk yoki guttapercha:



3) Divinil kauchuk – butadiyen-1,3 kauchuk:

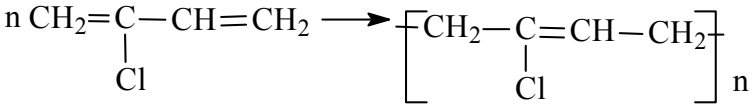


sis-izomer

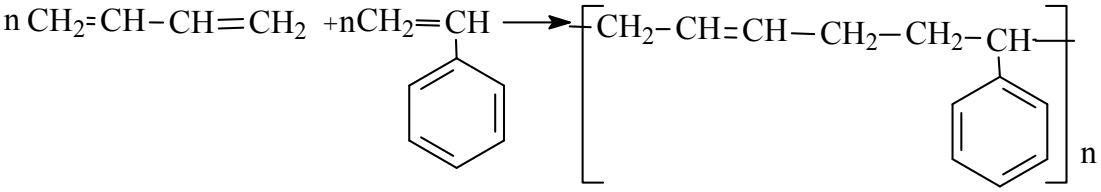


trans-izomer

4) Xloropren kauchuk:



5) Butadiyen stirol kauchuk:



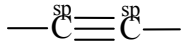
Tabiiy kauchuk asosan sis-izoprendan tuzulgan. U Braziliyadagi Geveya daraxtidan olinadi. Tabiiy kauchukning molekulyar massasi 200000 dan 400000 gacha bo‘ladi.

Kauchukning xossalarini yaxshilash uchun unga ishlov beriladi, ya’ni vulkanlanadi. Bunda oltingugurt qo‘shib qizdiriladi. Agar 32% dan kam S qo‘shilsa rezina, 32% dan ko‘p S qo‘shilsa ebonit hosil bo‘ladi. Shuningdek kauchukni “sovuq vulkanlash” uchun S_2Cl_2 ishlatiladi. Tabiiy kauchuk rezina olish uchun, sintetik kauchuk xo‘jalik mollari (shisha, penoplast, rezina asboblar) olishda ishlatiladi.

Mavzu: Alkinlar. Atsetilen qatori uglevodorodlari

Ta’rif: *Tarkibida bitta uchbog‘ tutgan ochiq zanjirli to‘yinmagan uglevodorodlarga alkinlar deyiladi.*

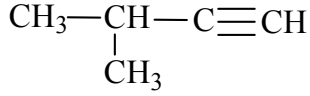
Ularning umumiy formulasi: C_nH_{2n-2}

Gibridlanishi – sp 

Nomlanishi va izomeriyasi:

Alkinlarni nomlash uchun tarkibida uchbog‘ tutgan eng uzun uglevodorod zanjiri tanlanib, uchbog‘ yaqin tomondan raqamlanadi va – *in* qo‘shimchasi qo‘shiladi.

$CH \equiv CH$	$CH_3 - C \equiv CH$	$CH \equiv C - C_2H_5$	$CH_3 - C \equiv C - CH_3$
etin, atsetilen	propin, metilatsetilen	butin, etilatsetilen	butin-2, dimetilatsetilen



3-metilbutin-1

Olinishi:

Alkinlar asosan parchalanish reaksiyalari yordamida olinadi.

1) Atsetilen CaC_2 ni gidroliz qilib olinadi:

$$CaC_2 + 2H_2O = Ca(OH)_2 + C_2H_2$$

2) Metan yoki etanni piroliz qilib olinadi:

$$2CH_4 \xrightarrow{1500°C} C_2H_2 + 3H_2$$

$$C_2H_6 \xrightarrow{t°C} C_2H_2 + 2H_2\uparrow$$

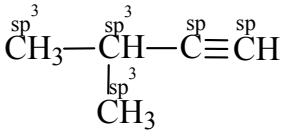
3) Atsetilenning gomologlari atsetilenni alkillab olinadi:

$$CH{\equiv}CH + Na \rightarrow CH \equiv C - Na + R - J \rightarrow CH_3 - C - R + NaJ$$

Fizikaviy xossalari:

C_2H_2 efir hidiga ega rangsiz gaz, C_4H_6 dan boshlab suyuqlik, $C_{12}H_{22}$ dan boshlab qattiq moddalardir.

Molekula tuzulishi:



1) sp^3 -3x4=12ta
2) sp -2x2=4ta
3) s -8ta
4) p-4ta

Kimyoviy xossalari:

Alkinlarda 2 ta π bog‘ bo‘lganligi uchun ular birikish reaksiyalariga oson kirishadi.

1) Alkinlar gidrogenlanib alken va alkanlarni hosil qiladi:

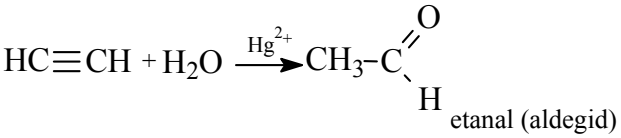
$$\underset{\text{etin}}{CH{\equiv}CH} + H_2 \xrightarrow{Ni} \underset{\text{eten}}{CH_2{=}CH_2} + H_2 \xrightarrow{Ni} \underset{\text{etan}}{CH_3{-}CH_3}$$

2) Atsetilen HCl bilan birikib vinilxloridni hosil qiladi:

$$CH{\equiv}CH + HCl \rightarrow \underset{\text{vinilxlorid}}{CH_2{=}CH{-}Cl}$$

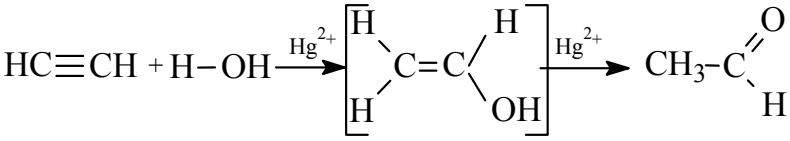
3) $CH_3{-}C{\equiv}CH + Br_2 \rightarrow \underset{\text{1,2-dibrompropen}}{CH_3{-}CBr{=}CHBr} \rightarrow \underset{\text{1,1,2,2-tetrabrompropan}}{CH_3{-}CBr_2{-}CHBr_2}$

4) Alkinlar $HgSO_4$ katalizatori ishtirokoda suv bilan birikadi. Bunda atsetilendan *sirka aldegid*, qolgan vakillaridan *ketonlar* hosil bo‘ladi. Bu reaksiyani M.G.Kucherov 1881 yil ochgan (Kucherov reaksiyasi).

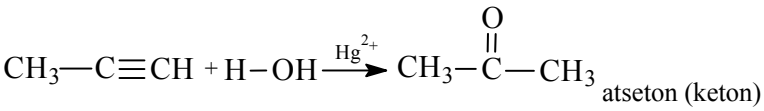


etanal (aldegid)

Reaksiya mexanizmi:



vinil spirt (beqaror) sirka aldegid



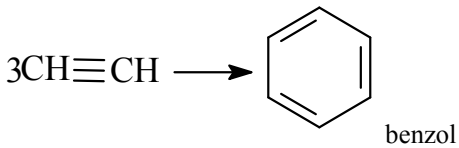
atseton (keton)

5) Alkinlar vodorod sianid bilan birikib alkilonitrillarni hosil qiladi:

$$CH{\equiv}CH + HCN \rightarrow \underset{\text{akrilonitril}}{H_2C{=}CH{-}C{\equiv}N}$$

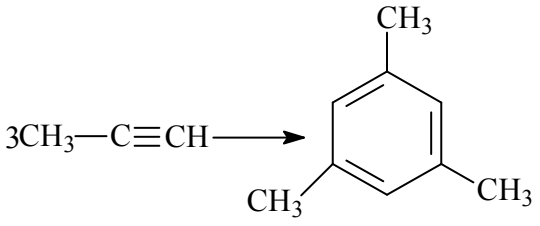
6) Alkinlar dimerlanish va polimerlanish reaksiyalariga kirishadi:

$$2HC{\equiv}CH \xrightarrow{Cu^+} \underset{\text{vinilatsetilen}}{HC{\equiv}C{-}CH{=}CH_2}$$



benzol

Bu reaksiyaga *Zelinskiy* reaksiyasi deyiladi.

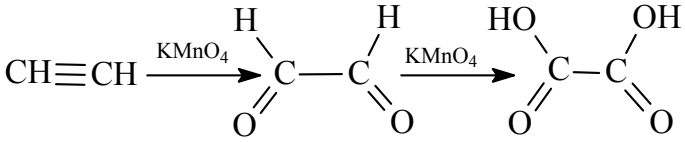


1,3,5-trimetilbenzol

7) Alkinlar og‘ir metallarning (I) valentli birikmalari bilan atsetilenidlarni hosil qiladi. Bunday reaksiya amalga oshishi uchun uchbog‘ birinchi o‘rinda (chetda) joylashishi kerak:

$$HC{\equiv}CH + 2Ag^{+} \rightarrow Ag{-}C{\equiv}C{-}Ag{\downarrow}$$
$$R{-}C{\equiv}CH + Cu{+} \rightarrow R{-}C{\equiv}C{-}Cu$$

8) Atsetilenning oxirgi oksidlanish mahsuloti oksalat kislota hisoblanadi:



glioksal oksalat kislota

9) Alkinlar yonganda suv va karbonat angidrid hosil bo‘ladi:

$$C_2H_2 + 2{,}5O_2 \rightarrow 2CO_2 + H_2O$$
$$C_nH_{2n-2} + 1{,}5n\text{-}0{,}5O_2 \rightarrow nCO_2 + n\text{-}1H_2O$$

Ishlatilishi:

Atsetilen PVX, poliakrilonitril, xloropren kauchuk, butadiyen kauchuk, sirka aldegid va sirka kislota olishda ishlatiladi. Atsetilen yonganda kuchli issiqlik ajralib chiqqanligi uchun u metallarni payvandlashda va qirqishda foydalaniladi.

Mavzu: Neftni qayta ishlash. Kreking jarayoni

Neft – turli uglevodorodlar aralashmasidan iborat yoqilg‘i sifatida ishlatiladigan foydali qazilma hisoblanadi.

Uning tarkibidagi uglevodorodlar soniga qarab 250-300°C da qaynaydi.

Neftning quyidagi turlari bor:

1) Metan neftlari – ko‘proq alkanlar tutadi;
2) Naften neftlari – ko‘proq sikloalkanlar tutadi;
3) Aralash neftlar – tarkibida alkan, naften va aromatik uglevodorodlar tutadi.

Shuningdek neft tarkibida *suv* va *yo‘ldosh gazlar* tutadi.

Neftning o‘rtcha zichligi 0,9g/ml atrofida bo‘ladi.

Neft *fraksion qayta ishlash* yo‘li bilan qayta ishlanadi. Ya’ni ular qaynash temperaturasiga ko‘ra ajratiladi. Bu jarayon *rektifikatsion kolonnada* olib boriladi. Bu kolonnada bug‘langan neft tarelkalarda kondensatlanadi.

Neftning asosiy fraksiyalari quyidagilar.

1) Benzin;
2) Kerosin;
3) Gazoyl;
4) Mazut.

Benzin fraksiyasi 150°C gacha olib boriladi. Bunda asosan uglerod soni 5-9 gacha bo‘lgan yengil uglevodorodlar ajraladi. Bunda 40-70°C da gazolin yoki *petroley efiri*, keyin qaynash temperaturasi 70-120°C bo‘lgan *benzin* ajraladi. Benzin fraksiyasida ichki yonuv dvigatellarida ishlatiladigan *aviatsiya* va *avtomobil benzini* olinadi.

Keyingi fraksiyada 120-140°C da qaynaydigan *ligroin* hosil bo‘ladi. Ligroin dizel yoqilg‘isi sifatida ishlatiladi.

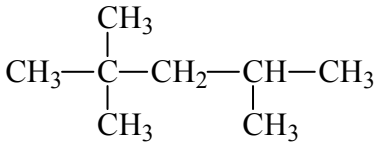
Kerosin fraksiyasida uglerod atomlari soni 9-11 gacha bo‘lgan uglevodorodlar bo‘ladi. Kerosin traktorlar uchun yoqilg‘i va uy-ro‘zg‘or ihslarida ishlatiladi.

Gazoyl fraksiyasida uglerod atomlari soni 11-16 gacha bo‘lgan uglevodorodlar bo‘ladi.

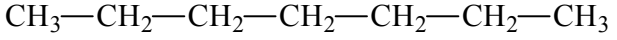
Mazut fraksiyasida atomlari soni 16 tadan ko‘p bo‘lgan uglevodorodlar bo‘ladi. Mazut(qoramoy) qayta haydaladi. Bundan *solyar moylari va surkov moylari* hosil bo‘ladi.

Qoramoy haydalgandan qolgan qoldiq *gudron* deyiladi va u *asfalt* sifatida ishlatiladi.

Benzinning eng muhim xusuiyati – *oktan soni* hisoblanadi. ya’ni izooktan va geptanga nisbatan olinadi.



2,2,4-trimetilpentan



n-geptan

Geptan qanchalik ko‘p bo‘lsa, benzin shuncha ko‘p *detonatsiyalanadi*. Uning oldini olish uchun antidetonator tetraeilqo‘rg‘oshin (TEQ) $Pb(C_2H_5)_4$ qo‘shiladi. Motor tubiga cho‘kkan qo‘rg‘oshinni tozalash uchun 1,2-dibrometan qo‘shiladi va qo‘rg‘oshin $PbBr_4$ holida atmosferaga chiqariladi. Bu esa atmosfera havosni ifloslanishiga sabab bo‘ladi.

Kreking

Neftdan olinayotgan benzin barcha iste’molchilar talabini qondirishga yetmaydi. Shuning uchun yuqori uglerod soniga ega uglevodorodlar *piroliz* qilinadi. Bu jarayon *kreking* (*crack* - parchalash) ham deyiladi.

Krekingni quyidagicha ifodalash mumkin:

Alkan → Alken + Alken

Kreking 2 xil bo‘ladi:

1) Termik kreking;
2) Katalatik kreking.

Termik krekingda temperatura 450°C dan yuqori bo‘ladi. Bunda yuqori uglerosli alkanlardan quyi alkan va alken hosil bo‘ladi:

$$C_{16}H_{34} \xrightarrow{t>450^\circ C} C_8H_{18} + C_8H_{16}$$

Katalitik kreking 450°C dan past temperaturada olib boriladi. Bunda katalizator sifatida $AlCl_3$ va alyumosilikatlar ishlatiladi.

Gazoyl → Yuqori oktan sonli benzin

Neftdan ajratib olingan benzinning oktan sonini oshirish uchun *rifroming* jarayonidan foydalaniladi. Riformingda tarmoqlanmagan uglevodorodlar tarmoqlangan uglevodorodlarga aylanadi. Bunda katalizator sifatida Al_2O_3 qo‘llaniladi.

Mavzu: Aromatik ugelvodorodlar – Arenlar

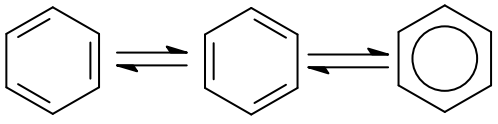
Ta’rif: *Tarkibida aromatik xalqa, ya’ni benzol xalqasi tutgan uglevodorodlarga aromatik uglevodorodlar ya’ni arenlar deyiladi.*

Umumiy formulasi: C_nH_{2n-6}. $n \geq 6$.

1825 yil M.Faradey toshko‘mirdan benzolni ajratib oladi va unda C va H atomlari 1:1 nisbatda ekanligini aniqlaydi.

Libix bu moddaga benzol nomini beradi.

Benzol o‘ziga xos hidga ega edi va u juda qiziqarli xossalarni namoyon qiladi. U juda “to‘yinmagan” bo‘lishiga qaramasdan birikish reaksiyalariga juda qiyin kirishadi va o‘rin olish

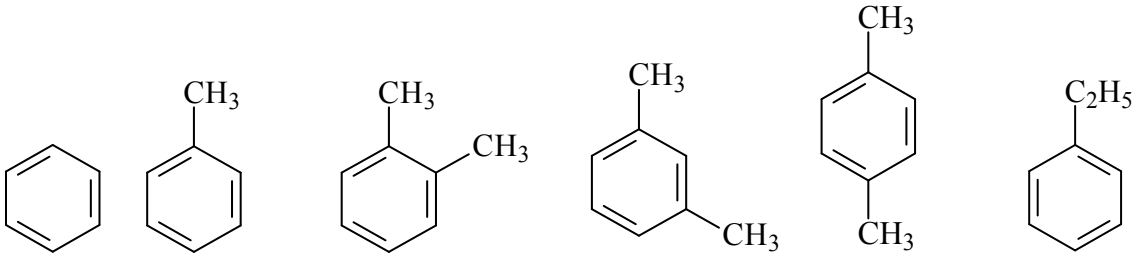


olish reaksiyalariga oson kirishadi. Shuning uchun benzol va hosilalari *aromatik uglevodorodlar* deb nomlanadi.

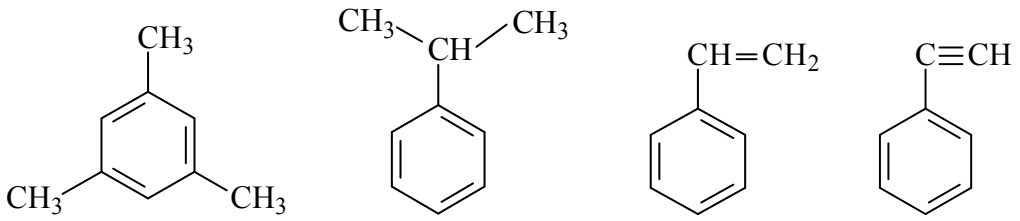
Benzolning tuzilishini 1865 yil nemis olimi A.Kekule taklif qilgan.

Nomlanishi va izomeriyasi:

Benzol va uning hosilalari benzol yadrosiga nisbatan nomlanadi. Bunda avval kichik radikal, so‘ngra kattaroq radikal nomlanadi.

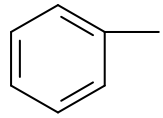


benzol | metilbenzol toluol | 1,2-dimetilbenzol o’-ksilol | 1,3-dimetilbenzol m’-ksilol | 1,2-dimetilbenzol p’-ksilol | etilbenzol

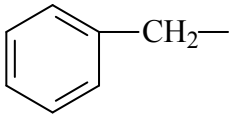


1,3,5-trimetilbenzol | izopropilbenzol kumol | vinilbenzol* stirol | fenilatsetilen*

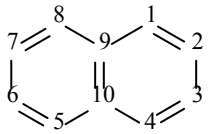
*vinilbenzol va fenilatsetilen benzol gomologi emas.



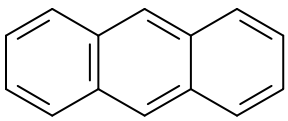
C_6H_5— fenil radikali



C_6H_5–CH_2— benzil radikali



naftalin



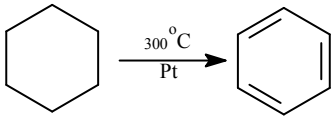
antratsen

Naftalinda 1,4,5,8- uglerodlar α, 1,3,6,7-uglerodlar β holat hisoblanadi.

Olinishi:

Dastlab arenlar toshko‘mirni quruq haydab olingan. Benzol va fenol neft tarkibida ham uchraydi.

1) Arenlar sikloalkanlarni degidrogenlab olinadi:

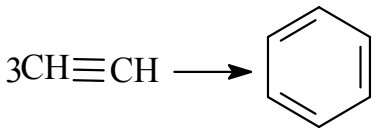


$C_6H_{12} \rightarrow C_6H_6 + 3H_2$

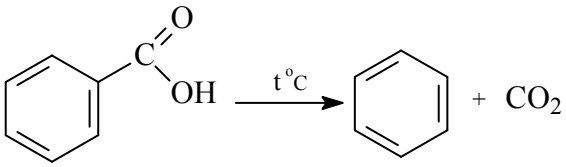
2) Alkanlarni degidrogenlab olinadi:

$$\underset{\text{geptan}}{CH_3–(CH_2)_5–CH_3} \xrightarrow{Al_2O_3,t°C} \underset{\text{toluol}}{C_6H_5–CH_3} + 4H_2$$

3) Atsetilenni trimerlab olinadi (Zelinskiy reaksiyasi):



4) Aromatik kislotalarni qizdirib olinadi (dekarboksillash):



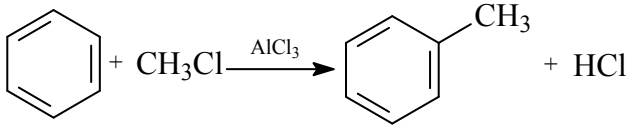
$C_6H_5–COOH \rightarrow C_6H_6 + CO_2$

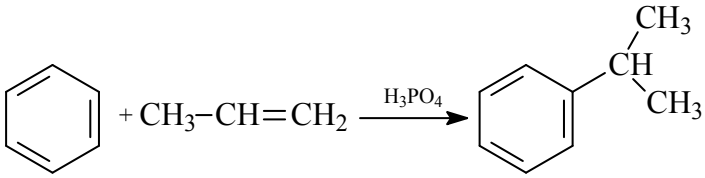
benzoy kislota benzol

5) Aromatik karbon kislota tuzlariga ishqor ta'sir ettirib olinadi:

$C_6H_5COONa + NaOH \rightarrow C_6H_6 + Na_2CO_3$

6) Benzol gomologlari Fridel-Krafts bo'yicha alkillab olinadi:





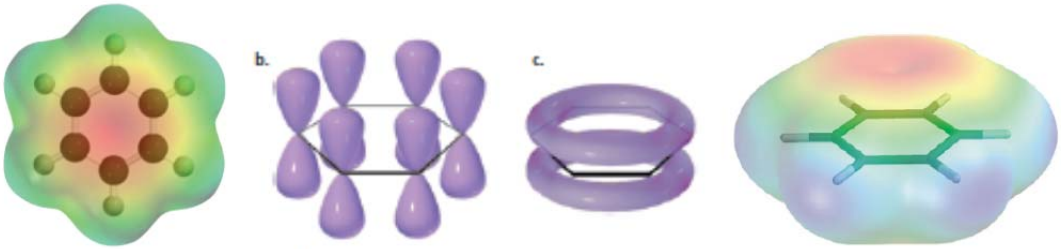
propen kumol

Fizikaviy xossalari:

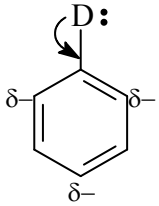
Benzol va gomologlari rangsiz suyuqliklar hisoblanadi. Yuqori vakillari kristall moddalardir.

Molekula tuzilishi:

Benzol yadrosidagi barcha uglerod atomlari sp^2 gibridlangan holda bo'ladi.



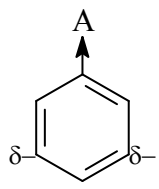
1) sp^2 – 6x3=18ta 2) p – 6tas – 6ta



Benzol yadrosiga 2 xil o'rinbosarlar ta'sir qiladi.

1) I tur o'rinbosarlar – *elektrodonor* guruhlar. *o'*- va *p'*- holat elektron buluti zichligini kuchaytiragi. Ularga $–CH_3$ (Alk), $-CH=CH_2$, -OH, $-NH_2$, -F, -Cl, -Br va –J kiradi.

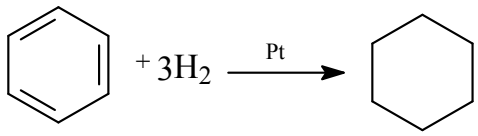
2) II tur o'rinbosarlar – *elektroakseptor* guruhlar. Ular *m'*- holatga yo'naltiradi. Ularga $-NO_2$, -CHO, -COOH, -CN va $–SO_3H$ kiradi.



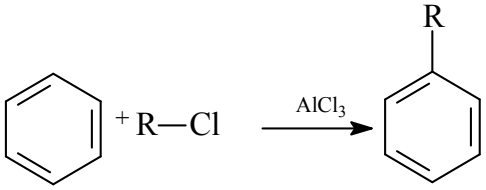
Kimyoviy xossalari:

Benzol va uning gomologlari uchun *o‘rin olish* reaksiyasi xarakterli. Chunki aromatik xalqa barqarorlikni ta’minlaydi.

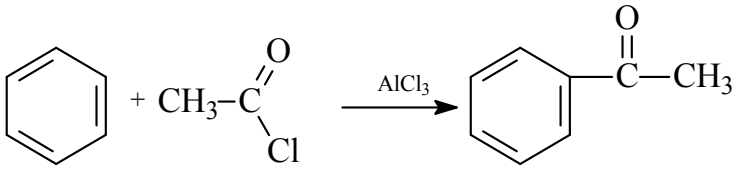
1) Benzol gidrogenlanganda siklogeksan hosil bo‘ladi:



2) Benzol galogenoalkanlar bilan alkillanish reaksiyasiga kirishadi:

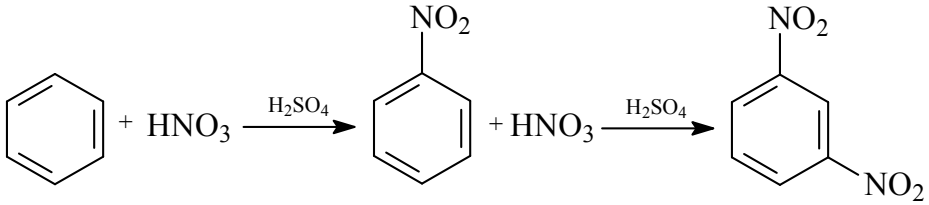


3) Benzol Fridel-Krafts katalizatori ishtirokida xlorangidridlar bilan atsillanib arilketonlarni hosil qiladi:



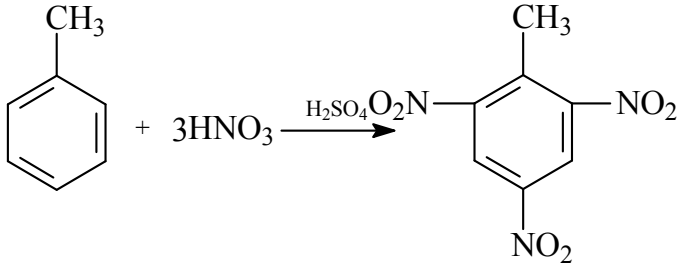
metilfenilketon

4) Benzol va uning gomologlari nitrolovchi aralashma (HNO_3 + H_2SO_4) ta’sirida nitrobirikmlarni hosil qiladi:



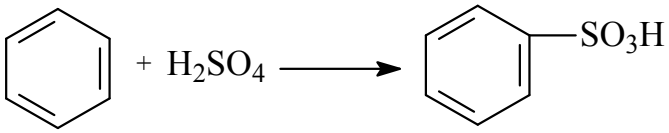
nitrobenzol 1,3-dinitrobenzol

5) Toluol nitrolanganda trinitrotoluol (TNT) hosil bo‘ladi. TNT kuchli portlovchi modda:



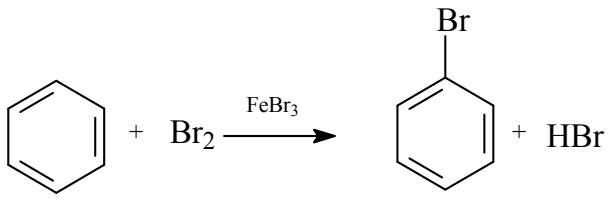
2,4,6-trinitrotoluol – TNT

6) Benzol kons. H_2SO_4 bilan qizdirilganda reaksiyaga kirishadi:

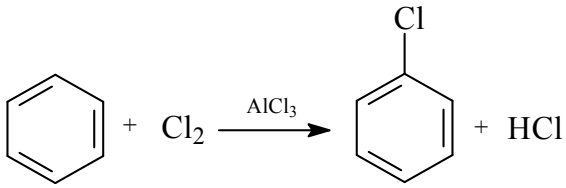


benzolsulfo kislota

7) Benzol va uning gomologlari galogenlanish reaksiyasiga oson kirishadi.
   a) Reaksiya $FeBr_3$ yoki $AlCl_3$ ishtirokida borganda o‘rin olish reaksiyasi sodir bo‘ladi:

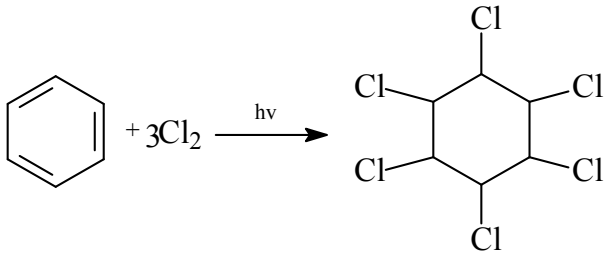


brombenzol



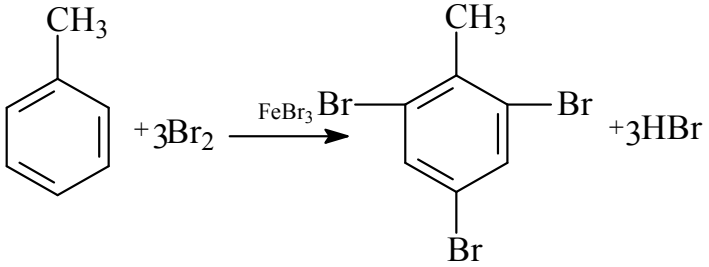
xlorbenzol

b)Benzol ultrabinafsha nurlar ta’sirida xlorlanganda birikish reaksiyasi sodir bo‘ladi:



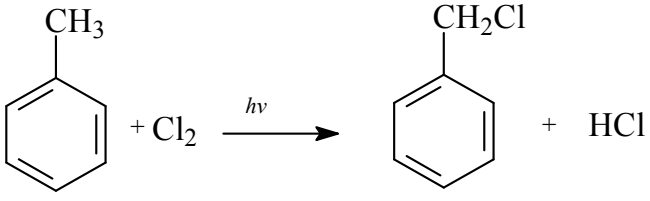
geksaxlorsiklogeksan, geksaxloran

c) Toluol katalizator ishtirokida galogenlanganda trigalogenli hosila hosil bo‘ladi:



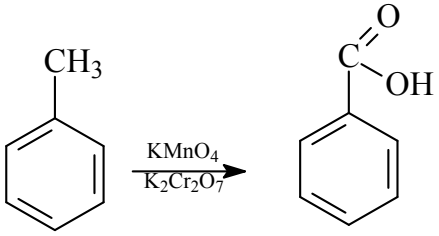
2,4,6-tribromtoluol

d)Toluol quyosh nurlari ishtirokida xlorlanganda xlor yon zanjirga birikadi:

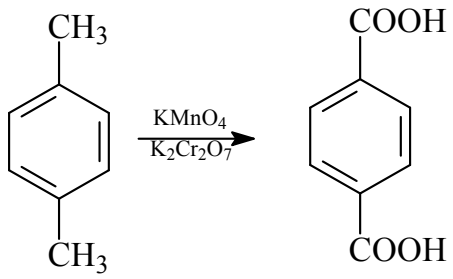


benzilxlorid

8) Benzol hosilalari oksidlanganda xalqadagi o‘rinbosarlar soniga ko‘ra aromatik mono- va dikarbon kislotalar hosil bo‘ladi. Oksidlovchi sifatida $KMnO_4$ yoki $K_2Cr_2O_7$ qo‘llaniladi:

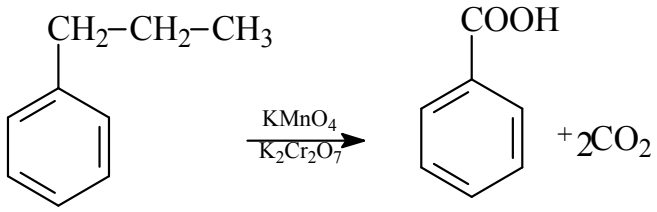


benzoy kislota



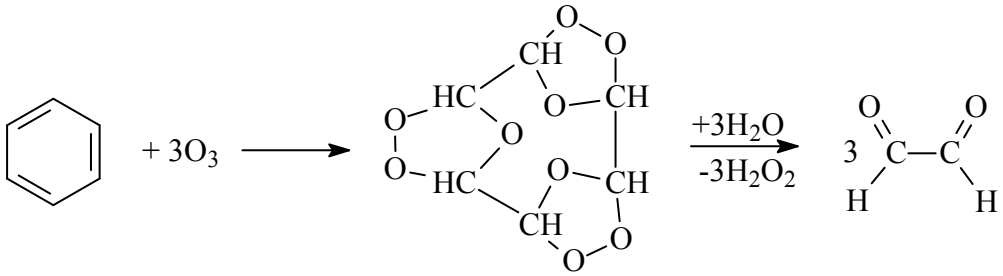
tereftal kislota

Shunisi muhimki, bitta o‘rinbosarli hosilada uglerod sonidan qat’iy nazar benzoy kislota hosil bo‘ladi. Qolgan uglerodlar CO_2 ko‘rinishida ajralib chiqadi:

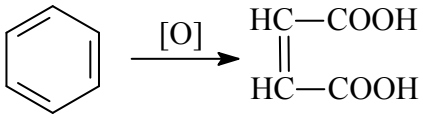


$$5C_6H_5–CH_2–CH_2–CH_3 + 18KMnO_4 + 28H_2SO_4 = 5C_6H_5–COOH + 10CO_2 + 9K2_SO_4 + + 18MnSO_4 + 42H_2O$$

9) Benzolga ozon ta’sir ettirilganda triozonid hosil bo‘ladi:

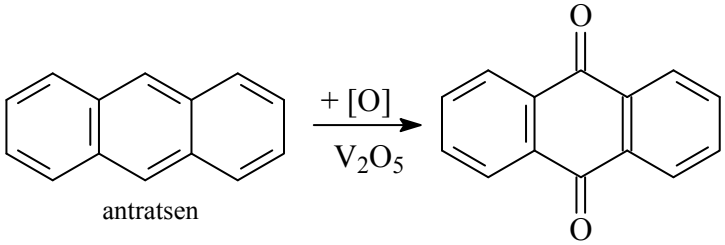


10) Yuqori remperaturada V_2O_5 ishtirokida benzol oksidlanib malein kislotani hosil qiladi:



$$+ 2CO_2 + H_2O$$

11) Antratsen oksidlanganda antraxinon hosil bo‘ladi:



antratsen

12) Arenlar yonganda suv va karbonat angidrid hosil bo‘ladi:

$$C_6H_6 + 7{,}5O_2 = 6CO_2 + 3H_2O$$

$$C_nH_{2n-6} + 1{,}5n\text{-}1{,}5O_2 = nCO_2 + n\text{-}3H_2O$$

Ishlatilishi:

Benzol erituvchi sifatida ishlatiladi. Unda yog‘, kauchuk va laklar yaxshi eriydi. Kumol atseton va fenol olishda oraliq mahsulot hisoblanadi. Stirol polistirol kauchuk olishda ishlatiladi. Geksaxloran insektitsid sifatida ishlatiladi.

III BOB. KISLOROD SAQLOVCHI ORGANIK BIRIKMALAR

Mavzu: Spirtlar

Ta'rif: *Tarkibida uglevodorod radikali bilan bog'langan gidroksil guruh –OH tutgan organik birikmalar sinfiga spirtlar deyiladi.*

Spirtlar radikal tabiatiga ko'ra to'yingan va to'yinmagan spirtlarga bo'linadi. Gidroksil guruh soniga ko'ra esa bir va ko'p atomli spirtlarga bo'linadi.

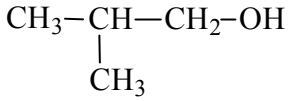
To'yingan bir atomli spirtlarning umumiy formulasi $C_nH_{2n+1}OH$.

Nomlanishi va izomeriyasi:

Spirtlarni nomlash uchun gidroksil guruh yaqin tomondan raqamlanib, tegishli alkan nomiga *–ol* qo'shimchasi qo'shiladi.

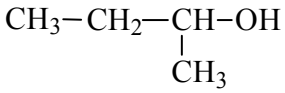
CH_3OH methanol, metil spirt

$CH_3–CH_2–CH_2–CH_2–OH$ butanol-1, butil spirt



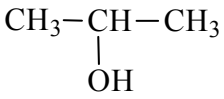
2-metilpropanol-1, izopropil spirt

C_2H_5OH etanol, etil spir

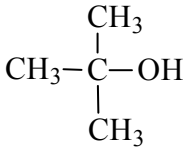


butanol-2, ikkilamchi butil spirt

$CH_3–CH_2–CH_2–OH$ propanol-1, propil spirt



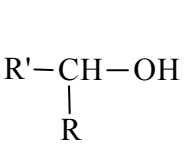
propanol-2, izopropil spirt



2-metilpropanol-2, uchlamchi butil spirt

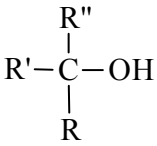
$C_5H_{11}–OH$ pentanol, amil spirt

Gidroksil guruh bilan bog'langan uglerod xarakteriga ko'ra birlamchi, ikkilamchi va uchlamchi spirtlarga bo'linadi:



birlamchi

ikkilamchi



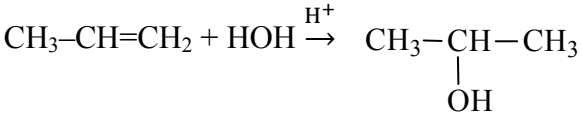
uchlamchi

Olinishi:

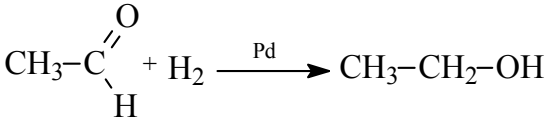
1) Galogenalkanlarga ishqorning suvli eritmasi ta'sir ettirib:

$$CH_3–Cl + NaOH \xrightarrow{H_2O} CH_3–OH + NaCl$$

2) Alkenlarni gidroliz qilib olinadi:

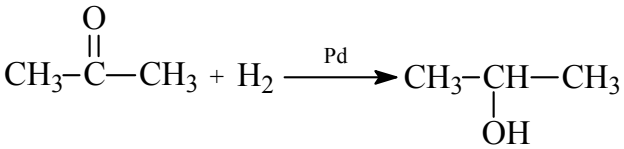


3) Aldegid va ketonlarni gidrogenlab olinadi. Aldegidlar gidrogenlanganda birlamchi, ketonlar gidrogenlanganda ikkilamchi spirtlar hosil bo'ladi:



etanal

etanol



propanon

propanol-2

4) Metanol sintez gazidan olinadi:

$$CO + 2H_2 \xrightarrow{ZnO,\ CuO} CH_3OH$$

5) Etanol glyukozaning spirtli bijg‘ishidan hosil qilinadi:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

Fizikaviy xossalari:

Spirtlarning quyi vakillari rangsiz suyuqliklar, yuqori vakillari kristall moddalardir. Ular o‘zaro va suv molekulalari bilan molekulalararo vodorod bog‘lanish hosil qiladi.

Molekula tuzilishi:

To‘yingan bir atomli spirtlarda uglerod atomlari sp^3 gibridlangan holda bo‘ladi:

$CH_3–CH_2–OH$ 1) sp^3 – 2x4=8ta 2) s – 6ta

Kimyoviy xossalari:

Alkanollar uchun gidroksil guruh –O–H va radikal bo‘yicha boradigan reaksiyalar farq qiladi.

1) Alkanollar juda kuchsiz kislota xossasini namoyon qiladi. ular ishqoriy metallar bilan alkogolyatlar hosil qiladi:

$$CH_3OH + Na \rightarrow \underset{\text{natriy metilat}}{CH_3ONa} + {}^1/_2H_2$$

2) Spirtlar karbon kislotalar bilan ta’sirlashib murakkab efirlarni hosil qiladi. reaksiya kislotali muhitda amalga oshadi. Bunda spirtning RO–H bog‘i uziladi:

$$CH_3COOH + C_2H_5OH \overset{H^+}{\Leftrightarrow} \underset{\text{etilatsetat}}{CH_3COOC_2H_5} + H_2O$$

3) Spirtlarga galogenovodrodlar ta’siridan alkilgalogenidlar hosil bo‘ladi:

$$R–OH + H–Г \rightarrow R–Г + HOH$$

$$C_2H_5OH + HCl \rightarrow C_2H_5Cl + H_2O$$

4) Spirtlar sulfat kislota ishtirokida 140°C da qizdirilganda molekulalararo degidratlanib oddiy efirlar hosil bo‘ladi:

$$2C_2H_5OH \xrightarrow{t<140^\circ C} \underset{\text{dietil efir}}{C_2H_5–O–C_2H_5} + H_2O$$

5) Spirtlar sulfat kislota ishtirokida 170°C da qizdirilganda ichki molekulyar degidratlanib alkenlar hosil bo‘ladi:

$$CH_3–CH_2–OH \xrightarrow{t>140^\circ C} \underset{\text{eten}}{CH_2=CH_2} + H_2O$$

6) Spirtlar CuO yoki ZnO ishtirokida oksidlanganda karbonil birikmalar hosil bo‘ladi.

a) Birlamchi spirtlar oksidlanganda aldegidlar hosil bo‘ladi:

$$CH_3–CH_2–OH \xrightarrow{CuO} CH_3–\underset{\displaystyle H}{\overset{\displaystyle O}{\overset{\displaystyle \parallel}{C}}}$$

b) Ikkilamchi spirtlardan esa ketonlar hosil bo‘ladi:

$$CH_3–\underset{\displaystyle OH}{\underset{|}{CH}}–CH_3 \xrightarrow{CuO} CH_3–\overset{\displaystyle O}{\overset{\displaystyle \parallel}{C}}–CH_3$$

c) Uchlamchi spirtlar oksidlanishga chidamli. Lekin kuchli oksidlovchilar ta’sirida oksidlanib C−C bog‘i uziladi:

$$CH_3–\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle OH}{\overset{|}{C}}}}–CH_3 \xrightarrow{[O]} CH_3–\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2 \xrightarrow{[O]} \underset{\text{propanon}}{CH_3–\underset{\displaystyle CH_3}{\underset{|}{C}}=O} + \underset{\text{metanal}}{O=CH_2}$$

7) Spirtlar yonganda suv va karbonat angidrid hosil bo‘ladi:

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

$$C_nH_{2n+1}OH + 1{,}5nO_2 \rightarrow nCO_2 + n{+}1H_2O$$

Ishlatilishi:

Methanol asosan erituvchi sifatida va formaldegid olish uchun ishlatiladi. U juda kuchli zahar (5ml ko‘r qiladi, 30ml o‘limga olib keladi).

Etanol oziq-ovqat sanoatida, erituvchi sifatida, Lebedev usulida butadiyen kauchuk olishda, sirka aldegid va etilatsetat olishda ishlatiladi.

Propanol va butanol lak va kraskalarni eritishda ishlatiladi.

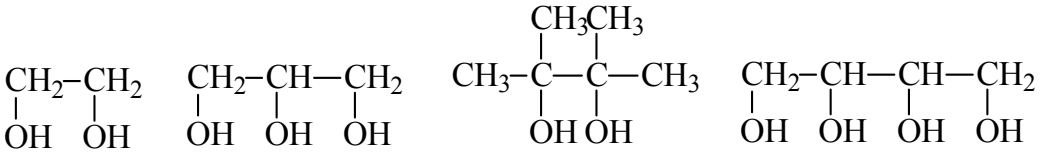
Mavzu: Ko‘p atomli spirtlar

Ta’rif: *Tarkibida ikki yoki undan ortiq gidroksil guruh –OH tutgan organik moddalarga ko‘p atomli spirtlar deyiladi.*

Umumiy formulasi: $R(OH)_n$ n= 2, 3, 4…

Nomlanishi va izomeriyasi:

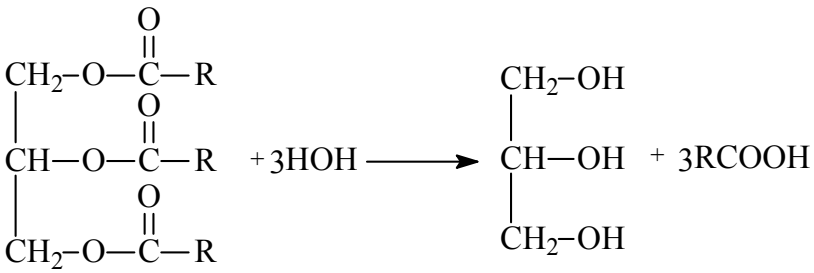
Ko‘p atomli spirtlarni nomlash uchun gidroksil guruhlar tutgan eng uzun uglevodorod zanjiri tanlanib, tegishli gidroksil guruhlar soniga *–ol* qo‘shimchasi qo‘shiladi.



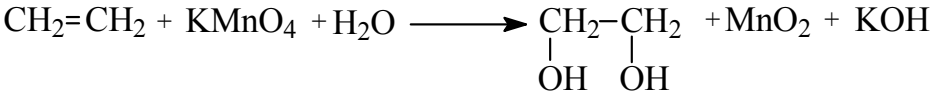
etandiol-1,2 glikol, etilenglikol | propantriol-1,2,3 glitserin | 2,3-dimetilbutandiol-2,3 | butantetraol-1,2,3,4

Olinishi:

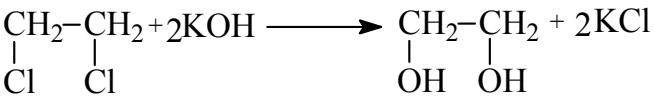
1) Glitserin yog‘larni gidroliz qilib olinadi:



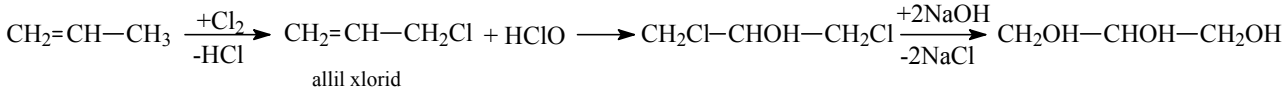
2) Etilenglikol etilenni $KMnO_4$ ning suvli eritmasi bilan oksidlab olinadi:



3) Glikol 1,2-dixloretanni ishqorning suvli eritmasi bilan ta’siridan olinadi:



4) Sanoatda glitserin propilendan olinadi:

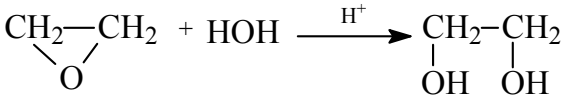


allil xlorid

5) Glitserinni oddiy qand bijg‘ishidan ham olish mumkin:

$$C_6H_{12}O_6 \rightarrow CH_2OH{-}CHOH{-}CH_2OH + CH_3COH + CO_2$$

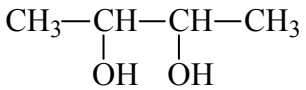
6) Etilenoksidni kislotali muhitda suv bilan ta’siridan olinadi:



Fizikaviy xossalari:

Etilenglikol rangsiz qovushqoq suyuqlik. Suv bilan har qanday nisbatda aralashadi. Zaharli. Glitserin qovushqoq shirin ta'mli rangsiz suyuqlik. Suv bilan har qnday nisbatda joylashadi.

Molekula tuzilishi:



Ko'p atomli spirtlarda barcha uglerod atomlari sp^3 gibridlangan holda bo'ladi.

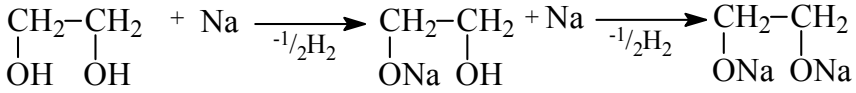
sp^3 – 4x4=1

s – 10ta

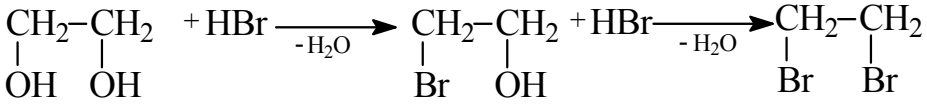
Kimyoviy xossalari:

Ko'p atomli spirtlar bir atomli spirtlar kabi xossalarga ega.

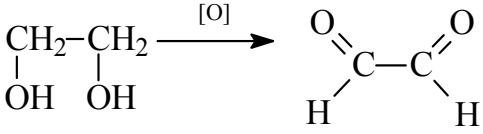
1) Ko'p atomli spirtlar aktiv metallar bilan alkogolyatlar hosil qiladi:



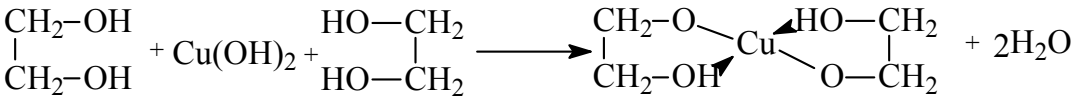
2) Ularning gidroksil guruhi galogenovodorodlar ta'sirida almashinadi:



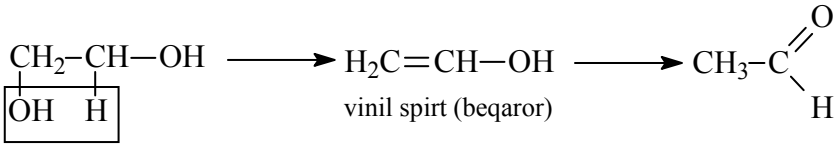
3) Etilenglikol oksidlanganda glioksal hosil bo'ladi:



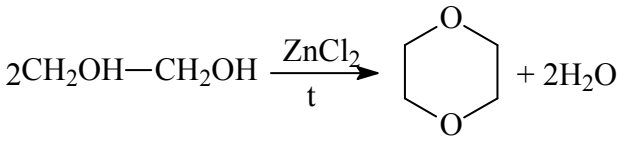
4) Glikollar yangi tayyorlangan $Cu(OH)_2$ bilan kompleks tuz hosil qiladi. bu reaksiyadan glikollarni aniqlashda foydalaniladi.



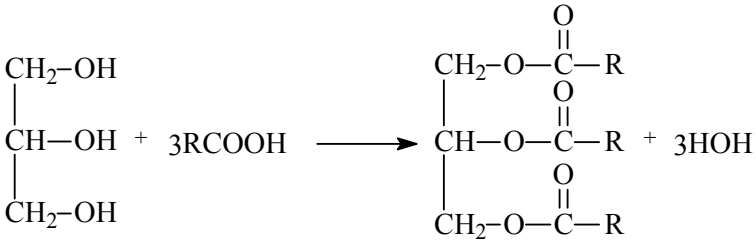
5) Etilenglikol ichki molekulyar degidratlanganda sirka aldegid hosil bo'ladi:



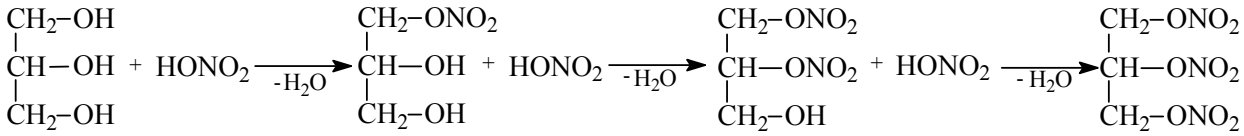
6) Etilenglikol molekulalararo degidratlanganda dioksan hosil bo'ladi:



7) Glitserin anorganik va organik kislotalar bilan murakkab efirlarni hosil qiladi. bunda mono, di- va tri- almashgan efirlar hosil bo'ladi:



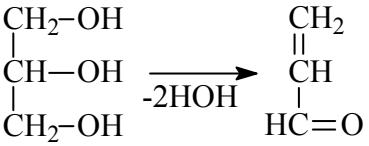
8) Glitserin nitrolanganda nitroefirlar hosil bo‘ladi:



mononitroglitserin dinitroglitserin trinitroglitserin

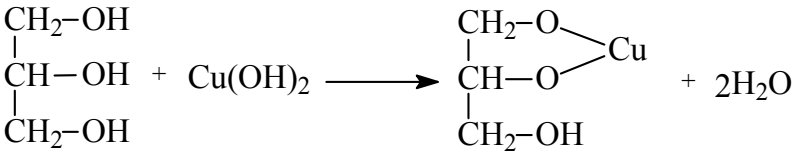
Trinitroglitserin kuchli portlovchi modda. Undan dinamit tayyorlanadi (A.Nobel).

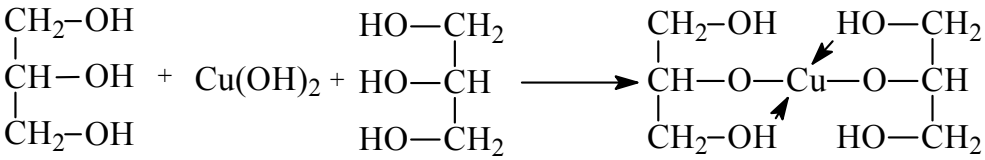
9) Glitserin $KHSO_4$ ta’sirida yuqori temperaturada degidratlanib, akroleinni hosil qiladi:



glitserin akrolein

10) Glitserin yangi tayyorlangan $Cu(OH)_2$ bilan glitserat hosil qiladi:





Ishlatilishi:

Etilenglikol antifriz, tormoz suyuqligi, poliefir tola (lavsan) olishda ishlatiladi. Glitserinni 1779 yili Sheele olgan. U dinamit tayyorlashda, poliefirlar olishda, kosmetika sanoati va meditsinada ishlatiladi.

Mavzu: Oddiy efirlar

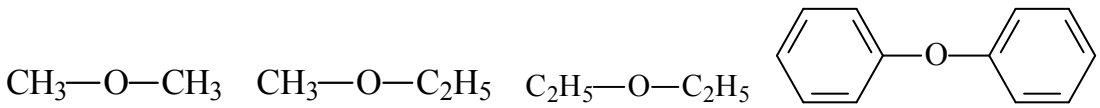
Ta’rif: *Ikkita uglevodorod radikali kislorod ko‘prigi (-O-) orqali bog‘langan organik moddalar sinfiga oddiy efirlar deyiladi.*

Umumiy formulasi: R–O–R’

R – radikal to‘yingan, to‘yinmagan yoki aromatik bo‘lishi mumkin.

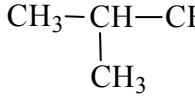
Nomlanishi va izomeriyasi:

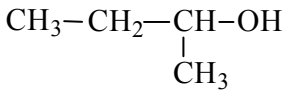
Oddiy efirlarni nomlash uchun avval kichik radikal, so‘ngra kattaroq radikal nomi aytilib, *efir* so‘zi qo‘shiladi.



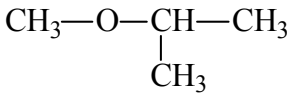
dimetil efir metiletil efir dietil efir difenil efir

To‘yingan efirlar to‘yingan bir atomli spirtlarga izomer hisoblanadi. Masalan, $C_4H_{10}O$ formulaga quyidagi spirt va oddiy efirlar mos keladi:

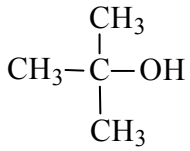
Spirt	*Oddiy efir*
$CH_3–CH_2–CH_2–CH_2–OH$ butanol-1	$C_2H_5—O—C_2H_5$ dietil efir
 2-metilpropanol-1	$CH_3—O—CH_2—CH_2—CH_3$ metilpropil efir



butanol-2



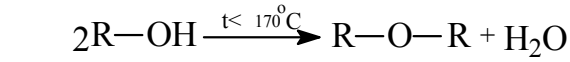
metilizopropil efir

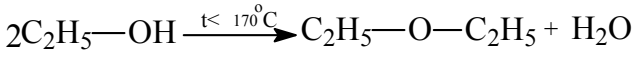


2-metilpropanol-2

Olinishi:

1) Spirtlarni pastroq temperaturada ichki molekulayar degidratlab olinadi:





2) Alkogolyatlarga alkilgalogenidlar ta'sir ettirib olinadi:

$$R–CH_2–ONa + Г–CH_2–R' \rightarrow R–CH_2–O–CH_2–R' + NaГ$$

Fizikaviy xossalari:

Oddiy efirlar oz'iga xos hidli, rangsiz suyuqliklar hisoblanadi. Ularning qaynash temperaturasi tegishli spirtlarnikiga qaraganda past. Chunki ularda vodorod bog'lanish yo'q.

Kimyoviy xossalari:

Oddiy efirlar asosan donor-akseptor bog'lanish hisobiga moddalar hosil qiladi.

Ishlatilishi:

Dietil efir metalorganik birikmalarni eritishda erituvchi sifatida va meditsinada umumiy narkoz sifatida ishlatiladi.

Mavzu: Fenollar

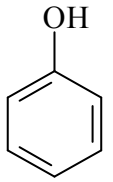
Ta'rif: *Benzol yadrosi bilan bevosita bog'langan gidroksil guruh –O–H ga ega organik moddalar sinfiga fenollar deyiladi.*

Ularning umumiy formulasi: Ar–OH.

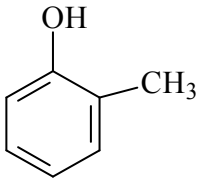
Benzol yadrosi uglerodlari sp^2 gibridlangan.

Nomlanishi va izomeriyasi:

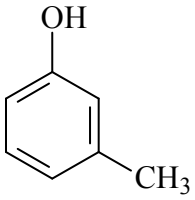
Fenollarni nomlash uchun tegishli aren nomiga *–ol* qo'shimchasi qo'shiladi.



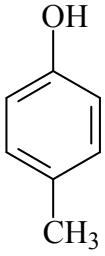
fenol, gidroksibenzol
karbol kislota



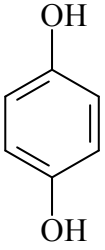
2-metilfenol
o'-krezol



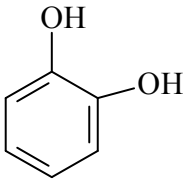
3-metilfenol
m'-krezol



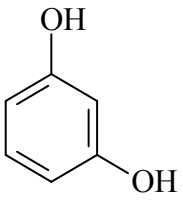
4-metilfenol
p'-krezol



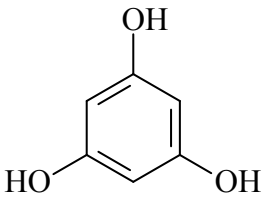
gidroxinon



pirokatexin



rezortsin

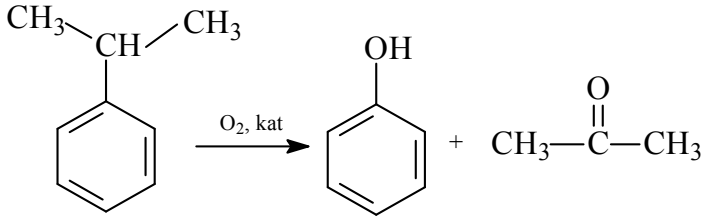


floroglutsin

Olinishi:

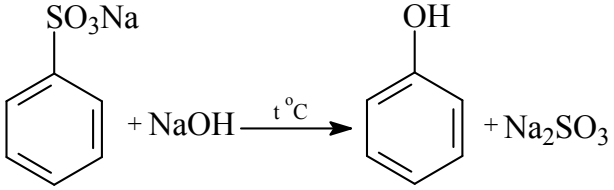
Fenol va uning gomologlari toshko‘mir smolasidan, shuningdek sintez usulida olinadi.

1) Fenol kumolni katalitik oksidlab olinadi:

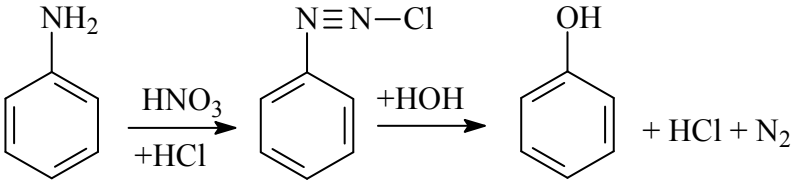


fenol, gidroksibenzol atseton

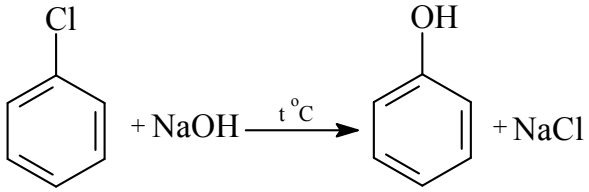
2) Aromatik sulfokislota tuzlariga ishqor qo‘shib suyuqlantirib olinadi:



3) Birlamchi aromatik aminlarga nitrat kislota ta’sir ettirib olinadi:



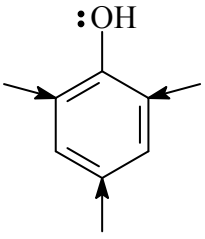
4) Fenol xlorbenzolga 350°C da yuqori bosimda NaOH eirtmasi ta’sir ettirib olinadi:



Fizikaviy xossalari:

Ko‘pchilik fenollar rangsiz moddalar hisoblanadi. Ular o‘ziga xos hidga ega.

Molekula tuzilishi:

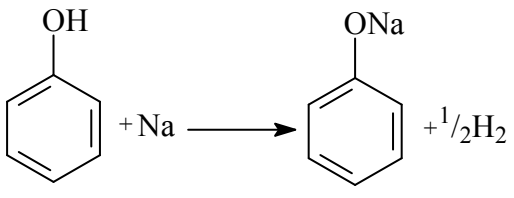


Fenol molekulasida benzol yadrosi uglerodlari sp^2 gibridlangan holda bo‘ladi. OH guruh I tur o‘rinbosar (elektrodonor) hisoblanadi. Shuning uchun o‘- va p’- holatlar aktiv bo‘ladi.

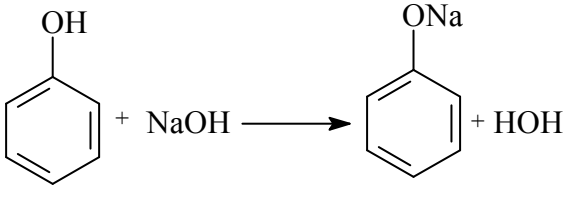
Kimyoviy xossalari:

Fenollar uchun benzol yadrosiga va gidroksil guruh bo‘yicha amalga oshadigan reaksiyalar farqlanadi.

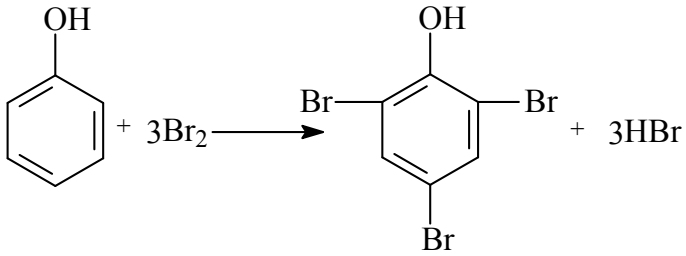
1) Fenollar spirtlarga qaraganda kuchliroq kislotalik xossasini namoyon qiladi. Shuning uchun ular ishqoriy metallar va ishqorlar bilan ta’sirlashib fenolyatlarni hosil qiladi:



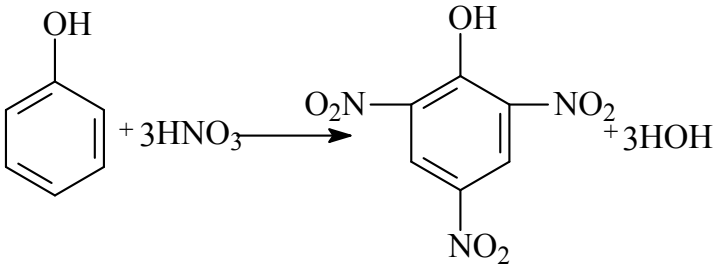
natriy fenolyat



2) Fenollar osonlik bilan galogenlanadi:

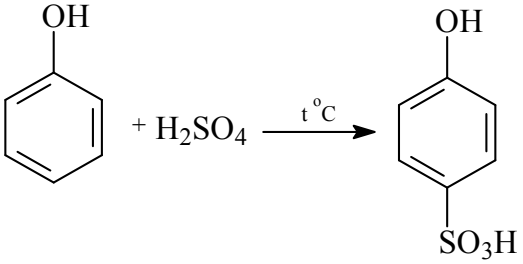


3) Fenol kons. nitrat kislota bilan ta'sirlashib trinitrofenol – kuchli portlovchi moddani hosil qiladi:



2,4,6-trinitrofenol, pikrin kislota

4) Fenol kons. sulfat kislota bilan qizdirilganda reaksiyaga kirishadi:

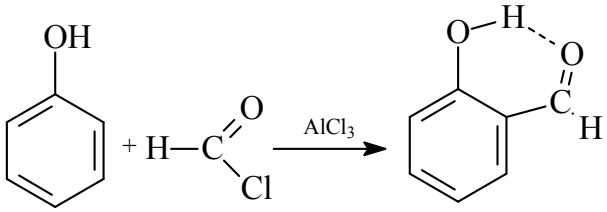


p'-fenolsulfokislota

5) Fenolning kislotalik xossasi karbonat kislotanikidan ham kcihik bo'lganligidan, fenolyatlarga karbonat kislota ta'siridan fenol hosil bo'ladi:

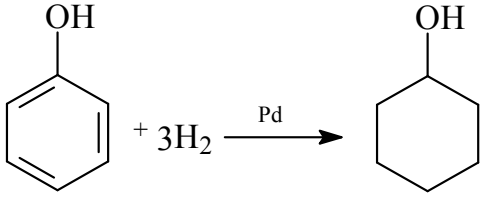
$$C_6H_5ONa + CO_2 + H_2O \rightarrow C_6H_5OH + NaHCO_3$$

6) Fenol Fridel-Krafts katalizatori ishtirokida osonlik bilan atsillanadi:



formilxlorid salitsil aldegid

7) Fenol katalitik gidrogenlanganda siklogeksanol hosil bo'ladi:



siklogeksanol

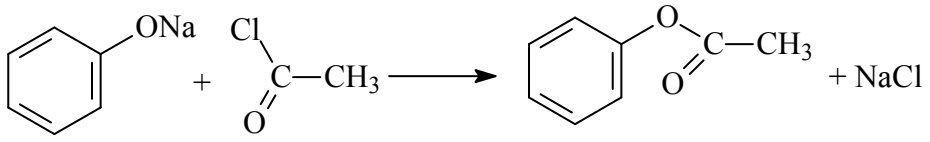
8) Fenollar yonganda suv va karbonat angidrid hosil bo'ladi:

$$C_6H_5–OH + 7O_2 \rightarrow 6CO_2 + 3H_2O$$

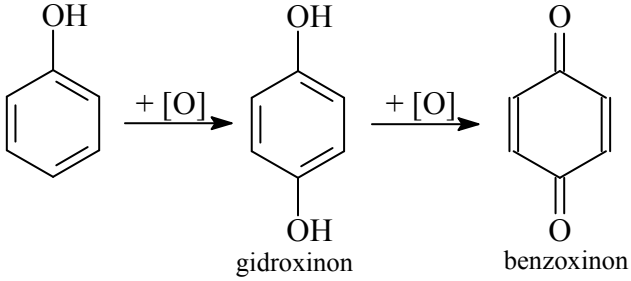
9) Fenolning oddiy efirlarini olish uchun galogenli hosilalar mis kukuni katalizatori ishtirokida ta’sir ettiriladi:

$$C_6H_5ONa + R{-}I \rightarrow C_6H_5{-}O{-}R + NaI$$

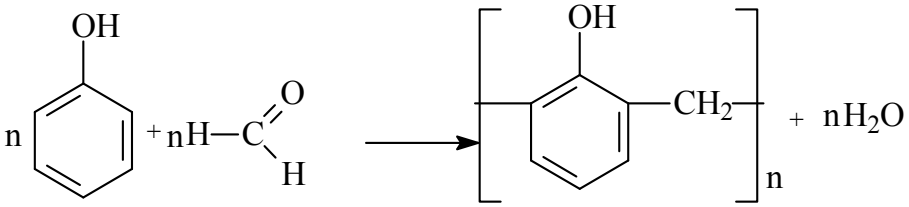
10) Fenolyatlarga kislota anidridlari yoki galogen angidridlar ta’sir ettirilsa, murakkab efirlar hosil bo‘ladi:



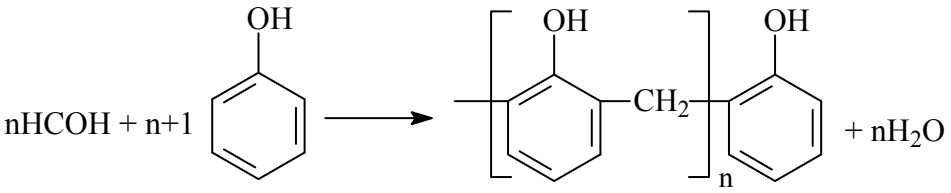
11) Fenol oksidlanganda gidroxinon va benzoxinon hosil bo‘ladi:



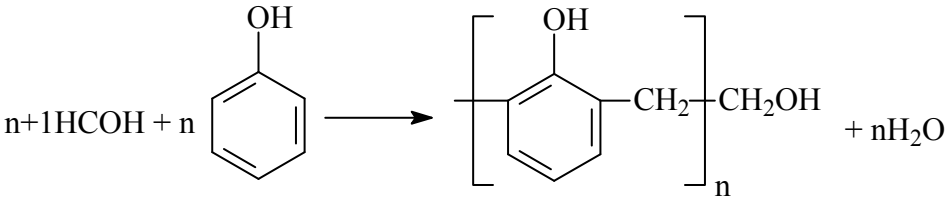
12) Fenol metanal bilan sopolimerlanib fenolformaldegid smolasini hosil qiladi:



Bunda fenol miqdori ko‘p bo‘lsa, novolak, formaldegid ko‘p bo‘lsa rezol smolasi hosil bo‘ladi:

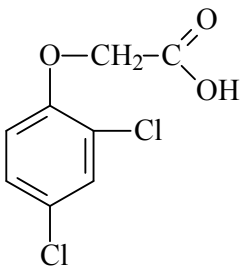


novolak smolasi



rezol smolasi

Ishlatilishi:



Fenolning ko‘p qismi fenolformaldegid smolasi olsih uchun ishlatiladi. Fenol shuningdek antiseptik sifatida ham ishlatiladi. U terini ya’llig‘laydi.

Krezollar bo‘yoqlar sifatida ishlatiladi. Salitsil kislotasi farmasevtikada qo‘llaniladi. 2,4-dixlorfenoksisirka kislota va uning natriyli tuzi gerbitsid sifatida ishlatiladi.

Sifat reaksiya:

Eritmada fenol borligi $FeCl_3$ eritmasi bilan aniqlanadi. Bunda binafsha rangli kompleks hosil bo‘ladi.

Mavzu: Karbonil birikmalar

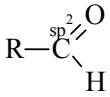
Ta'rif: *Tarkibida karbonil guruh*  *tutgan birikmlarga karbonil birikmalar deyiladi.*

Karbonil birikmalar 2 ga bo'linadi:

1) Aldegidlar
2) Ketonlar.

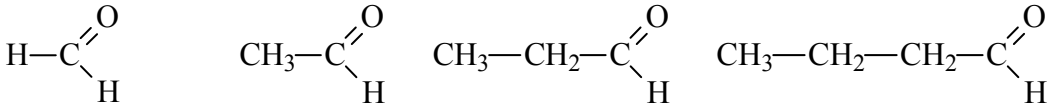
Mavzu: Aldegidlar

Ta'rif: *Tarkibida aldegid*  *guruh tutgan organik moddalarga aldegidlar deyiladi.*

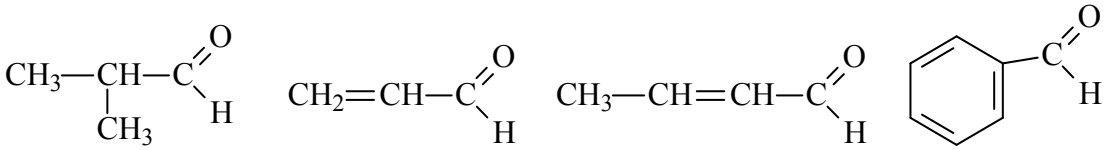
Umumiy formulasi: 

Nomlanishi va izomeriyasi:

Aldegidlarni nomlash uchun karbonil guruh tutgan eng uzun uglevodorod zanjiri tanlanib, aldegid guruh uglerodi 1 raqamli deb olinadi. Tegishli uglevodorod nomiga *–al* qo'shimchasi qo'shiladi.



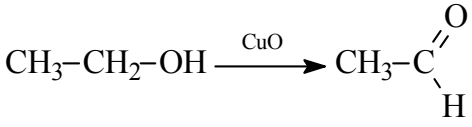
metanal, formaldegid chumoli aldegid — etanal sirka aldegid — propanal propion aldegid — butanal moy aldegid



2-metilpropanal izomoy aldegid — propenal akrolein — buten-2-al kroton aldegid — benzaldegid

Olinishi:

1) Birlamchi spirtlarni oksidlab olinadi:

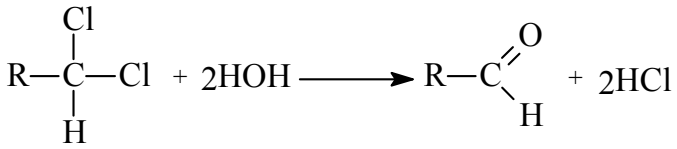


etanol — etanal

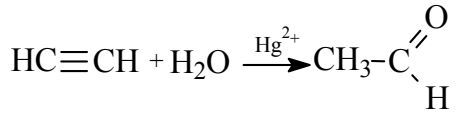
2) Formaldegid metanni 450°C da $AlPO_4$ yoki NO_x katalizatorlari ishtirokida oksidlab olinadi:

$$CH_4 \xrightarrow{[O]} HCOH + H_2O$$

3) Digalogenalkanlarni gidroliz qilib olinadi:



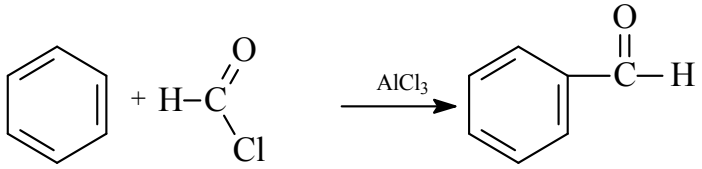
4) Atsetilenni Kucherov reaksiyasi asosida gidratlab olinadi:



5) Etilenni $PdCl_2$ katalizatori ishtirokida oksidlab etanal olinadi:

$$2CH_2{=}CH_2 + O_2 \rightarrow 2CH_3{-}CHO$$

6) Benzaldegid benzolga $AlCl_3$ katalizatori ishtirokida formilxlorid ta'siridan olinadi:

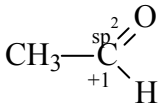


chumoli kilota xlorangidridi — benzaldegid

Fizikaviy xossalari:

To'yingan aldegidlar rangsiz o'ziga xos hidli suyuqliklardir. Formaldegid o'tkir hisli gaz.

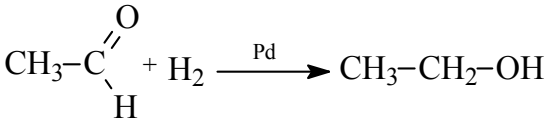
Molekula tuzilishi:



Aldegidlardagi karbonil guruh uglerodi sp^2 gibridlangan holda bo'ladi.
1) sp^3 – 4ta 2) sp^2 – 3ta
3) p – 2ta 4) s – 4ta

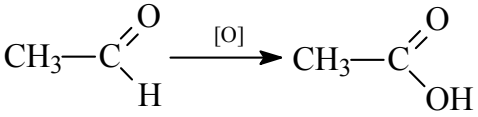
Kimyoviy xossalari:

1) Aldegidlar qaytarilganda birlamchi spirtlar hosil bo'ladi:



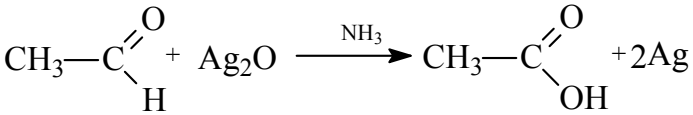
etanal — etanol

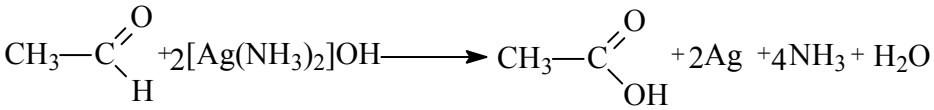
2) Aldegidlar oksidlanganda karbon kislotalar hosil bo'ladi:

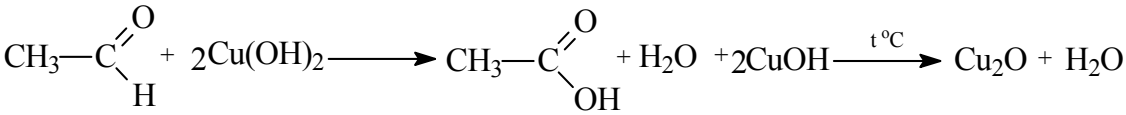


sirka aldegid — sirka kislota

3) Aldegidlar uchun sifat reaksiya bu – ularning Ag_2O ning ammiakdagi eritmasi yoki yangi tayyorlangan $Cu(OH)_2$ bilan oksidlanish reaksiyasidir. Birinchi reaksiyaga "kumush ko'zgu" reaksiyasi deyiladi:

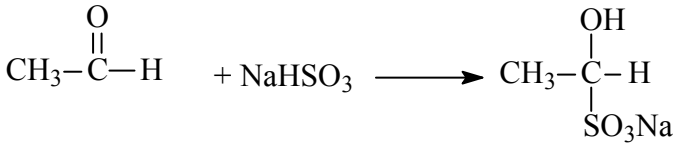




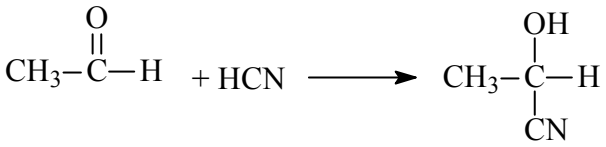


zangori — sariq — qizil

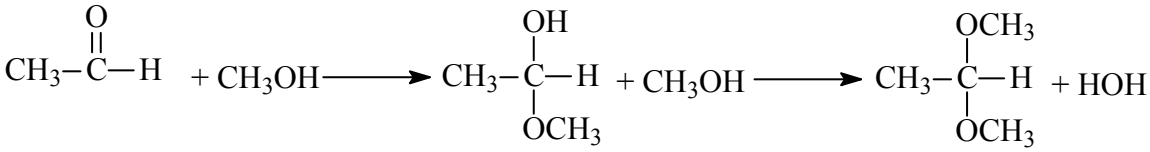
4) Aldegdlar natriy gidrosulfit bilan birikib, bisulfit birikmalarni hosil qiladi:



5) Aldegidlar sianid kislota bilan birikib oksinitrillarni hosil qiladi:

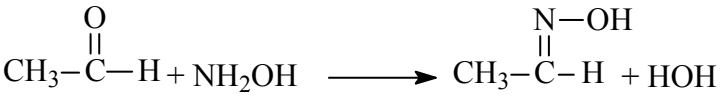


6) Aldegidlar suvsiz $CuSO_4$ ishtirokida spirtlar bilan asetallar hosil qiladi:

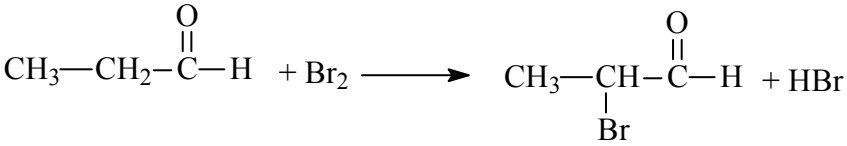


sirka aldegidining metil asetali

7) Aldegidlar gidroksilamin bilan oksimlar hosil qiladi:

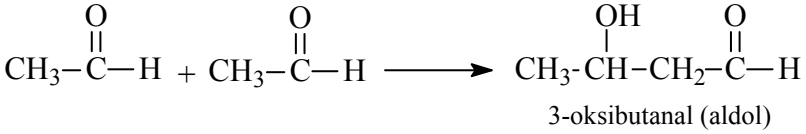


8) Aldegidlarning α-holatdagi vodorod atomlari harakatchan bo‘lganligidan galogenlarga oson almashinadi:

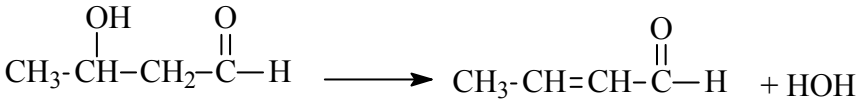


2-brompropanal

9) Aldegidlar uchun ishqor yoki kislotalar ta’sirida aldol va kroton kondensatsiyasi xarakterli:



3-oksibutanal (aldol)

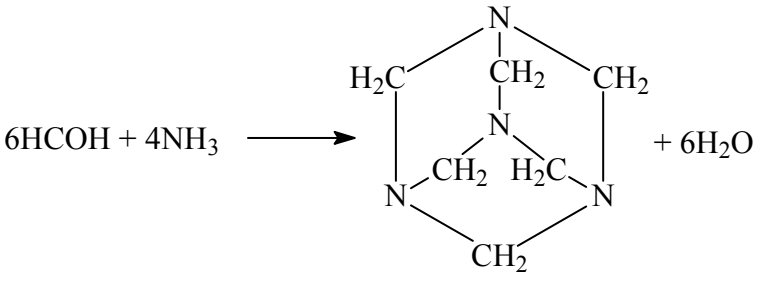


buten-2-al (kroton aldegid)

10) Chumoli aldegid ishqorlar ta’sirida Kannissaro reaksiyasiga kirishadi:

$$2HCOH + KOH \rightarrow CH_3OH + HCOOK$$

11) Formaldegid ammiak bilan ta’sirlashib urotropinni hosil qiladi:



geksametilentetramin

12) Formaldegid aldol kondensatsiyaga uchraganda geksoza hosil bo‘lishi mumkin:

$$6HCOH \rightarrow C_6H_{12}O_6$$

13) Formaldegid polimerlanish reaksiyasiga kirishganda poliformaldegid hosil bo‘ladi:

$$n CH_2O \rightarrow (–CH_2–O–)_n$$

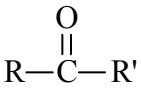
Ishlatilsihi:

Formaldegid fenolformaldegid smolasi olishda, uning 35-40% li suvli eritmasi – formalin biopreparatlarni saqlashda ishlatiladi.

Atsetalsegid sirka kislota va sirka angidridi olishda ishlatiladi.

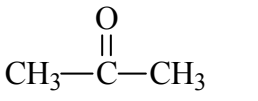
Akrolein atseton va glitserin olishda ishlatiladi.

Mavzu: Ketonlar

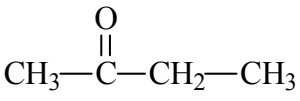
Ta'rif: *Tarkibi*  *bo'lgan organik moddalarga ketonlar deyiladi.*

Nomlanishi va izomeriyasi:

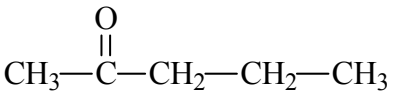
Ketonlarni nomlash uchun karbonil guruh tutgan eng uzun uglevodorod zanjiri tanlanib, karbonil guruh yaqin tomondan raqamlanadi va tegishli uglevodorod nomiga *–on* qo'shimchasi qo'shiladi.



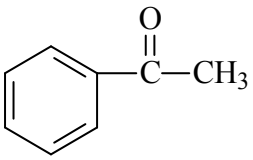
propanon
dimetilketon



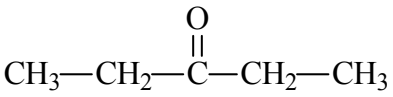
butanon
metiletilketon



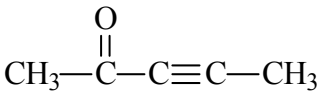
pentanon-2
metilpropilketon



metilfenilketon
atsetofenon



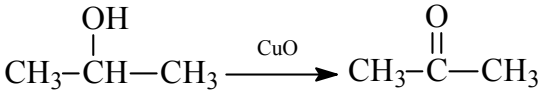
pentanon-2
dietilketon



geksin-3-on-2

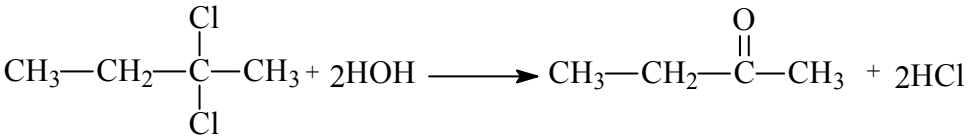
Olinishi:

1) Ikkilamchi spirtlarni oksidlab olinadi:



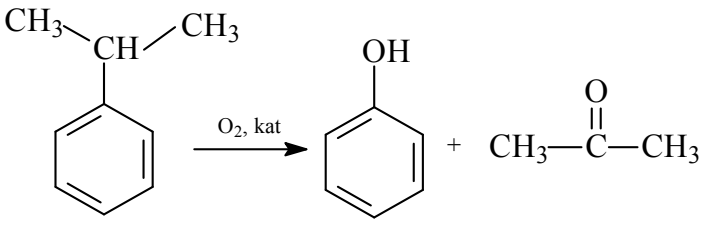
propanol-2 — propanon

2) Digalogenalkanlarni gidroliz qilib olinadi:



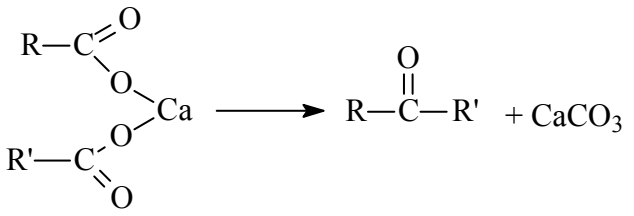
2,2-dixlorbutan — butanon

3) Atseton kumolni oksdilab olinadi:



kumol — fenol — atseton

4) Karbon kislota tuzlarini piroliz qilib olinadi. Bunda agar chumoli kislota tuzi bo‘lsa, aldegid hosil bo‘ladi:



agar R=H yoki R'=H bo'lsa, R-COH yoki R'-COH aldegid, R=R' bo'lsa simmetrik keton hosil bo'ladi

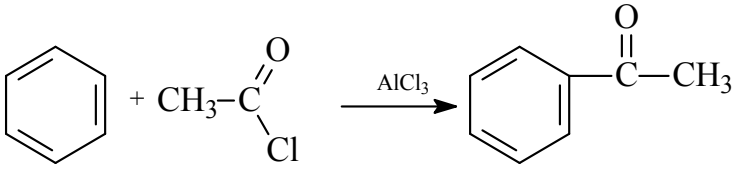
5) Karbon kislotalarni 400-500°C da bug‘latib, metal oksid katalizatoridan o‘tkazilib olinadi:

$$2R{-}COOH \rightarrow R{-}CO{-}R + CO_2 + H_2O$$

6) Karbon kislota xlorangidridlaridan olinadi:

$$R{-}COCl + C_2H_5CdBr \rightarrow R{-}CO{-}C_2H_5 + CdClBr$$

7) Aromatik ketonlar benzolni atsillab olinadi:



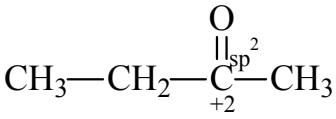
sirka kislota xlorangidridi — atsetofenon

Fizikaviy xossalari:

Atseton yoqimli hidli rangsiz suyuqlik.

Molekula tuzilishi:

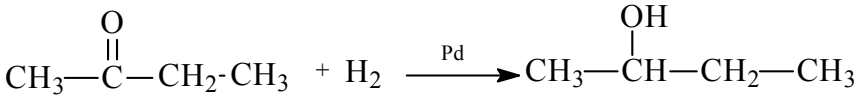
Ketonlardagi karbonil guruh uglerodi sp^2 gibridlangan holda bo‘ladi.



1) sp^3 – 3x4=12ta
2) sp^2 – 3ta
3) p – 2ta
4) s – 8ta

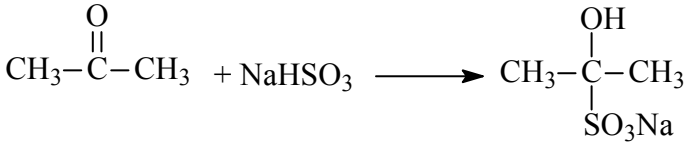
Kimyoviy xossalari:

1) Ketonlar qaytarilganda ikkilamchi spirtlar hosil bo‘ladi:

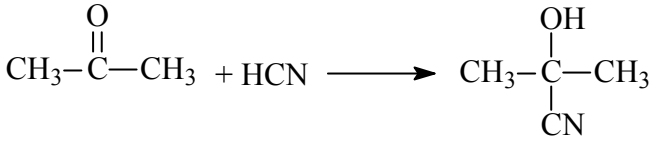


butanon — ikkilamchi butil spirt

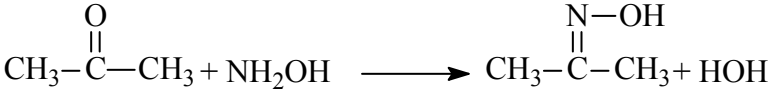
2) Ketonlar aldegidlar kabi natriy gidrosulfitni biriktirib, bisulfit birikmalarni hosil qiladi:



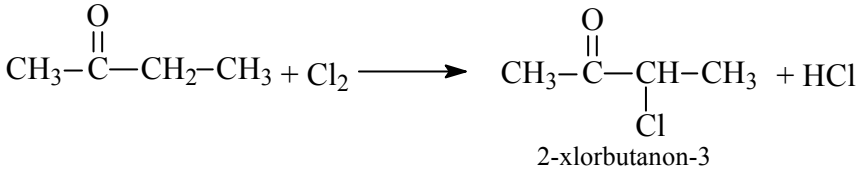
3) Ketonlar sianid kislota bilan birikish reaksiyasiga kirishadi:



4) Ketonlar gidroksilamin bilan oksimlar hosi qiladi:

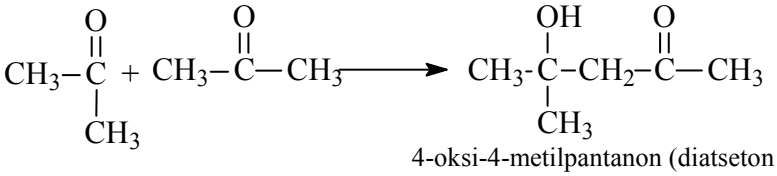


5) Ketonlarning α-holatdagi vodorod atomlari harkatchan bo‘lganligidan ular galogenlar bilan oson almashinadi:

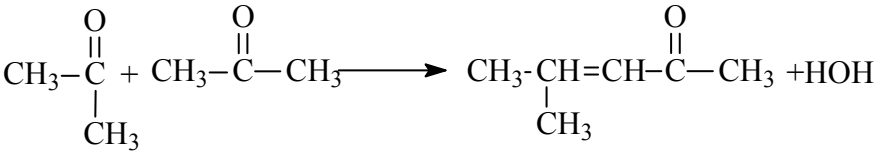


2-xlorbutanon-3

14) Ketonlar uchun ishqor yoki kislotalar ta’sirida aldol va kroton kondensatsiyasi xarakterli:



4-oksi-4-metilpantanon (diatseton spirt)



4-metilpenten-3-on-2

6) Ketonlarga PCl_5 yoki PBr_5 ta’sir ettirilganda digalogenalkanlar hosil bo‘ladi:

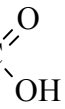
$$R_2C{=}O + PCl_5 \rightarrow R_2CCl_2 + POCl_3$$

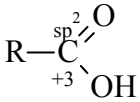
7) Ketonlar oksidlanishga chidamli. Ular “kumush ko‘zgu” reaksiyasiga kirishmaydi. Lekin kuchli oksidlovchilar ta’sirida karbonil guruhning ikkala tomonidan uzilib karbon kislotalar aralshmasi hosil bo‘ladi (Popov qoidasi).

Ishlatilishi:

Atseton nitrosellyuloza va boshqa moddalarni eritishda erituvchi sifatida ishlatiladi. Shuningdek u kinoplenka va portlovchi moddalar olishda ishlatiladi.

Mavzu: Karbon kislotalar

Ta’rif: *Tarkibida uglevodorod radikali bili bog‘langan karboksil guruh*  *tutgan organik moddalar sinfiga karbon kislotalar deyiladi.*

Ularning umumiy formuladi: 

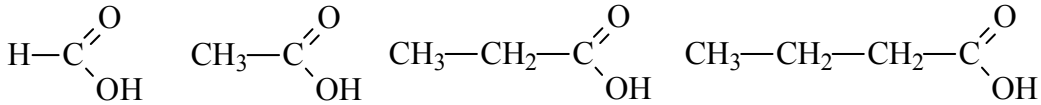
Karbon kislotalar quyidagicha bo‘linadi:

1) Monokarbon kislotalar (to‘yingan, to‘yinmagan, aromatik);
2) Dikarbon kislotalar (to‘yingan, to‘yinmagan, aromatik);
3) Karbon kislotalarning hosilalalri (galogen, gidroksi, aminokarbon kislotalar).

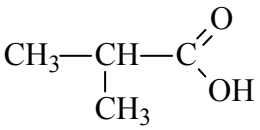
Nomlanishi va izomeriyasi:

Karbon kislotalarni nomlash uchun karboksil guruh uglerodi 1 deb olinib, tegishli uglevodorod nomiga *kislota* so‘zi qo‘shib aytiladi.

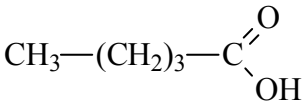
To‘yingan monokarbon



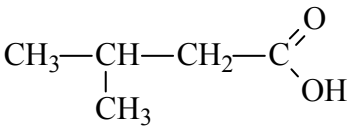
metan kislota	etan kislota	propan kislota	butan kislota
chumoli kislota	sirka kislota	propion kislota	moy kislota



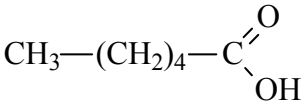
2-metilpropan kislota
izomoy kislota



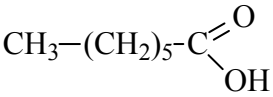
pentan kislota
valerian kislota



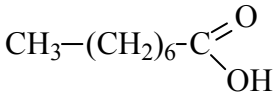
3-metilbutan kislota
izovalerian kislota



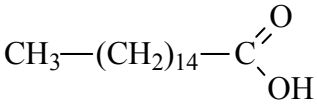
geksan kislota
kapron kislota



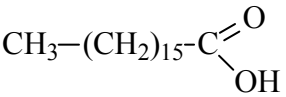
geptan kislota
enant kislota



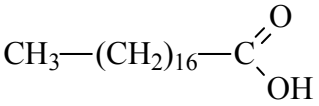
oktan kislota
pellargon kislota



geksadekan kislota
palmitin kislota

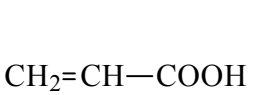


geptadekan kislota
margarin kislota

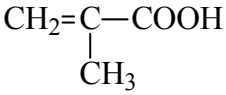


oktadekan kislota
stearin kislota

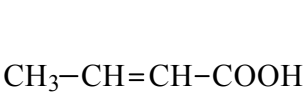
To‘yinmagan monokarbon



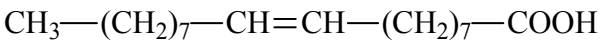
propen kislota
akril kislota



2-metilpropen kislota
metakril kislota

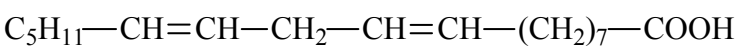


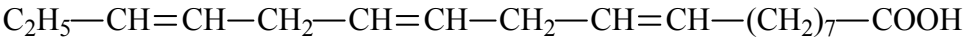
buten-2 kislota
kroton kislota



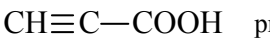
yoki $C_{17}H_{33}COOH$ olein kislota

yoki $C_{17}H_{31}COOH$ linol kislota



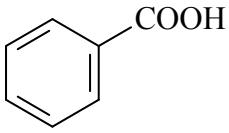


yoki $C_{17}H_{29}COOH$ linolen kislota

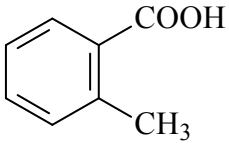


propin kislota

Aromatik monokarbon kislotalar

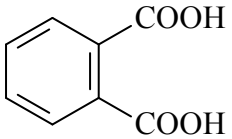


benzoy kislota

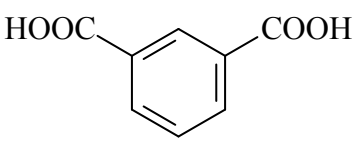


o‘-toluol kislota

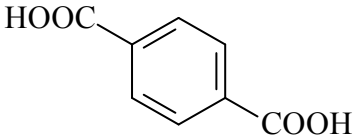
Aromatik dikarbon kislotalar



ftal kislota (*orto*)

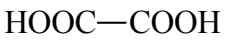


izoftal kislota (*meta*)



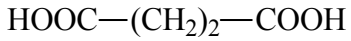
tereftal kislota (*para*)

Dikarbon kislotalar

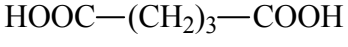


oksalat kislota

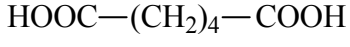
malon kislota



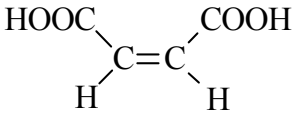
qahrabo kislota



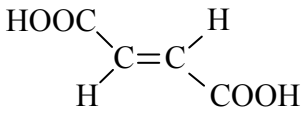
glutar kislota



adipin kislota

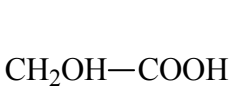


malein kislota

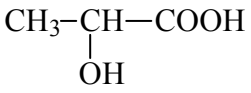


fumar kislota

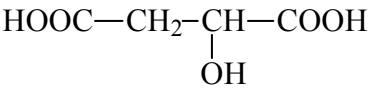
Oksikarbon kislotalar



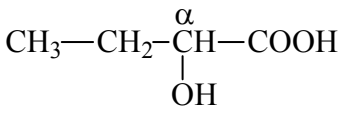
etanol kislota



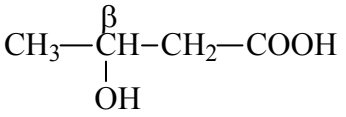
propanol-2 (sut) kislota



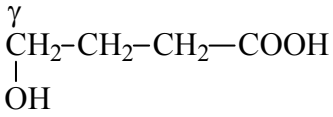
olma kislota



α-oksimoy kislota



β-oksimoy kislota

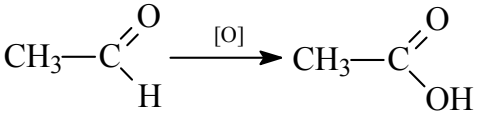


γ-oksimoy kislota

Olinishi:

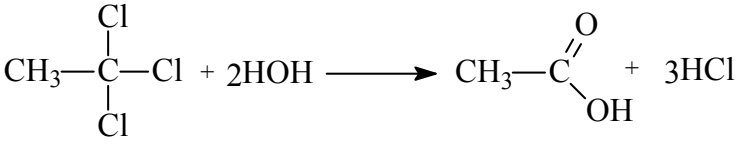
Ko‘pchilik organik moddalar, masalan, spirtlar va aldegidlarning oxirgi oksidlanish mahsuloti karbon kislotalar hisoblanadi.

1) Aldegidlarni oksidlab olinadi:

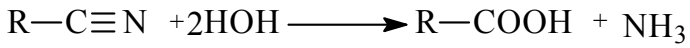


sirka aldegid — sirka kislota

2) Alkil trixlorli hosilalarni, orto-efirlarni, amidlarni, xlorangidridlarni yoki nitrillarni gidroliz ailib olinadi:



1,1,1-trixloretan — etan kislota



$$R-C(OCH_3)_3 + 2H_2O \rightarrow R-COOH + 3CH_3OH$$

$$R-CONH_2 + H_2O \rightarrow R-COOH + NH_3$$

$$R-COCl + H_2O \rightarrow R-COOH + HCl$$

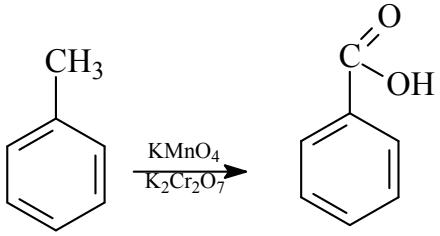
3) Sianid kislota gidrolizlanganda ham chumoli kislota hosil bo‘ladi:

$$HCN + 2HOH \rightarrow HCOOH + NH_3$$

4) Sirka kislota sanoatda Kucherov reaksiyasi yordamida sirka aldegiddan yoki butanni yuqori temperaturada oksidlab olinadi:

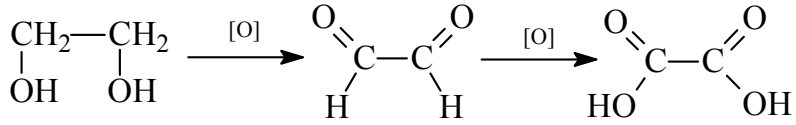
$$2C_4H_{10} + 5O_2 \rightarrow 4CH_3COOH + 2H_2O$$

5) Benzol hosilalari oksidlanganda benzoy kislota hosil bo‘ladi:



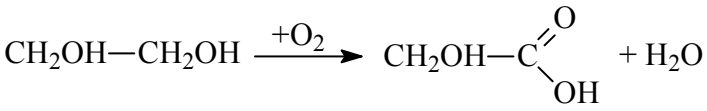
benzoy kislota

6) Etilenglikol oksidlanganda oksalat kislota hosil bo‘ladi:

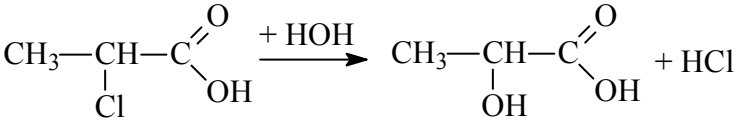


etilenglikol glioksal oksalat kislota

7) Oksikarbon kislotalar glikollar yoki ularning kamida bitta birlamchi spirt gruppasi ($-CH_2OH$) bo’lgan hosilalarini oksidlab olinadi:



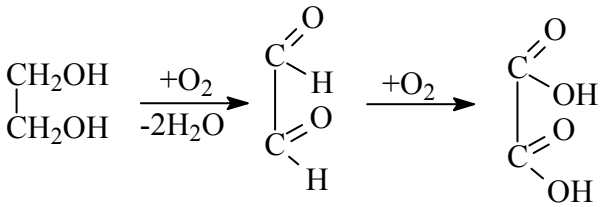
8) α-galoid kislotalarni gidrolizidan oliandi:



9) Dikarbon kislotalar dinitrillarni gidroliz qilib olinadi:

$$NC-CH_2-CH_2-CN + 4H_2O \rightarrow HOOC-CH_2-CH_2-COOH + 2NH_3$$

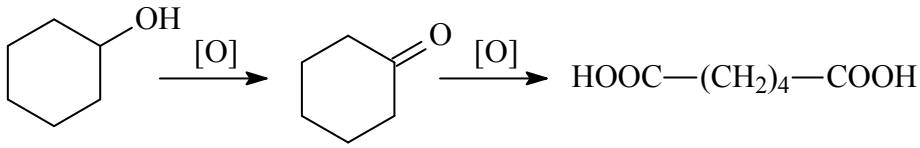
10) Birlamchi glikollar yoki dialdegidlarni oksidlab:



11) Natriy yoki kaliy formiatni o‘yuvchi ishqor bilan 400°C da qizdirib:

$$2HCCONa \rightarrow NaC_2O_4 + H_2$$

12) Adipin kislotani quyidagicha olish mumkin:

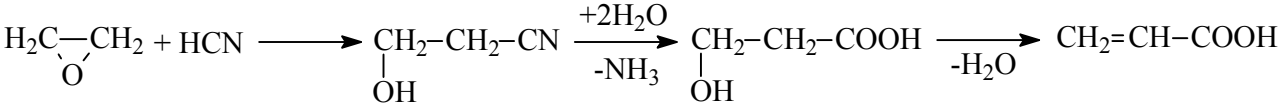


13) Akril kislota quyidagicha oliandi:

$$CH_2=CH-CH_2OH + [O] \rightarrow CH_2=CH-COOH$$

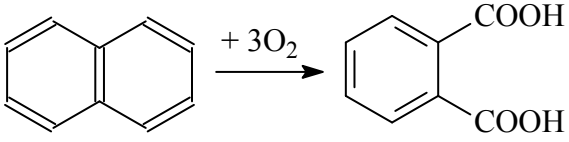
$$CH_2=CH-CHO + [O] \rightarrow CH_2=CH-COOH$$

$$CH_2=CH-CN + 2H_2O \rightarrow CH_2=CH-COOH + NH_3$$

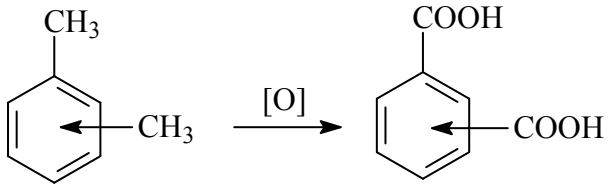


$$C_2H_2 + CO + H_2O \rightarrow CH_2=CH-COOH$$

14) Ftal kislotalar naftalin va ksilol izomerlarini oksidlab olinadi:

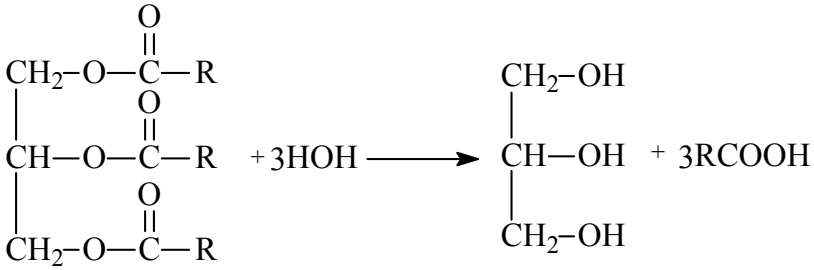


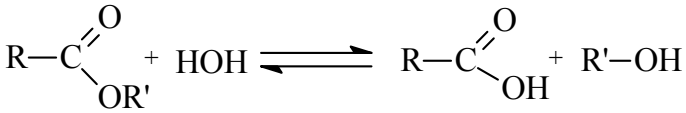
naftalin o-ftal kislota



ksilollar ftal kislotalar

15) Yog‘lar va murakkab efirlar gidrolizlanganda ham karbon kislotalar hosil bo‘ladi:





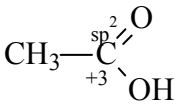
Fizilaviy xossalari:

Karbon kislotalarning quyi vakillari suyuq rangsiz moddalardir. Yuqoti vakillari rangsiz kristall moddalardir. Molekulada uglerod soni ortishi bilan ularning suvda eruvchanligi kamayadi.

Karbon kislotalarda molekulalararo vodorod bog‘lanish mavjud bo‘lganligi uchun ularning qaynash temperaturasi tegishli murakkab efirlarnikiga qaraganda yuqori.

Molekula tuzilishi:

Karbon kislotalarda karboksil guruh uglerodi sp^2 gibridlangan holda bo‘ladi:



1) sp^2 – 3ta
2) sp^3 – 4ta
3) s – 4ta
4) p – 2ta

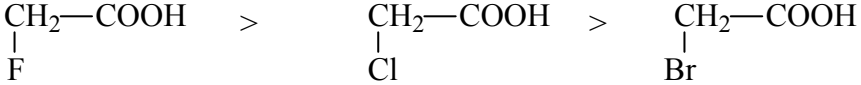
Kimyoviy xossalari:

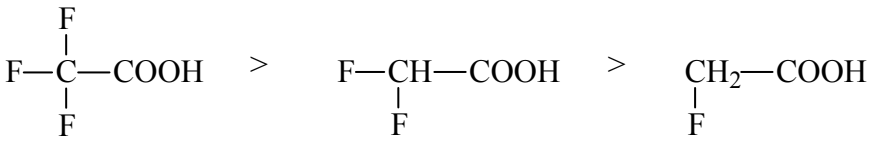
Karbon kislotalar kislotalik xossasini namoyon qiladi. To‘yingan karbon kislotalarda radikalda uglerod soni ortishi bilan kislotalik kuchi kamayadi:

$$HCOOH > CH_3COOH > C_2H_5COOH > C_3H_7COOH > C_4H_9COOH$$

Dikarbon kislotalarning kislotalik kuchi monokarbon kislotalarnikiga qaraganda kuchliroq bo‘ladi.

Agar to‘yingan radikalda galogen mavjud bo‘lsa, kislota kuchi ortadi:





1) Karbon kislotalar metallar, metal oksidlari va ishqorlar bilan ta’sirlashib karbon kislota tuzlarini hosil qiladi:

$$CH_3COOH + Na \rightarrow CH_3COONa + {}^1/_2H_2$$
$$CH_3COOH + NaOH \rightarrow CH_3COONa + HOH$$
$$2CH_3COOH + CaO \rightarrow (CH_3COO)_2Ca + H_2O$$

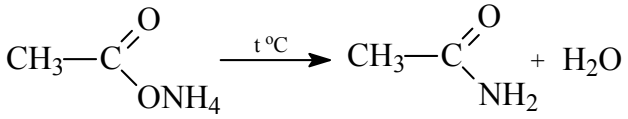
2) Hosil bo‘lgan karbon kislota tuzlari ishqor bilan qizdirilganda dekarboksillanish reaksiyasi amalga oshadi:

$$CH_3–CH_2–COONa + NaOH \xrightarrow{t°C} CH_3–CH_3 + Na_2CO_3$$

3) Karbon kislotalar shuningdek NH_3 va NH_4OH bilan ta’sirlashib ammoniy tuzlarini hosil qiladi:

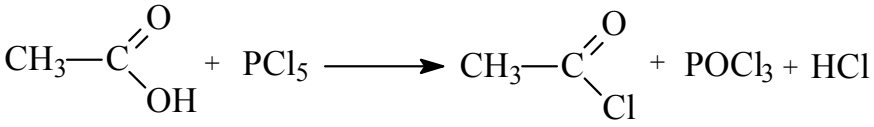
$$CH_3COOH + NH_3 \rightarrow CH_3COONH_4$$

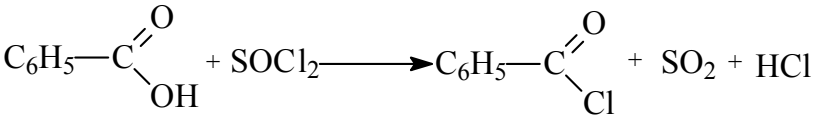
Ammoniy tuzlari 200°C da qizdirilganda degidratlanib amidlarni hosil qiladi:



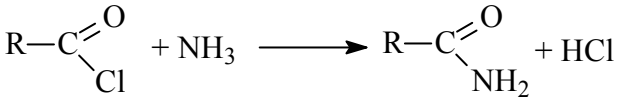
ammoniy atsetat — atsetamid

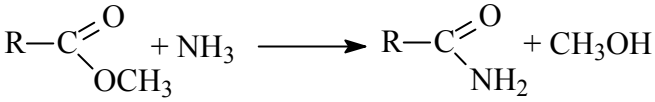
4) Karbon kisloatalarga PCl_5 yoki tionilxlorid $SOCl_2$ ta’sir ettirilganda xlorangidridlar hosil bo‘ladi:



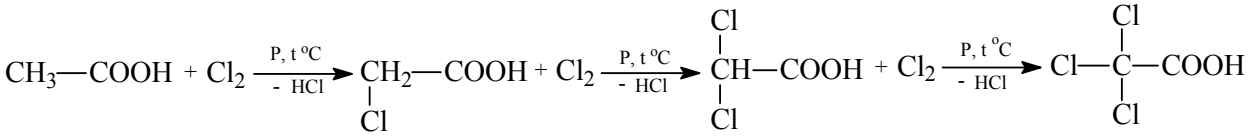


5) Xlorangidridlarga va murakkab efirlarga ammiak ta’sir ettirilsa, kislota amidlari hosil bo‘ladi:



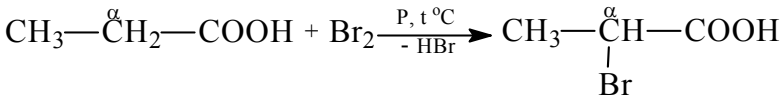


6) Issiq sirka kislota qizil fosfor ishtirokida xlorlanganda xlor radikalga birikadi:



sirka kislota — xlorsirka kislota — dixlorsirka kislota — trixlorsirka kislota

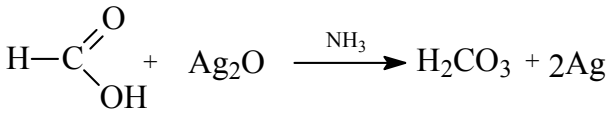
Qolgan gomologlari ham galogenlanganda dastlab faqat α-holat galogenlanadi:



7) Karbon kislotalar qaytarilganda spirtlar hosil bo‘ladi:

$$CH_3–COOH + H_2 \xrightarrow{Pd} CH_3–CH_2OH$$

8) Karbon kislotalardan faqat chumoli kislota “kumush ko‘zgu” reaksiyasiga kirishadi:

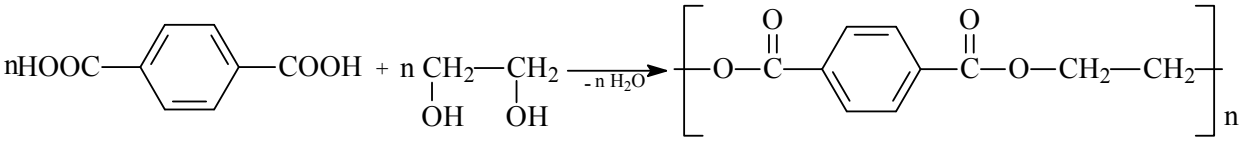


metan kislota — karbonat kislota

9) Chumoli kislota yaxshi qaytaruvchi hisoblanib, u sulemadan simobni qaytaradi:

$$HCOOH + 2HgCl_2 \rightarrow 2HCl + CO_2 + 2HgCl$$
$$HCOOH + 2HgCl \rightarrow 2Hg + 2HCl + CO_2$$

10) Tereftal kislota etilenglikol bilan eterifikatsiyasidan lavsan poliefiri hosil bo‘ladi:

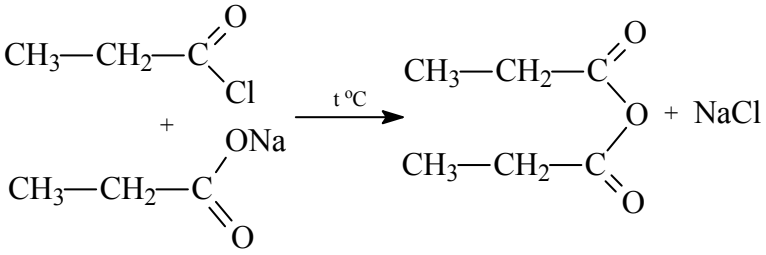


tereftal kislota etandiol-1,2 lavsan, Dakron

11) Karbon kislota angidridlari ular degidratlanganda hosil bo‘ladi:

$$2R{-}COOH \rightarrow (R{-}CO)_2O + H_2O$$

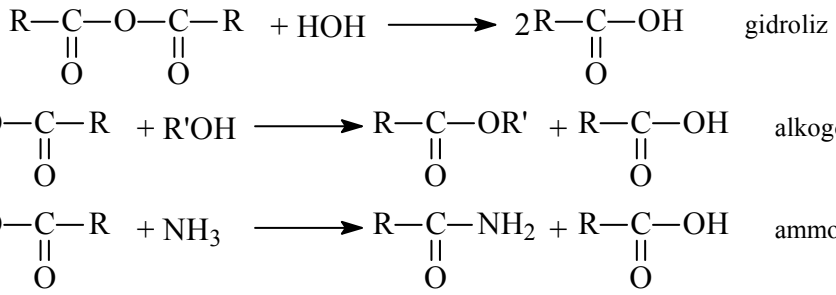
12) Karbon kislota xlorangidridlari tegishli tuzlar bilan qizdirilganda angidridlar hosil bo‘ladi:



13) Hozirgi vaqtda sirka kislota angidridi ketenga sirka ksilota ta’siridan olinadi:

$$CH_3COOH + CH_2{=}C{=}O \rightarrow (CH_3CO)_2O$$

14) Angidridlar gidroliz, alkogoliz va ammonoliz reaksiyalariga kirishadi:

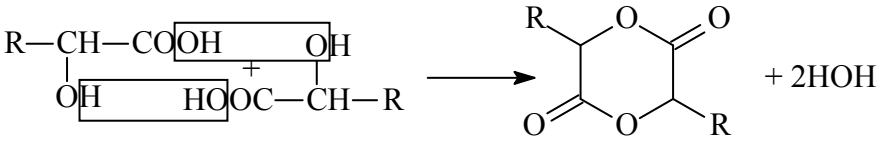


gidroliz

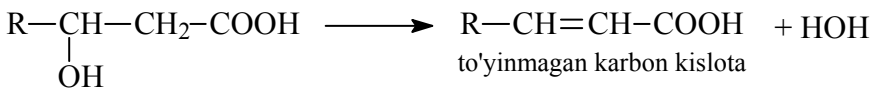
alkogoliz

ammonoliz

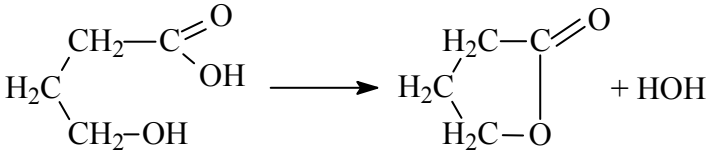
15) Oksikarbon kislotalar qizdirilganda osonlik bilan degidratlanib, tuzilishiga bog’liq ravishda turli moddalarni hosil qiladi – ya’ni α-oksikarbon kislotalardan laktidlar, β-oksikarbon kislotalardan to‘yinmagan kislotalar, γ va yuqorilaridan laktonlar hosil bo‘ladi:



siklik murakkab efirlar - laktidlar



to'yinmagan karbon kislota



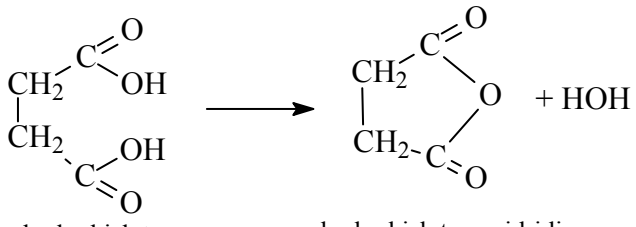
lakton

16) Oksalat va malon kislotalar qizdirilganda dekarboksillanib, tegishli kislotalarni hosil qiladi:

$$HOOC{-}COOH \rightarrow H{-}COOH + CO_2$$

$$HOOC{-}CH_2{-}COOH \rightarrow CH_3{-}COOH + CO_2$$

17) Molekulasida to‘rt yoki beshta uglerod atomi bo‘lgan dikarbon ksilotalar qizdirilganda siklik angidridlar hosil bo‘ladi:

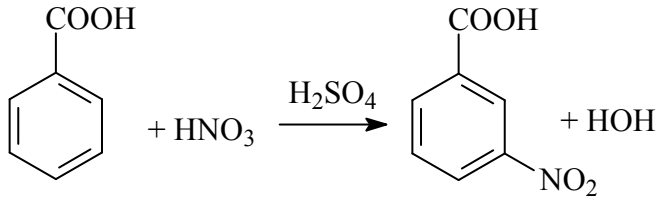


qahrabo kislota qahrabo kislota angidridi

18) Adipin kislota geksametilen diamin bilan polikondensatlalib, neylon tolasini hosil qiladi:

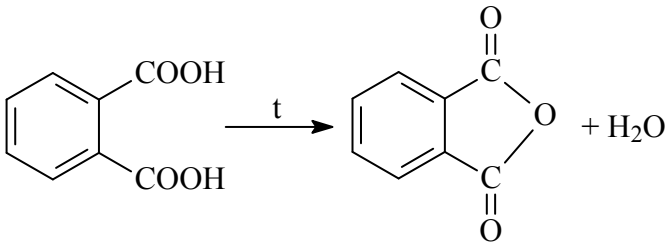
$$nHOOC{-}(CH_2)_4{-}COOH + nH_2N{-}(CH_2)_6{-}NH_2 \rightarrow$$
$$-[-CO{-}(CH_2)_4{-}CO{-}NH{-}(CH_2)_6{-}NH-]_n- + 2nH_2O$$

19) Karboksil guruh ikkinchi utr o‘rinbosar bo‘lganligidan, u meta-holatga yo‘naltiradi:



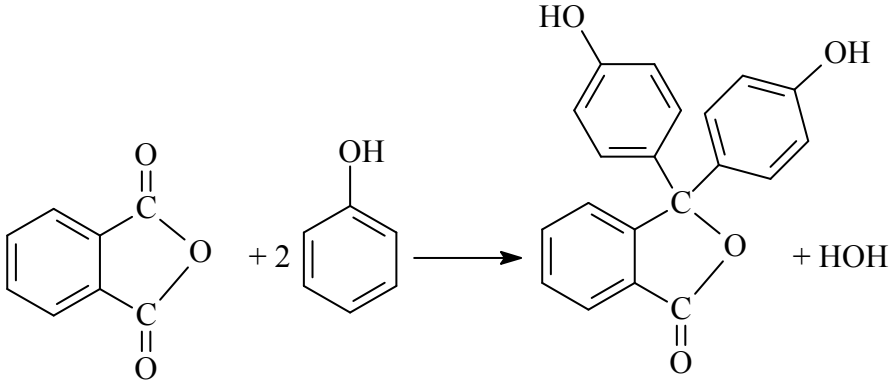
m-nitrobenzoy kislota

20) Ftal kislotalardan faqat ortoftal kislota yuqori temperaturada qizdirilganda ftal angidridni hosil qiladi:



o-ftal kislota ftal angidrid

21) Ftal angidriddan fenolftalein indikatori olish mumkin:

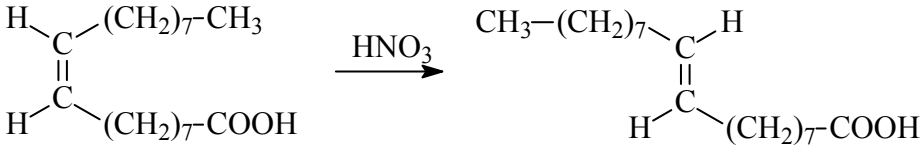


fenolftalein

22) Olein kislota kuchli oksidlovchilar ta’sirida parchalanadi:

$$CH_3{-}(CH_2)_7{-}CH{=}CH{-}(CH_2)_7{-}COOH + 2O_2 \rightarrow \underset{\text{pelargon kislota}}{CH_3{-}(CH_2)_7{-}COOH} + \underset{\text{azelain kislota}}{HOOC{-}(CH_2)_7{-}COOH}$$

23) Olein kislota nitrat kislota ta’sirida trans-izomer elaidin kislotaga aylanadi:



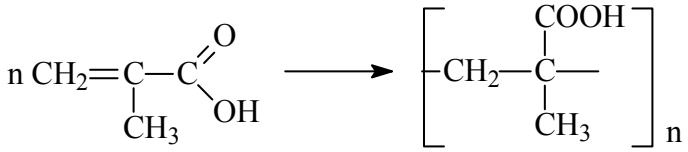
olein kislota (*sis*) elaidin kislota (*trans*)

24) Karbon kislotalar yonganda suv va karbonat angidrid hosil bo‘ladi:

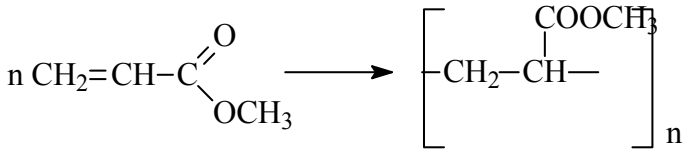
$$CH_3COOH + 2O_2 \rightarrow 2CO_2 + 2H_2O$$

Ishlatilishi:

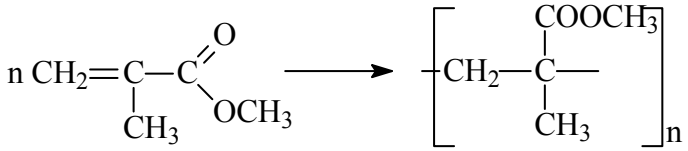
Chumoli kislota junga ishlov berishda, sirka kilsota sirka va sirka angidrid (undan atsetat shoyisi va aspirin olinadi) olishda ishlatiladi. Palmitin va stearin kislotalar sovun ichlab chiqarishda ishlatiladi. Akril va metakril kislotaning metil efirlari organik shisha (pleksiglas) ishlab chiqarishda ishlatiladi:



metakril ksilota — polimetakrilat



metilakrilat efiri — polimetilakrilat

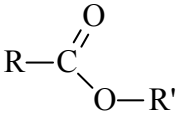


metilmetakrilat efiri — polimetilmetakrilat

Olein va linol kislotalar moylar tarkibiga kiradi. Benzoy kislota konserva va dori-darmon sanoatida ishlatiladi.

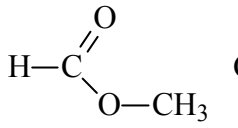
Mavzu: Murakkab efirlar

Ta'rif: *Karbon kislotalar va spirtlardan hosil bo'lgan karbon kislota hosilalariga murakkab efirlar deyiladi.*

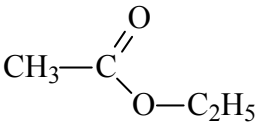
Ularning umumiy formulasi: 

Nomlanishi va izomeriyasi:

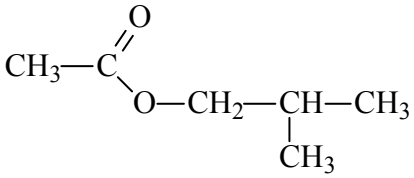
Murakkab efirlarni nomlash uchun tegishli kislota nomiga spirt nomi qo'shib *efiri* deyiladi, yoki spirt nomidan keyin tegishli kislota nomi aytiladi.



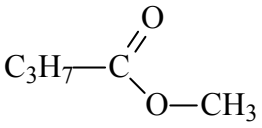
chumoli kislotaning metil efiri, metilformiat



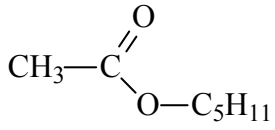
sirka kislotaning etil efiri, etilatsetat



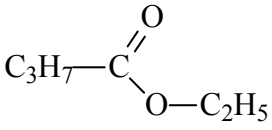
sirka ksilotaning izobutilefiri izobutilatsetat (banan hidi)



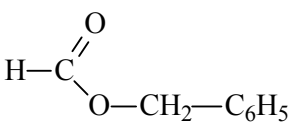
moy kislotaning metil efiri metilbutirat (olma hidi)



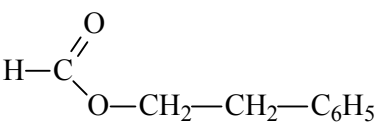
sirka kislotaning izoamil efiri, izoamilatsetat (nok hidi)



moy kislotaning etil efiri etilbutirat (ananas hidi)



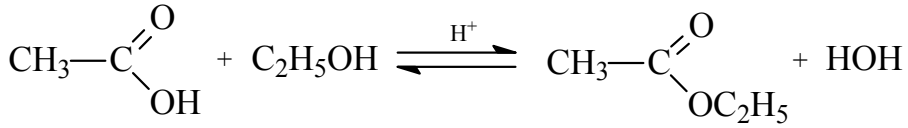
chumoli kislotaning benzil efiri, benzilformiat (jasmin hidi)



chumoli kislotaning feniletil efiri feniletilformiat (xrizantema hidi)

Olinishi:

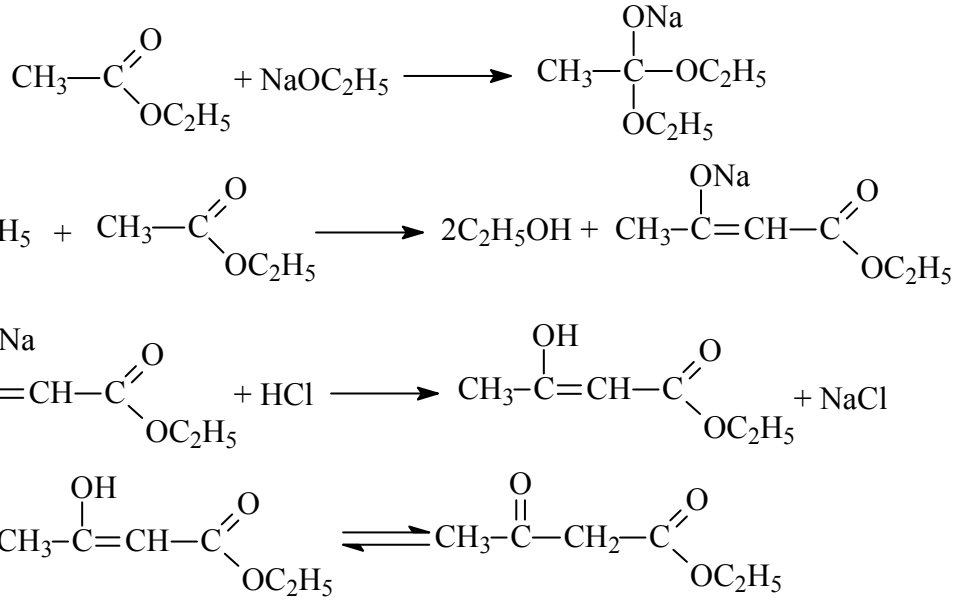
1) Murakkab efirlar asosan eterifikatsiya reaksiyasi yordamida olinadi:



2) Vinilatsetilen atsetilenga sirka kislota ta'siridan olinadi:

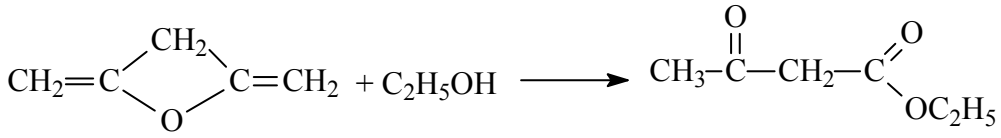
$$HC{\equiv}CH + CH_3COOH \rightarrow CH_3COOCH{=}CH_2$$

3) Asetosirka efiri Klayzen kondensatsiyasi yordamida olinadi:

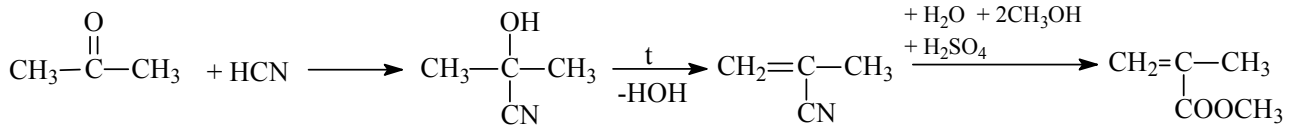


enol shakli keton shakli

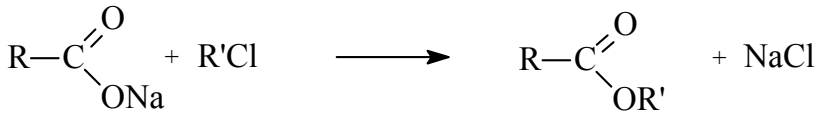
4) Asetosirka efiri shuningdek diketenga spirt ta'siridan ham olinadi:



5) Metakril kislotaning metil efirini quyidagicha olish mkin:



Murakkab efirlar shuningdek shuningdek karbon kislota tuzlariga galogenoalkanlar ta'siridan olinadi:

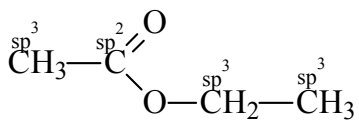


Fizikaviy xossalari:

Murakkab efirlar rangsiz, yoqimli hidli suyuqliklar hisoblanadi. Ularda vodorod bog'anish mavjud emas.

Molekula tuzilishi:

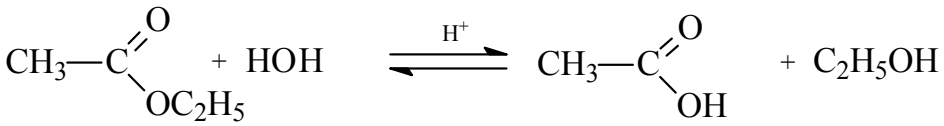
Murakkab efirlardagi karboksil guruh uglerodi sp^2 gibridlangan holda bo'ladi.



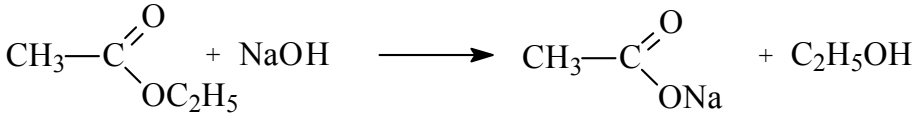
1) sp^3 – 4x4=16ta
2) sp^2 – 3ta
3) s – 8ta
4) p -2 ta

Kimyoviy xossalari:

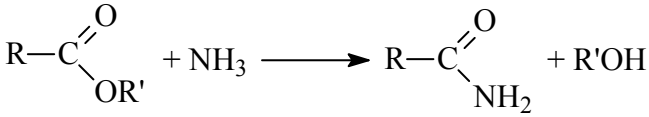
1) Murakkab efirlar kislotali muhitda qaytar gidrolizga uchraydi. Bunda tegishli kislota va spirt hosil bo‘ladi:



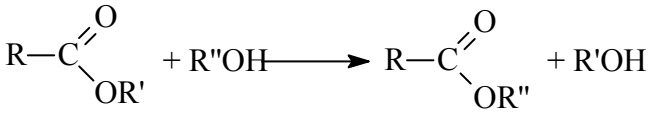
2) Murakkab efirlar ishqorlar bilan qaytmas gidrolziga uchraydi. Bunda karbon kislota tuzi va spirt hosil bo‘ladi:



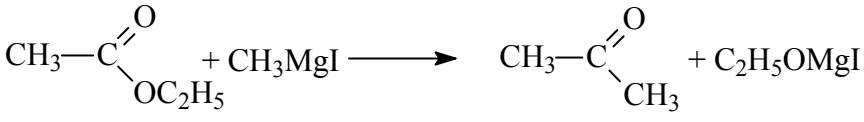
3) Murakkab efirlar ammiak ta’sirida kislota amidlarini hosil qiladi (ammonoliz):

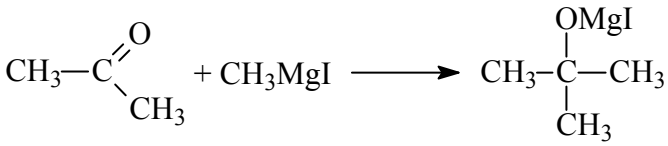


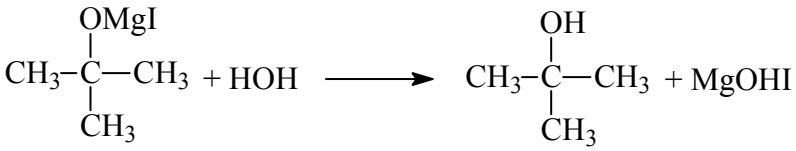
4) Murakkab efirlarga spirtlar ta’sir ettirilganda, yangi murakkab efir va spirt hosil bo‘ladi (qayta efirlasnish):



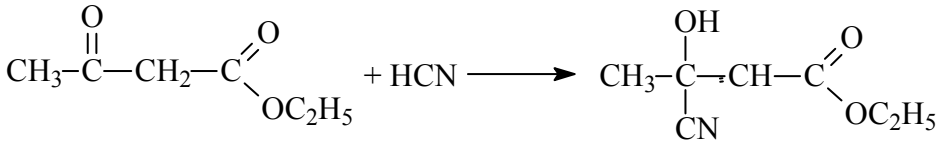
5) Murakkab efirlarga magniy-organik birikmalar ta’sir ettirilganda keton va uchlamchi spirt hosil bo‘ladi:





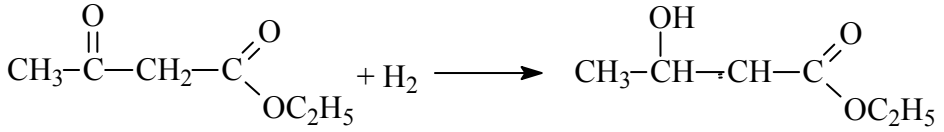


6) Asetosirka efiri ikki xil tautomer shaklda uchragani uchun keton hamda enollarga xos reaksiyalarga kirishadi. Masalan, u ketonlar kabi sianid kislota bilan oson ta’sirlashadi:

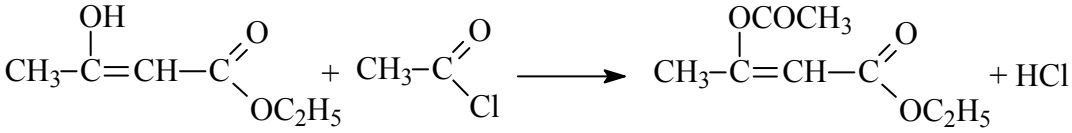


siangidridn

7) Vodorod ta’rida asetosirka efiri karbonil guruhi qayarilib, β-oksimoy kislotaning etil efiri hosil bo‘ladi:

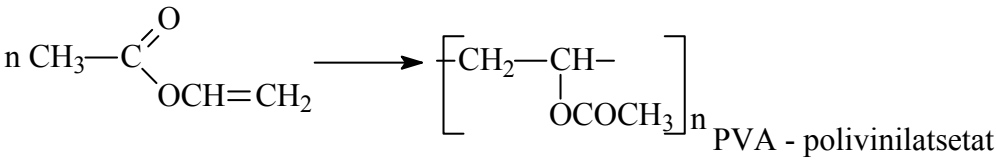


8) Asetosirka efiri enollarga xos bo‘lgan reaksiyalarga ham kirishadi. Masalan, piridin ishtirokida galoid angidridlar bilan atsillanadi:



Ishlatilishi:

Murakkab efirlar yoqimli hidga ega bo‘lganligi uchun mevalarning sun’iy hidlarini hosil qilishda ishlatiladi. Vinilatsetatning polimeri kley va laklar tayyorlashda ishlatiladi.



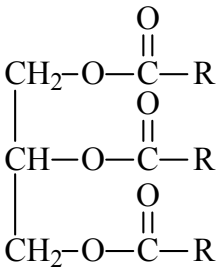
PVA - polivinilatsetat

Polimetilmetakrilat organik shisha sifatida ishlatiladi.

Mavzu: Yog‘lar

Ta’rif: *Glitserin va yuqori yog‘ kilsotalarining murakkab efirlariga yog‘lar deyiladi.*

Ularning umumiy formulasi:



To‘yingan yog‘ kislotalaridan qattiq yog‘lar hosil bo‘ladi. Ularga quyidagilar kiradi:

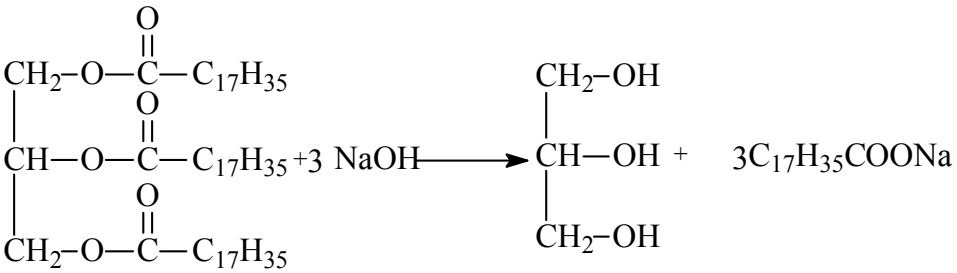
$C_{13}H_{27}–COOH$	$C_{15}H_{31}–COOH$	$C_{17}H_{35}–COOH$	$C_{19}H_{39}–COOH$	$C_{23}H_{47}–COOH$
miristin kislota	palmitin kislota	stearin kislota	araxin kislota	lignotserin kislota

To‘yinmagan yog‘ kisloatalaridan suyuq yog‘lar, ya’ni moylar hosil bo‘ladi:

$C_{13}H_{25}–COOH$	$C_{17}H_{33}–COOH$	$C_{17}H_{31}–COOH$	$C_{17}H_{29}–COOH$	$C_{19}H_{29}–COOH$
palmitoolein kislota	olein kislota	linol kislota	linolen kislota	araxidon kislota

Hayvon yog‘lari to‘yingan, o‘simlik yog‘lari to‘yinmagan kislotalaridan hosil bo‘ladi.

Yog‘larga ishqor ta’sir ettirilganda glitserin va karbon kislotaning ishqorli tuzi hosil bo‘ladi. Bunga “*yog‘larning sovunlanishi*” reaksiyasi deyiladi.

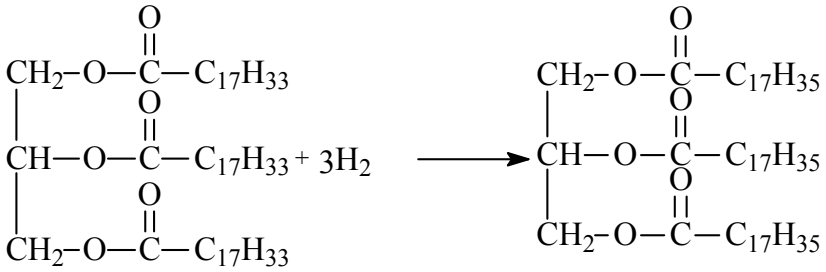


glitserin tristearati — glitserin — natriy stearat – sovun

Parafinlarni oksidlab olingan yog‘ kislotalariga ishoqr qo‘shib ham sovunlar olinadi:

$$C_{17}H_{35}COOH + NaOH \rightarrow C_{17}H_{35}COONa + H_2O$$

Suyuq moylar gidrogenlanganda qattiq yog‘lar hosil bo‘ladi. Bu reaksiyaga *gidrogenlash* reaksiyasi deyilib, S.A.Fokin tomonidan sanoatda ishlab chiqilgan:



glitserin trioleati glitserin tristearati

Yog‘ kislotalarining kaliyli tuzlari suyuq bo‘ladi.

Yog‘ kislotalarining Ca li va Mg li tuzlari suvda erimaydi. Shuning uchun “qattiq suv”da sovun ishlatib bo‘lmaydi. Bunda sintetik yuvish vositalari – sulfokislotalarning natriyli tuzlari ishlatiladi.

Mavzu: Uglevodlar

Ta’rif: *Tarkibida gidroksil va karbonil guruhga ega organik moddalarga uglevodlar deyiladi.*

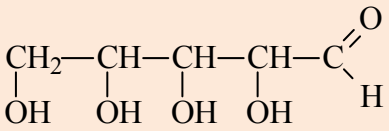
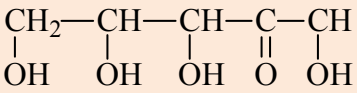
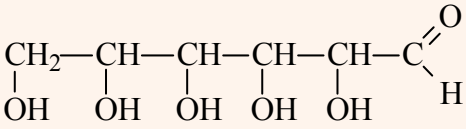
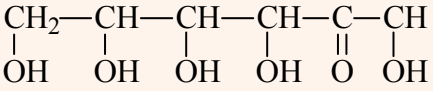
Umumiy formuladi: $C_n(H_2O)_m$.

Uglevodlar monosaxaridlar, disaxaridlar va polisaxaridlarga bo‘linadi.

Mavzu: Monosaxaridlar

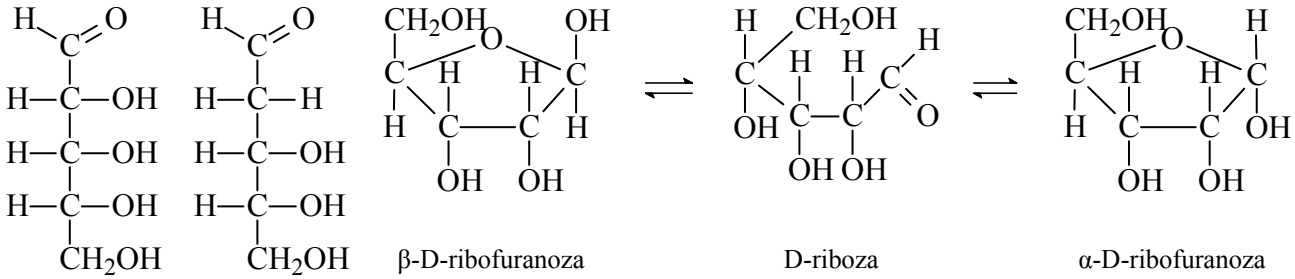
Monosaxaridlarda bitta uglevod molekulasi mavjud bo‘ladi. Ular tarkibidagi uglerod soniga ko‘ra tetroza, pentoza va geksozalarga bo‘linadi.

Shuningdek, tarkibidagi karbonil guruh tabiatiga qarab aldoza va ketozalarga bo‘linadi.

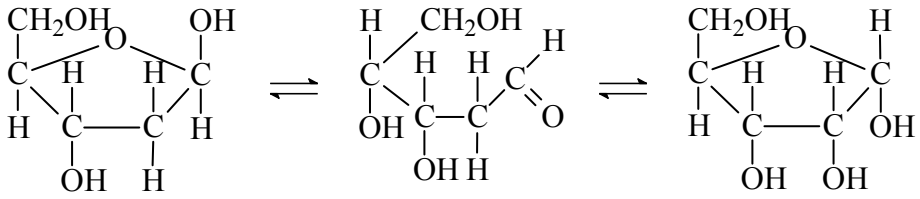
	Aldoza	Ketoza
Pentoza		
Geksoza		

Pentozalar $C_5H_{10}O_5$ formulaga muvofiq keladi. Ularning asosiy vakillari riboza va dezoksiriboza hisoblanadi.

Uar ochiq, shiningdek, yopiq, ya’ni poluatsetal shaklda ham bo‘ladi:



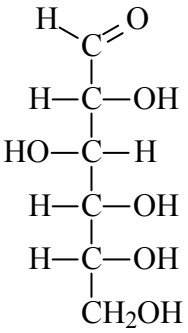
D-riboza D-dezoksi-riboza β-D-ribofuranoza D-riboza (aldegid shakli) α-D-ribofuranoza



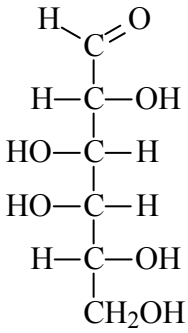
β-D-dezoksiriboza D-dezoksiriboza (aldegid shakli) α-D-dezoksiriboza

RNK da ribozaning siklik β-shakli, DNK da dezoksiribozaning siklik β-shaklida bo‘ladi.

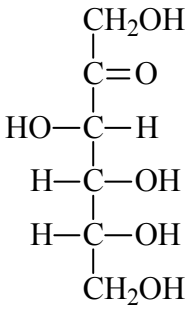
Geksozalar $C_6H_{12}O_6$ formulaga muvofiq keladi. Ularning asosiy vakillari glyukoza, fruktoza va galaktoza hisoblanadi.



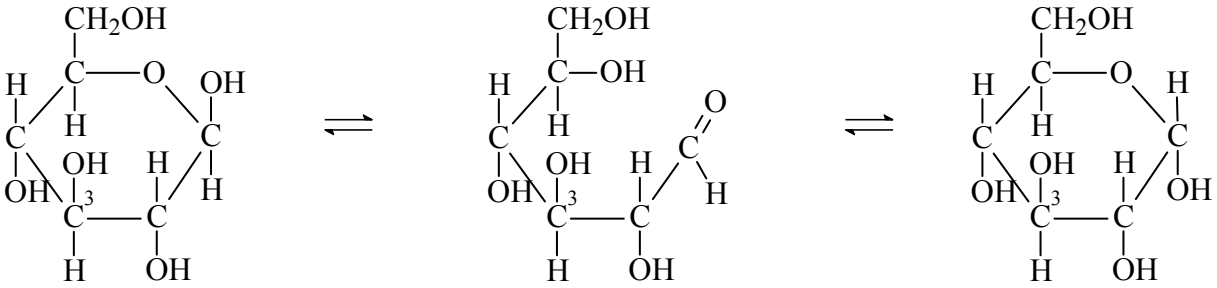
D-glyukoza



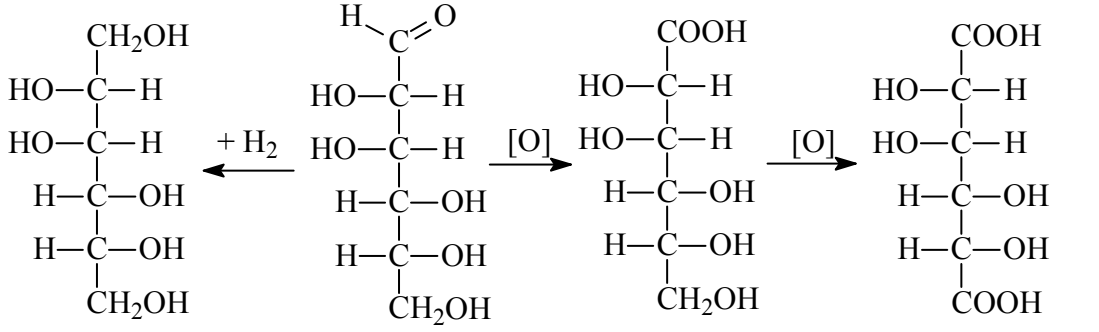
D-galaktoza



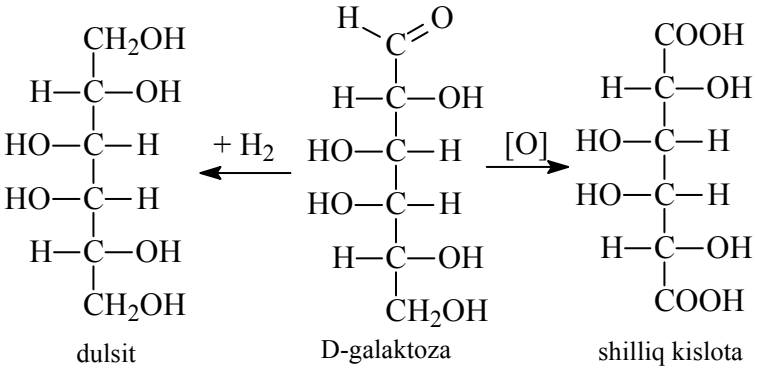
D-fruktoza



β-D-glyukoza D-glyukoza α-D-glyukoza



D-mannit D-mannoza D-mannon kislota D-mannoshakar kislota



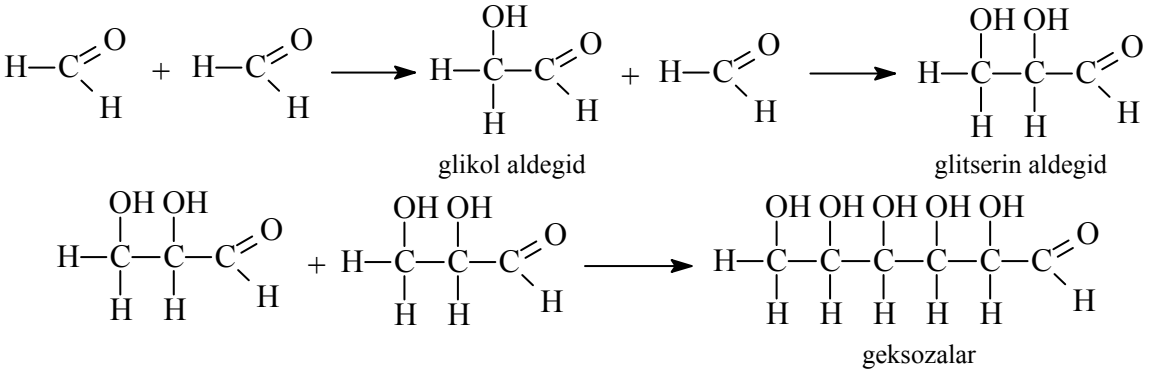
dulsit D-galaktoza shilliq kislota

Olinishi:

1) Sanoatda glyukoza kraxmalni mineral kisloatalar ishtirokida gidrolzilab olinadi:

$$(C_6H_{10}O_5)_n + nH_2O \rightarrow nC_6H_{12}O_6$$

2) Shakarsimon moddalarni birinchi marta 1861-yil A.M.Butlerov chumoli aldegiddan sintez qilgan:



glikol aldegid

glitserin aldegid

geksozalar

Fizikaviy xossalari:

Glyukoza va fruktoza rangsiz shirin ta'mli moddalardir. Ular suvda yaxshi eriydi.

Kimyoviy xossalari:

1) Glyukoza qaytarilganda olti atomli spirt hosil bo'ladi:

$$CH_2OH–(CHOH)_4–CHO + H_2 \rightarrow \underset{\text{geksit}}{CH_2OH–(CHOH)_4–CH_2OH}$$

2) Glyukoza aldegidlar kabi "kumush ko'zgu" reaksiyasiga kirishadi. Bunda glyukon kislota hosil bo'ladi:

$$CH_2OH–(CHOH)_4–CHO + Ag_2O \xrightarrow{NH_3} \underset{\text{glyukon kislota}}{CH_2OH–(CHOH)_4–COOH}$$

3) Glyukoza shuningdek yangi tayyorlangan $Cu(OH)_2$ bilan ham aldegildar kabi ta'sirlashadi:

$$CH_2OH–(CHOH)_4–CHO + 2Cu(OH)_2 \rightarrow \underset{\text{glyukon kislota}}{CH_2OH–(CHOH)_4–COOH} + 2CuOH + H_2O$$

4) Aldozalar kuchli oksidlovchilar ta'sirida oksidlanganda ikki asosli oksikislotalar hosil bo'ladi:

$$CH_2OH–(CHOH)_4–COH + [O] \rightarrow \underset{\text{shakar kislota}}{HOOC–(CHOH)_4–COOH}$$

5) Glyukoza uchun 5 xil bijg'ish xarakterli:

a) Spirtli bijg'ish – etanol hosil bo'ladi:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

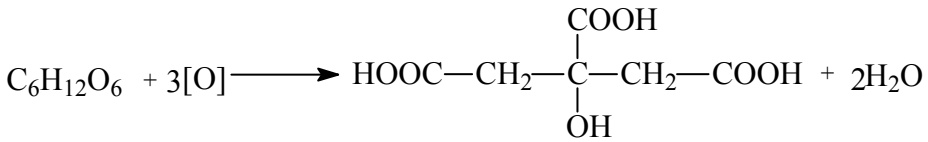
b) Moy kislotali bijg'ish – butan kislota hosil bo'ladi:

$$C_6H_{12}O_6 \rightarrow C_3H_7COOH + 2CO_2 + 2H_2$$

c) Sut kislotali bijg'ish – 2-gidroksipropan kislota hosil bo'ladi:

$$C_6H_{12}O_6 \rightarrow 2CH_3–CH(OH)–COOH$$

d) Limon kislotali bijg'ish:

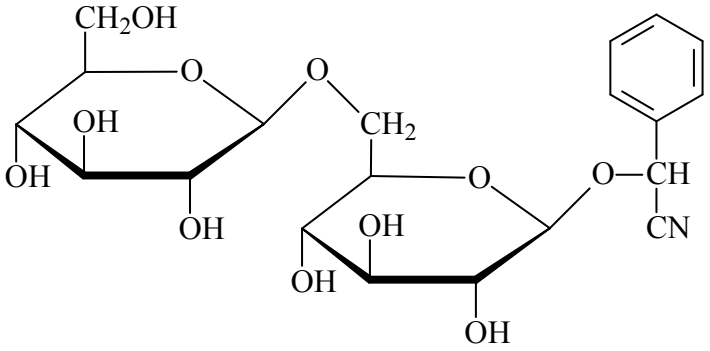


e) Glitserinli bijg'ish – glitserin, sirka aldegid va karbonat angidrid hosil bo'ladi:

$$C_6H_{12}O_6 \rightarrow C_3H_5(OH)_3 + CH_3CHO + CO_2$$

6) Monosaxarid tarkibidagi glikozid gidroksilining vodorodi biror radikal bilan almashinishidan hosil bo‘lgan moddalarga glikozidlar deyiladi. Masalan, amigdalin – $C_{20}H_{27}O_{11}N \cdot H_2O$ gidrolizlanganda glyukoza, benzaldegid va vodorod sianidga parchalanadi:

$$C_{20}H_{27}O_{11}N + 2H_2O \rightarrow 2C_6H_{12}O_6 + C_6H_5CHO + HCN$$

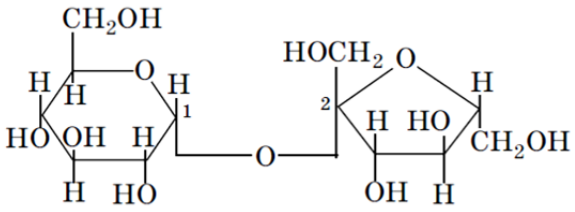


7) Glyukoza yonganda suv va karbonat angidrid hosil bo‘ladi:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

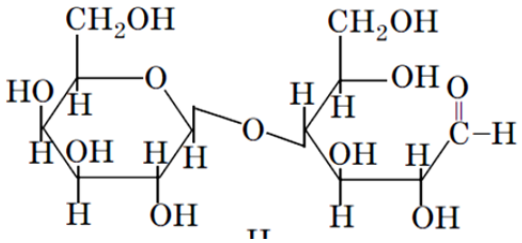
Mavzu: Disaxaridlar-$C_{12}H_{22}O_{11}$

Disaxaridlar ikkita monosaxaridlardan hosil bo‘lgan. Ularga saxaroza, maltoza va laktoza kiradi.



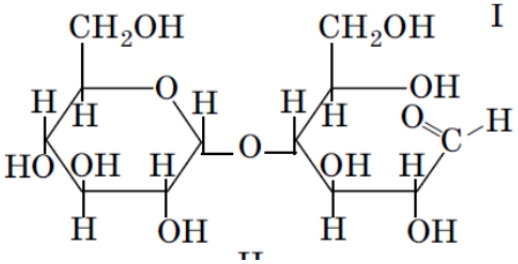
Saxaroza α-D-glyukoza va β-D-fruktozadan tuzilgan. Shuning uchun saxaroza gidrolizidan glyukoza va fruktoza hosil bo‘ladi.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow \underset{\text{glyukoza}}{C_6H_{12}O_6} + \underset{\text{fruktoza}}{C_6H_{12}O_6}$$



Laktoza β-D-galaktoza va β-D-glyukozadan tuzilgan. Shining uchun laktoza gidrolizidan galatoza va glyukoza hosil bo‘ladi.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow \underset{\text{glyukoza}}{C_6H_{12}O_6} + \underset{\text{galaktoza}}{C_6H_{12}O_6}$$



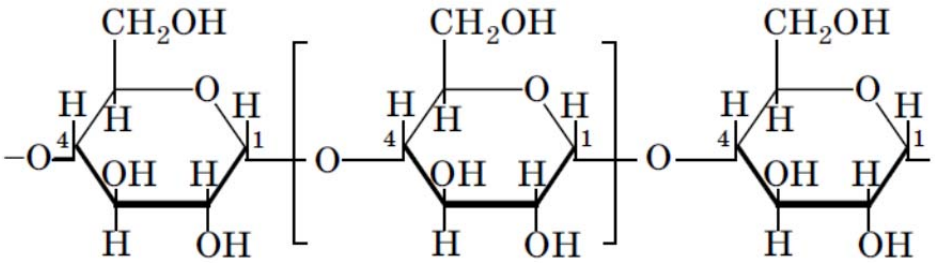
Maltoza ikki molekula α-D-glyukozadan tuzilgan. Shing uchin maltoza gidrolizidan faqat glyukoza hosil bo‘ladi.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow 2\underset{\text{glyukoza}}{C_6H_{12}O_6}$$

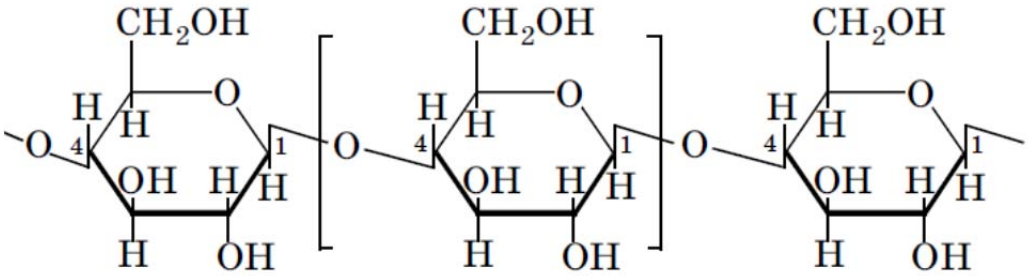
Mavzu: Polisaxaridlar – $(C_6H_{10}O_5)_n$

Polisaxaridlarga kraxmal, sellyuloza va glikogen kiradi.

Kraxmal α-D-glyukozalar zanjiridan tuzilgan:



Sellyuloza β-D-glyukozalar zanjiridan tuzilgan:



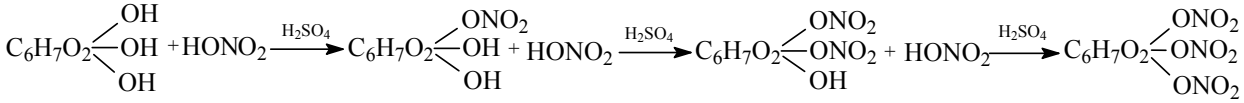
Kraxmal va sellyuloza gidrolizining oxirgi mahsuloti glyukoza hisoblanadi:

$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow{t^\circ C,\ H^+} nC_6H_{12}O_6$$

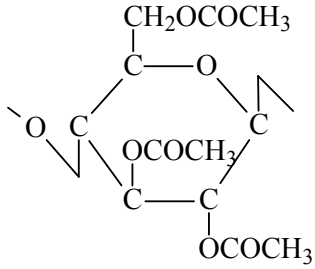
Kraxmalning sekin gidrolizlanib, glyukoza hosil bo‘lish jarayonini quyidagicha tasvirlash mumkin:

$$\underset{\text{kraxmal}}{(C_6H_{10}O_5)_n} \rightarrow \underset{\text{dekstrin}}{(C_6H_{10}O_5)_m} \rightarrow \underset{\text{maltoza}}{C_{12}H_{22}O_{11}} \rightarrow \underset{\text{glyukoza}}{C_6H_{12}O_6}$$

Sellyuloza molekulasida 3 ta gidroksil guruh bo‘ganligi uchun u nitrat kislota bilan mono-, di- va trinitrohosilalarni hosil qiladi. Hosil bo‘lgan mahsulotlar murakkab efir hisoblanadi:



sellyuloza — mononitroselyuloza — dinitroselyuloza — trinitroselyuloza

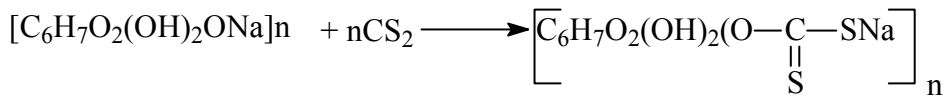


Trinitrosellyuloza – piroksilin tutunsiz porox sifatida ishlatiladi.

Shuningdek sellyuloza sirka kislota bilan atsetat efirlar hosil qiladi. bu efirlar sun’iy atsetat tolalar olishda ishlatiladi:

Sellyuloza ksantogenati quyidagicha olinadi:

$$[C_6H_7O_2(OH)_3]n + nNaOH \longrightarrow [C_6H_7O_2(OH)_2ONa]n + nHOH$$



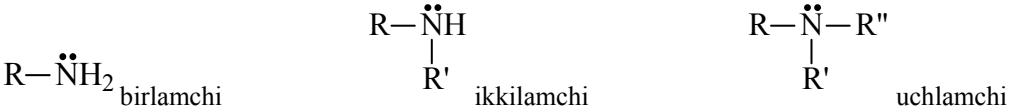
IV BOB. AZOT SAQLOVCHI ORGANIK BIRIKMALAR

Mavzu: Aminlar

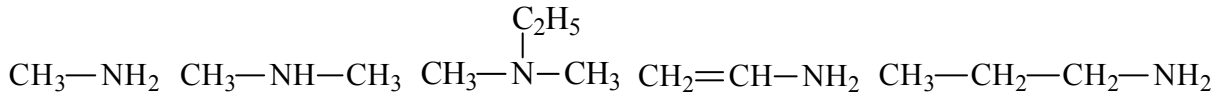
Ta'rif: *Ammiak molekulasidagi bitta, ikkita yoki uchta vodorod atomining uglevodorod radikaliga almashinishidan hosil bo'lgan organik moddalar sinfiga aminlar deyiladi.*

Nomlanishi va izomeriyasi:

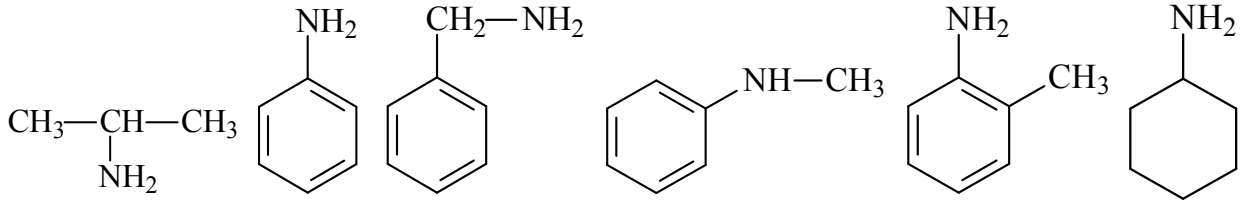
Aminlar ammiakdagi vodorod almashinish darajasiga ko'ra birlamchi, ikkilamchi va uchlamchi aminlarga bo'linadi:



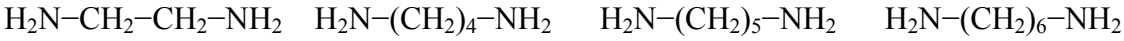
Aminlarni nomlash uchun azotga tutash radikallar nomi aytiladi:



metilamin dimetilamin dimetiletilamin vinilamin 1-aminopropan, propilamin



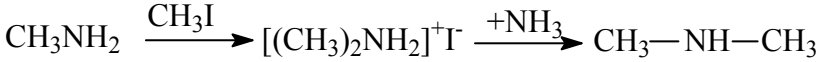
2-aminopropan izopropilamin fenilamin anilin benzilamin N'-metilanilin o'-toluidin siklogeksilamin

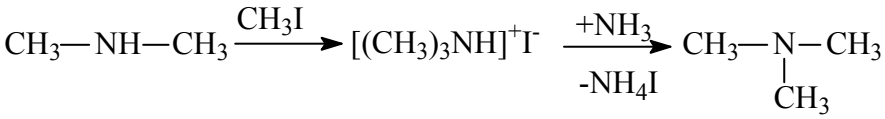


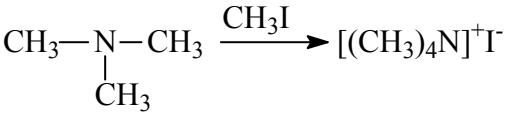
etilendiamin tetrametilendiamin putressin pentametilendiamin kadaverin geksametilendiamin

Olinishi:

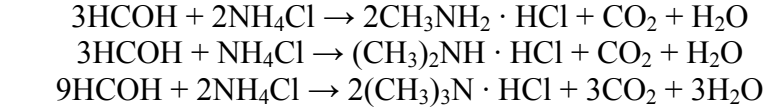
1) Ammiak va aminlarni galgenalkanlar bilan alkillab olinadi (A.V.Gofman bo'yicha):



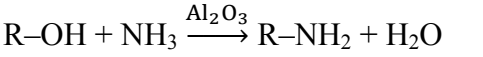




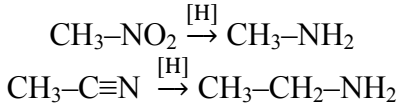
2) Metilamin, dimetilamin va trimetilamin ammoniy xloridga yuqori temperaturada formaldegid ta'sir ettirib olinadi:

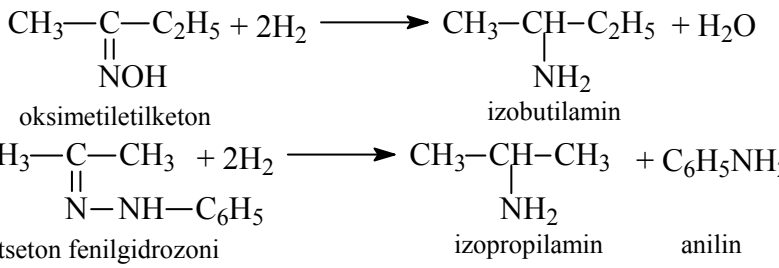


3) Spirtlarning Al_2O_3 katalizatori ishtirokida ammiak bilan ta'siridan olinadi:



4) Nitrobirikmalarni, oksimlarni, gidrozonlarni yoki nitrillarni katalitik gidrogenlab olinadi:

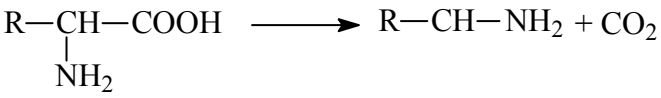




5) Kislota amidlariga ishqoriy muhitda gipoxlorit tuzlari ta'sir ettirib olinadi:

$$CH_3CONH_2 + 2NaOH + NaOCl \rightarrow CH_3NH_2 + Na_2CO_3 + NaCl + H_2O$$

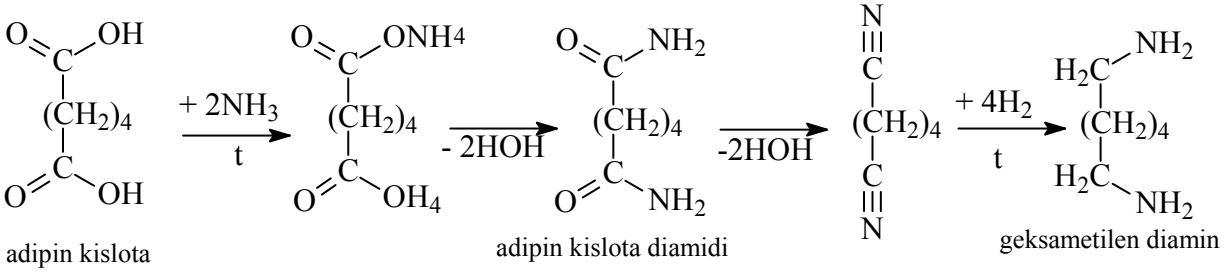
6) Aminokislotalar bakteriyalar ta'sirida parchalanib (dekarboksillanib) aminlarni hosil qiladi:



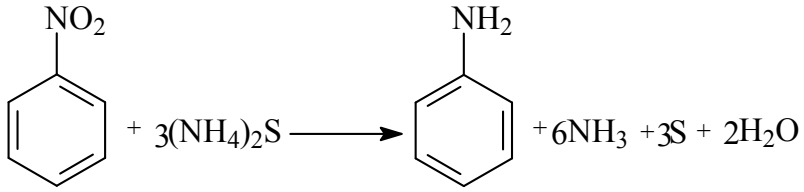
7) Etilendiamin 1,2-dibrometanga ammiak ta'siridan olinadi:

$$Br{-}CH_2{-}CH_2{-}Br + 2NH_3 \rightarrow HBr \cdot H_2N{-}CH_2{-}CH_2{-}NH_2 \cdot HBr$$

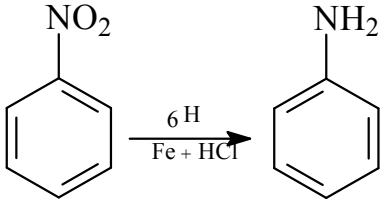
8) Geksametilendiamin quyidagicha olinadi:



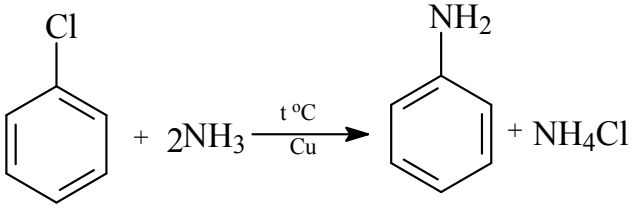
9) Anilinni birinchi bo'lib 1842 yil Zinin nitrobenzolni ammoniy sulfid bilan qaytarib olgan:



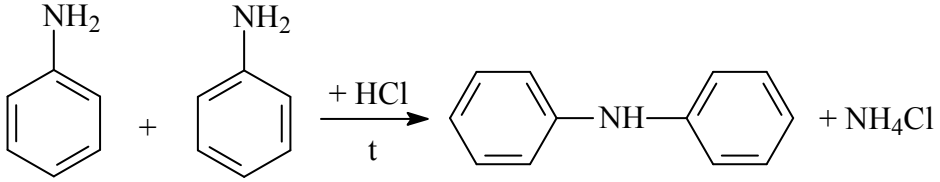
10) Hozirgi vaqtda anilin nitrobenzolni katalitik gidrogenlab olinadi:



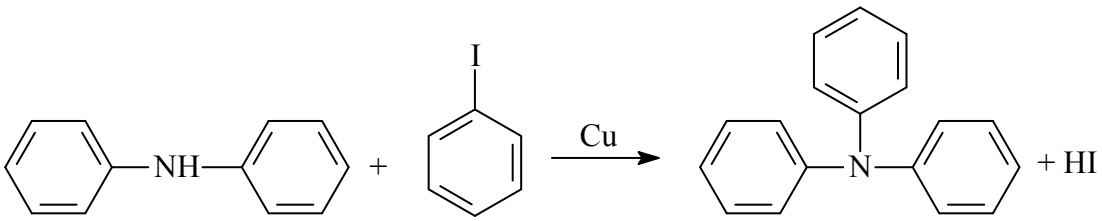
11) Galogenalkanlarga ammiak ta'sir ettirib olinadi:



12) Ikkilamchi aromatic aminlarni olish uchun birlamchi aminlar kislotali muhitda qizdiriladi:



13) Uchlamchi arpmatik aminlar esa ikkilamchi aromatic aminlarga mis katalizatori ishtirokida aril galoidlar ta'sir ettirib olinadi:



Fizikaviy xossalari:

Alkinaminlar rangsiz gaz yoki suyuqliklardir. Anilin o'ziga xos hidli moysimon suyuqlik.

Aminlarda molekulalararo vodorod bog'lanish mavjud.

Yuqori aminlar aminokislotalar parchalanishidan hosil bo'lganligi uchun ular aynigan baliq hidiga ega.

Molekula tuzilishi:

Aminlarda gibridlanish radikal tabiatiga bog'liq.

Kimyoviy xossalari:

Aminlar asoslik xossasini namoyon qiladi. Alifatik aminlar ammiakdan kuchliroq asos hisoblansa, aromatik aminlarning asosligi ammiaknikidan kuchsiz:

$$(C_6H_5)_3N \rightarrow (C_6H_5)_2NH \rightarrow C_6H_5NH_2 \rightarrow NH_3 \rightarrow CH_3NH_2 \rightarrow (CH_3)_2NH \rightarrow (CH_3)_3N$$

1) Aminlar mineral kislotalar bilan ta'sirlashib alkilammoniy tuzlarini hosil qiladi:

$$CH_3–NH_2 + HCl \rightarrow [CH_3–NH_3]^+Cl^-$$

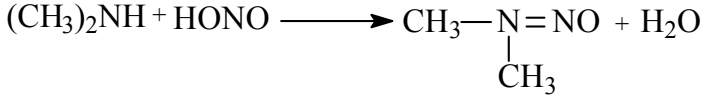
metilammnoniyxlorid

2) Aminlar nitrit kislota bilan ta'sirlashadi:

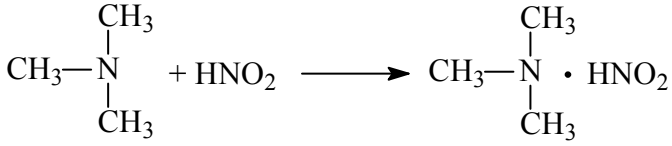
a) Birlamchi aminlar nitrit kislota bilan ta'sirlashganda spirt, azot va suv hosil bo'ladi:

$$CH_3–NH_2 + HONO \rightarrow CH_3–OH + N_2 + H_2O$$

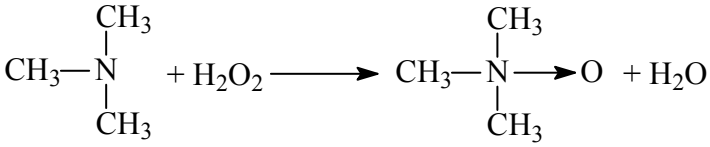
b) Ikkilamchi aminlar nitrit kislota ta'sirida nitrozaaminlarni hosil qiladi:



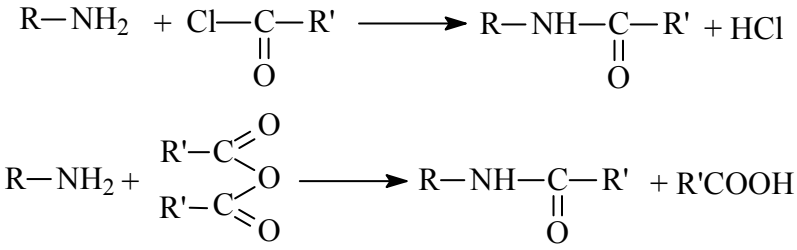
c) Uchlamchi aminlar nitrit kislota ta'sitiga chidamli bo'lib, tuz hosil bo'ladi:



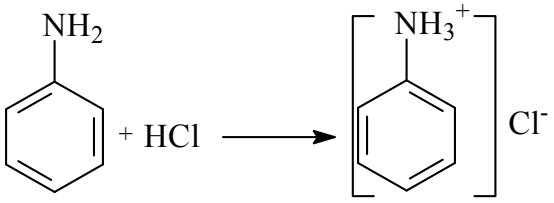
3) Uchlamchi aminlar peroksidlar ta'sirida oksidlanib, N-oksibirikmalarni hosil qiladi:



4) Birlamchi va ikkilamchi aminlarga organik kislota nagidridlari va galogenangidridlari ta'sir ettirlsa amidlar hosil bo'ladi. Bu reaksiya aminoguruh vodorodi hisobiga sodir bo'lganligidan, uchlamchi aminlar atsillanmaydi:

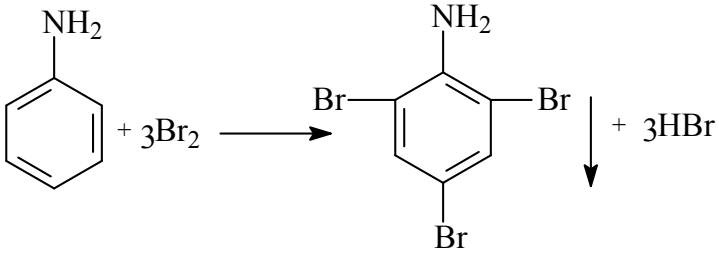


5) Anilin kislotalar bilan xuddi alifatik aminlardek ta’sirlashadi:



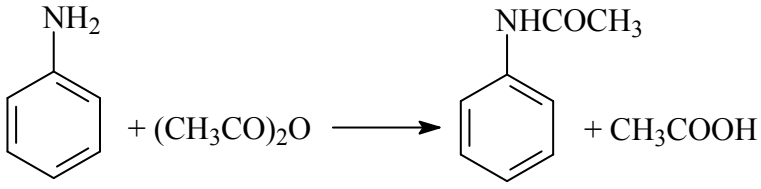
fenilammoniyxlorid

6) Aminoguruh I tur o‘rinbosar hisoblanganligi uchun reaksion markazni o‘ va p’ holatga yo‘naltiradi:

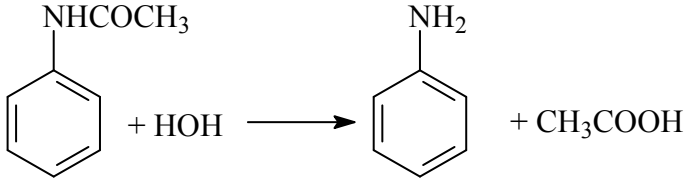


2,4,6-tribromanilin

7) Aromatic aminlar alkilaminlarga o‘xshash alkillanish va atsillanish reaksiyalariga kirishadi:

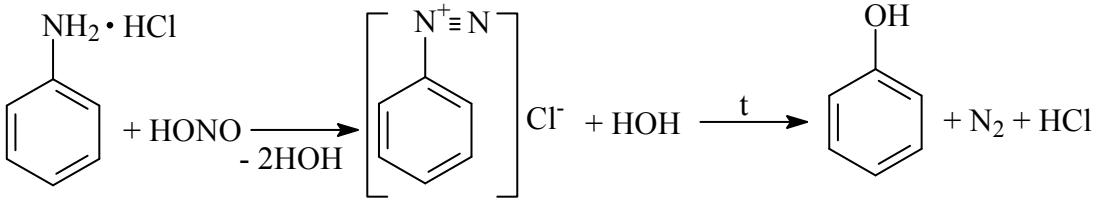


asetanilid

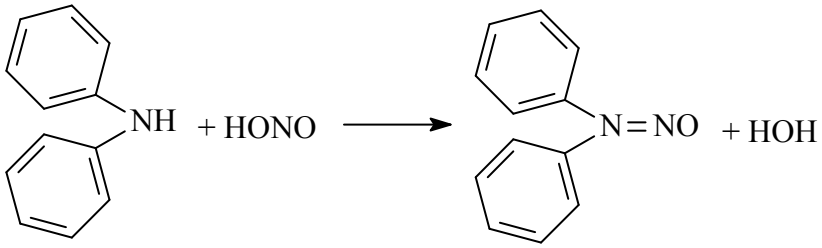


8) Aromatic aminlarga nitirit kislota ta’siridan aminlarning birlamchi, ikkilamchi yoki uchlamchiligi aniqlanadi:

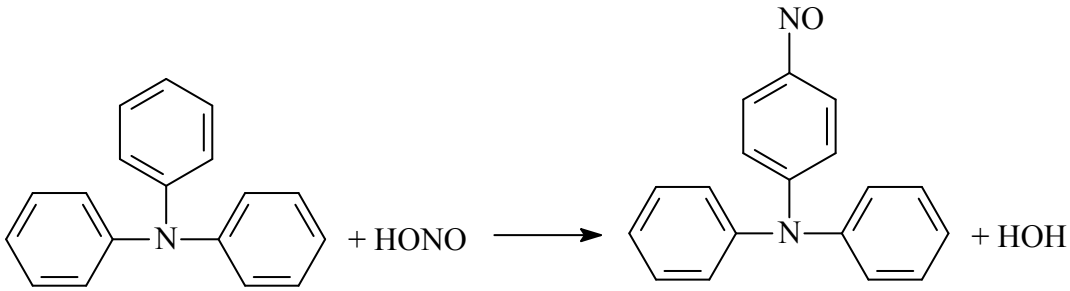
a) Birlamchi aromatik aminlardan dastlab diazoniy tuzi, suv ta’siridan esa fenol hosil bo‘ladi:



b) Ikkilamchi aromatik aminlardan nitrozoaminlar hosil bo‘ladi:



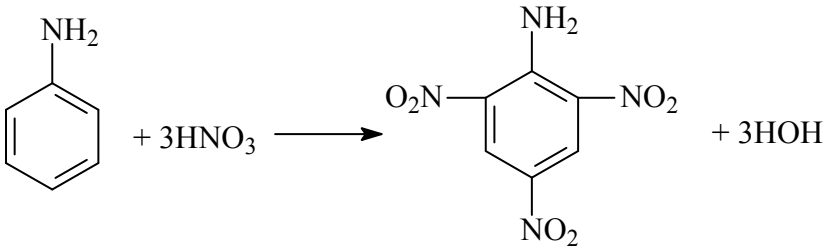
c) Uchlamchi aromatik aminlardan paranitrozo birikmalar hosil bo‘ladi:



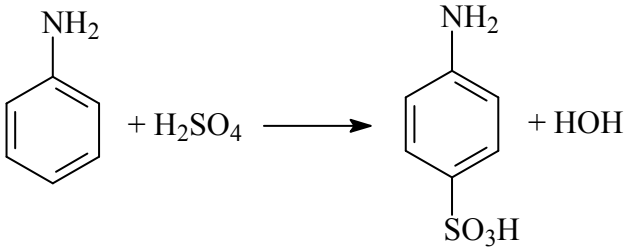
9) Aminlar yonganda karbonat angidrid, azot va suv hosil bo‘ladi:

$$4CH_3–NH_2 + 9O_2 \rightarrow 4CO_2 + 2N_2 + 10H_2O$$

10) Anilin nitrat kislota bilan pikramid, sulfat kislota bilan sulfanil kislota hosil qiladi:



pikramid



sulfanil kislota

Ishlatilishi:

Anilin bo‘yoqlar va portlovchi moddalar olishda ishlatiladi. Metilamin va dimetilamin dori ishlab chiqarishda ishlatiladi.

Mavzu: Nitrobirikmalar

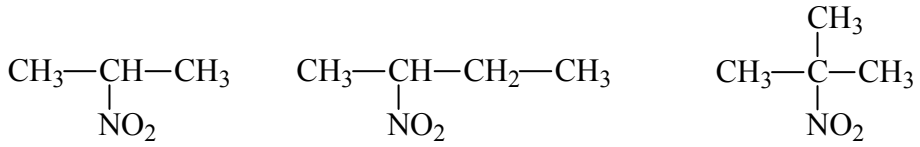
Ta’rif: *Molekuladagi uglerod atomleri bevosita nitroguruh –NO_2 bilan bog‘langan organik moddalar sinfiga nitrobirikmalar deyiladi.*

Umumiy formulasi: R−NO_2

Nomlanishi va izomeriyasi:

IUPAC bo‘yicha nitroguruh yaqin tomondan raqamlanib, uglevodorod nomidan oldin tegishli raqam bilan nitro so‘zi qo‘shib aytiladi:

$CH_3−NO_2$	$C_2H_5−NH_2$	$CH_3−CH_2−CH_2−NO_2$	$CH_3−CH_2−CH_2−CH_2−NO_2$
nitrometan	nitroetan	1-nitropropan (birlamchi nitropropan)	1-nitrobutan (birlamchi nitrobutan)



2-nitropropan
ikkilamchi nitropropan

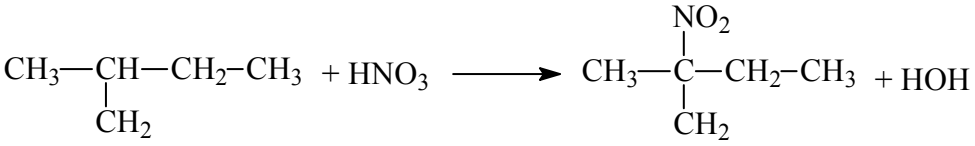
2-nitrobutan
ikkilamchi nitrobutan

2-nitro-2-metilpropan
uchlamchi nitrobutan

Olinishi:

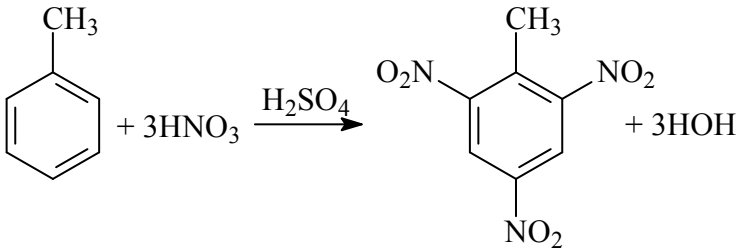
Organik moddalarga nitroguruh kiritish nitrolash deyiladi.

1) To‘yingan uglevodorodlarga 150-475°C nitrat kislota ta’sir ettirish (Konovalov reaksiyasi):



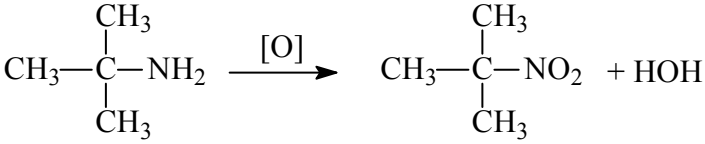
2-nitro-2-metilbutan

2) Aromatik birikmalarga kons. $HNO_3+H_2SO_4$ ta’sir ettirib olinadi:



2,4,6-trinitrotoluol

3) Aminlarni oksidlab olinadi:



Fizikaviy xossalari:

Nitrobirikmalarning quyi vakillari qo‘lansa hidli suvda erimaydigan rangsiz suyuqliklardir. Ularning qaynash temperaturasi molekulyar massa ortishi bilan oshib, zichligi kamayadi.

Kimyoviy xossalari

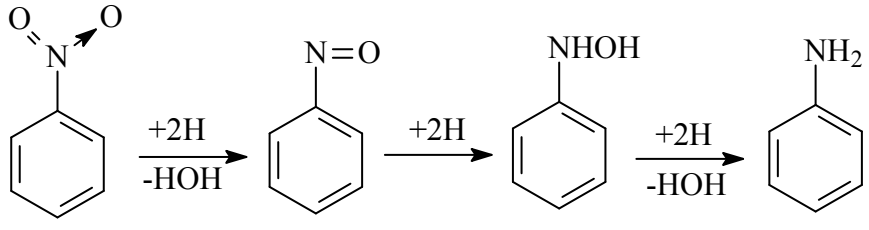
1) Nitrobirikmalar qaytarilganda birlamchi aminlar hosil bo‘ladi:

$$CH_3{-}NO_2 + 3H_2 \rightarrow CH_3{-}NH_2 + 2H_2O$$

Bu reaksiya nitrobirikmalardagi azot uglerod bilan bevosita bog‘langanligini ko‘rsatadi. Nitrobirikmalarning izomerlari – nitrit kislota efirlari qayatarilganda spirt va gidroskilamin/ammiak hosil bo‘ladi:

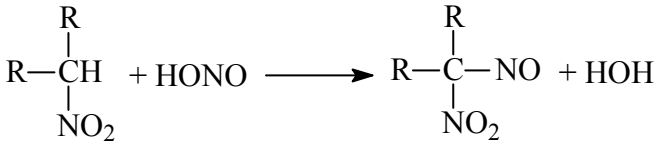
$$CH_3{-}O{-}N{=}O + 2H_2 \rightarrow CH_3{-}OH + NH_2OH$$

2) Nitrobenzol qaytarilganda yakuniy mahsulot anilin hisoblansada, oraliq mahsulotlar ham hosil bo‘ladi:



nitrozobenzol fenilgidroksilamin

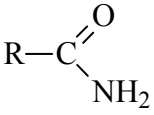
3) Ikkilamchi nitrobirikmalar nitrit kislota bilan birib psevdonitrollarni hosil qiladi. Uchlamchi nitrobirikmalar nitrit kislota bilan ta’sirlashmaydi.



psevdonitrol

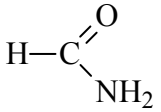
Mavzu: Amidlar

Ta'rif: *Karbon kislota karboksil guruh gidroksil guruhi –OH amino guruhga –NH2 almashingan karbon kislota hosilalariga aytiladi.*

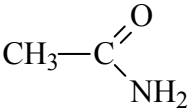
Umumiy formulasi: 

Nomlanishi va izomeriyasi:

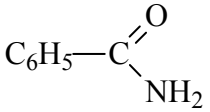
Amidlarni nomlash uchun kislota nomiga amid so'zi qo'shiladi.



chumoli kislota amidi
formamid



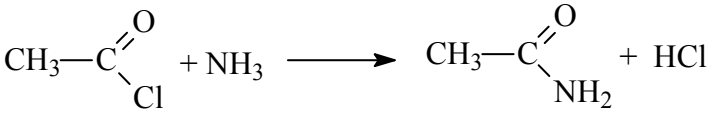
sirka kislota amidi
atsetamid

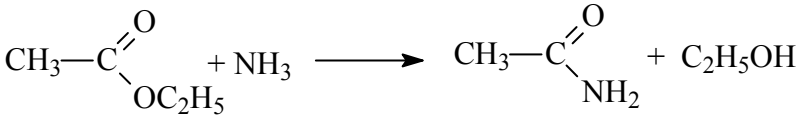


benzoy kislota amidi
benzamid

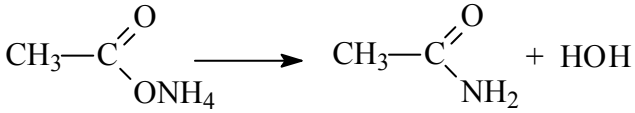
Olinishi:

1) Karbon kislota galogen angidridlariga yoki murakkab efirlarga ammiak ta'siridan:

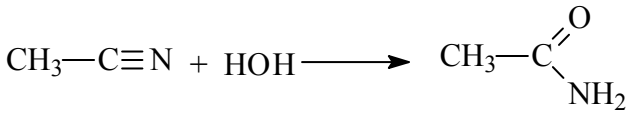




2) Kislotalarning ammoniyli tuzlarini qizdirib:



3) Kislota nitrillarini gidroliz qilib olinadi:

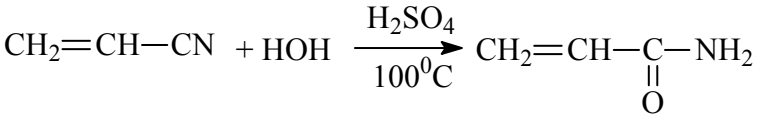


4) Mochevinani 1-bo'lib F.Vyoler ammoniy sianatdan olgan:

$$NH_4OCN \rightarrow CO(NH_2)_2$$

5) Hozirda mochevina angidridga ammiak ta'siridan olinadi:

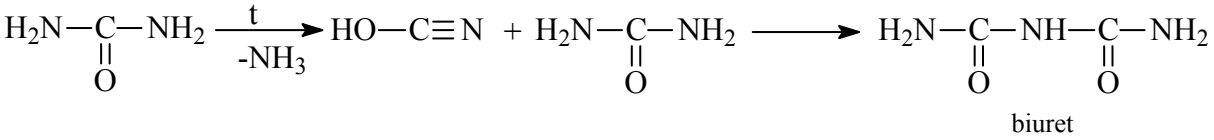
6) Akrilamid akril kislota nitrilini gidroliz qilib olinadi:



akrilamid

Kimyoviy xossalari:

1) Mochevina 140°C gacha qizdirilganda biuret hosil bo‘ladi:



2) Mochevina suv bilan qizdirilganda qaytadan ammiak va karbonat angidridga parchalanadi:

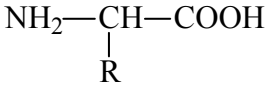
$$CO(NH_2)_2 + H_2O \rightarrow CO_2 + 2NH_3$$

Ishlatilishi:

Mochevina o‘g‘it sifatida va qoramollarga oziq sifatida ishlatiladi. Poliakrilamid suvni tozalashda, oltinni qayt ishlash sanoatida, qog‘oz sanoatida ishlatiladi.

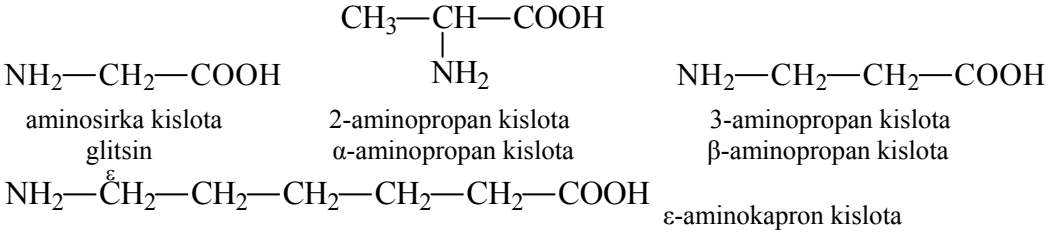
Mavzu: Aminokislotalar

Ta’rif: *Tarkibida ham amino –NH_2 ham karboksil –COOH guruh tutgan organik moddalarga aminokislotalar deyiladi.*

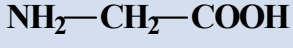
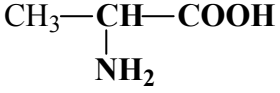
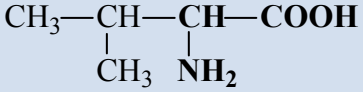
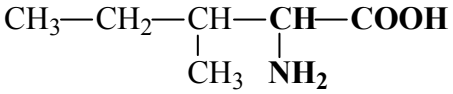
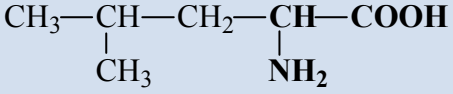
Umumiy formulasi: 

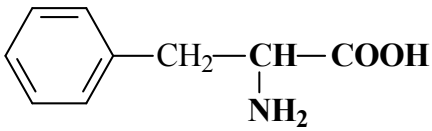
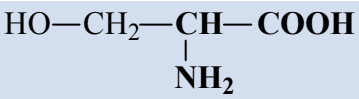
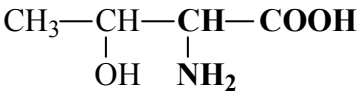
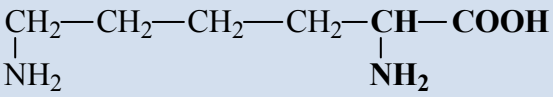
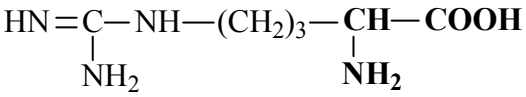
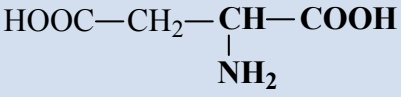
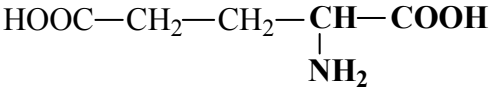
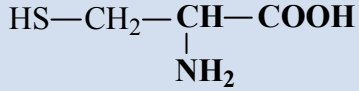
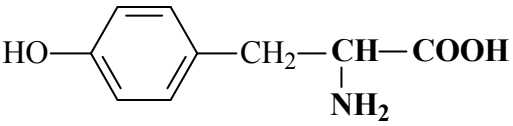
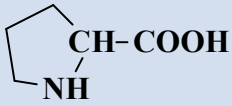
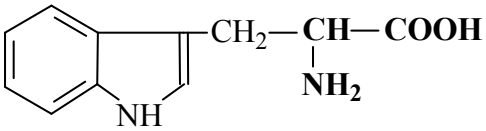
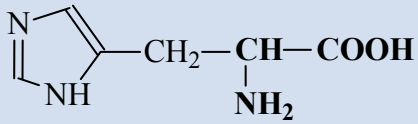
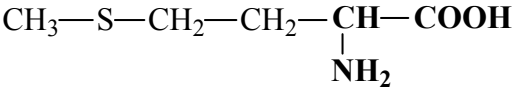
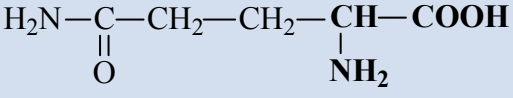
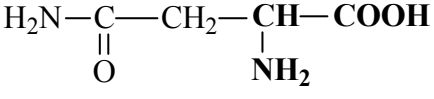
Nomlanishi va izomeriyasi:

Aminokislotalarda karboksil guruh 1 deb olinib, aminoguruh joyi qo‘shib aytiladi. Shuningdek karboksil guruhdan keying uglerod α holatga nisbatan nomlanadi:



Eng ko‘p uchraydigani bu α-aminokislotalar hisoblanadi:

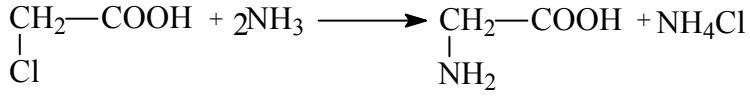
№	*Nomi*	*Formulasi*	*Belgisi*	*Harfli belgisi*
1	Glitsin		Gly	G
2	Alanin		Ala	A
3	Valin		Val	V
4	Izoleysin		Ile	I
5	Leysin		Leu	L

6	Fenilalanin		Phe	F
7	Serin		Ser	S
8	Treonin		Thr	T
9	Lizin		Lys	K
10	Arginin		Arg	R
11	Asparagin kislota		Asp	D
12	Glutamin kislota		Glu	E
13	Sistein		Cys	C
14	Tirozin		Tyr	Y
15	Prolin		Pro	P
16	Triptofan		Trp	W
17	Gistidin		His	H
18	Metionin		Met	M
19	Glutamin		Gln	Q
20	Asparagin		Asn	N

Olinishi:

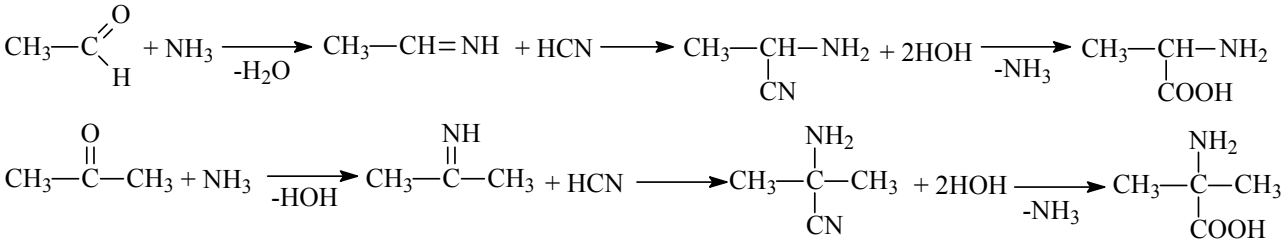
Aminokislotalar oqsillarning monomeri hisoblanadi. Shuning uchun ular oqsil gidrolizidan hosil bo‘ladi.

1) Karbon kislotaning gelogenli hosilalariga ammiak ta’siridan olinadi:

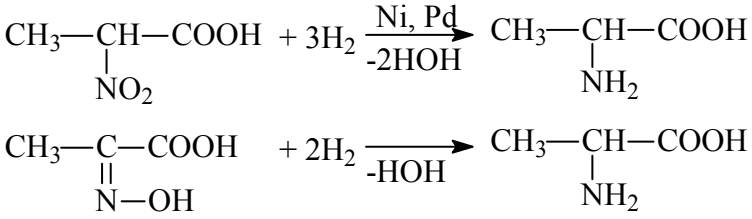


2-xlorsirka kisloata — 2-aminosirka kislota

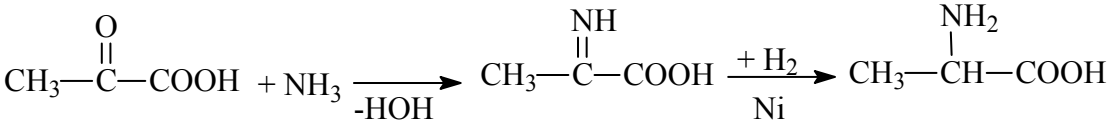
2) Aldegid va ketonlarning sianid kislota bilan aralashmasiga ammiak ta’siridan aminonitril olinib, u gidrolizlanganda α-aminokislota hosil bo‘ladi:



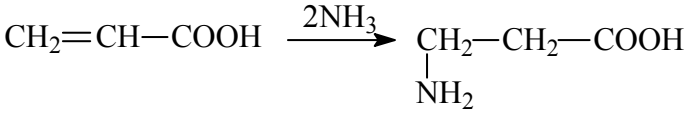
3) Nitrokislotalar va oksimlarni qaytarib olinadi:



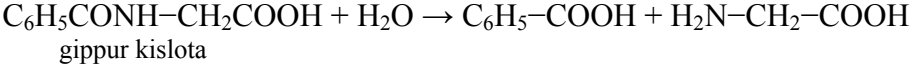
4) Aldegido va leto – kislotalarni ammiak ishtirokida katalitik qaytarib olinadi:



5) To‘yinmagan kislotalarga ammiak ta’sir ettirib olinadi:

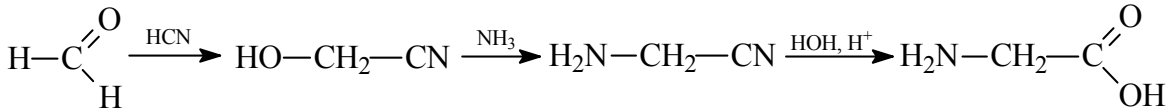


6) Glitsinni gippur kislota gidrolizidan olish mumkin:



gippur kislota

7) Glitsinni formaldegiddan olish mumkin:

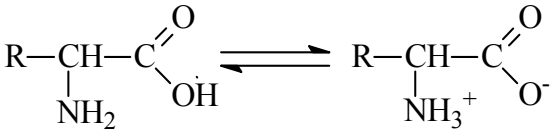


Fizikaviy xossalari:

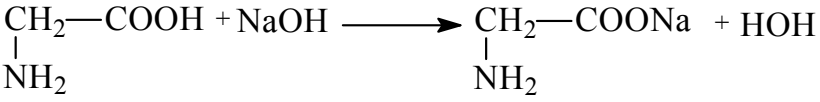
Aminokislotalar rangsiz kristall moddalar bo‘lib, suvda yaxshi eriydi. Organik erituvchilarda kam eriydi. Ko‘pchiligi shirin ta’mli.

Kimyoviy xossalari:

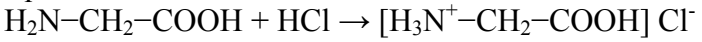
Aminokislotalarda ham amino (asos), ham karboksil (kislota) guruh bo‘lganligi uchun ular ichki tuz – betainlarni hosil qiladi:



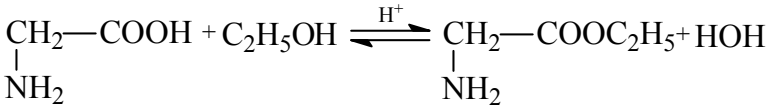
1)Aminokislotalar kuchsiz kislotalik xossasini namoyon qiladi. Ular ishqorlar bilan ta'sirlashib tuzlarni hosil qiladi:



2) Aminokislotalar aminoguruh hisobiga asoslik xossasini namoyon qiladi va kislotlar bilan tuzlar hosil qiladi:

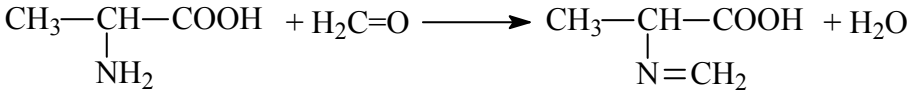


3)Aminokislotalar kislotalar ishtirokida spirtlar bilan eterifikatsiya reaksiyasiga kirishadi:

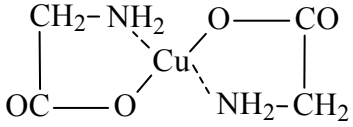


4)Aminokislotalar nigtrit kislota ta'sirida oksikislota, azot va suv hosil qiladi:

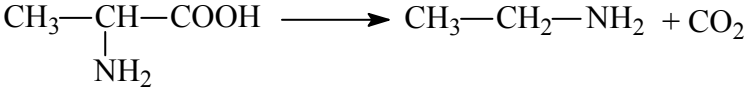
5)Aminokislotalarga formaldegid ta'sirida N−metilen hosilalar hosil qiladi:



6)Barcha α-aminokislotalar maxsus sharoitlarda mis tuzlari bilan ichki kompleks tuz-xelatlarni hosil qiladi:

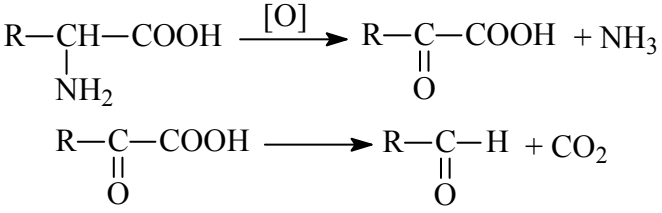


7) α-aminokislotalar dekarboksillanganda aminlar hosil bo‘ladi:



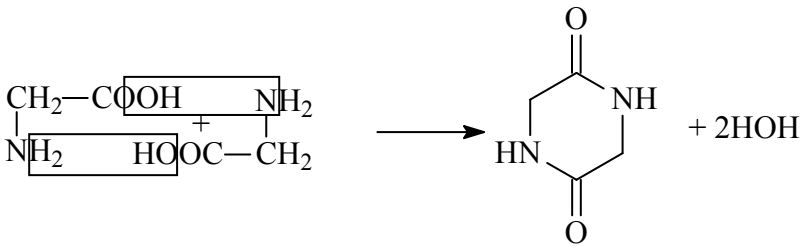
alanin etilamin

8)Aminokislotalar fermentative dezaminlanganda ketokislotalar hosil bo‘ladi:

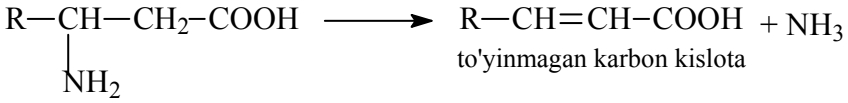


9)Aminokislotalarning temperaturaga munosabati oksikislotalarnikiga o‘xshash bo‘ladi

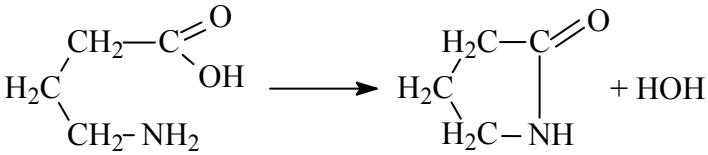
a) α-aminokislotalar qizdirilganda osonlik bilan suv ajralib diketopiperazalar hosil bo‘ladi:



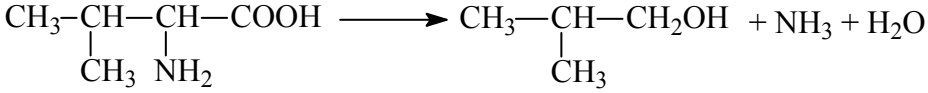
b) β-aminokislotalar qizidilganda ammiak ajralib chiqib, to‘yinmagan kislotalar hosil bo‘ladi:



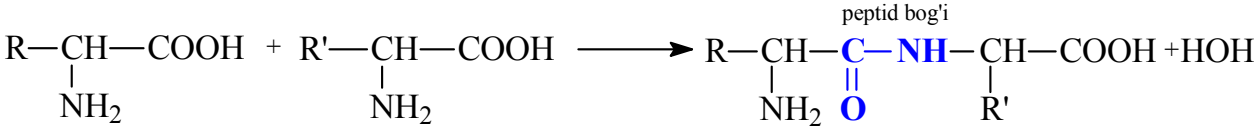
c) γ-aminokislotalar qizdirilganda degidratlanib, siklik amidlar – laktamlarni hosil qiladi:



10) Oqsil achisa tarkibidagi valin izobutil spirtga aylanadi:



11) Aminokislotalar o‘zaro kondensatlanib polipeptidlarni hosil qiladi:



dipeptid

Ishlatilishi:

Aminokislotalar muhim biologik moddalar hisoblanadi. Ular oqsillarning asosiy tarkibidir. ε-aminokapron kislota kaprolaktam olishda ishlatiladi. Kaprolaktam poliamid materiallar (naylon) olishda ishlatiladi.

Mavzu: Oqsillar

Ta’rif: *Bir-birlari bilan peptid bog‘lari orqali bog‘langan α-aminokislotalardan tashkil topgan tabiiy biopolimerlarga oqsillar deyiladi.*

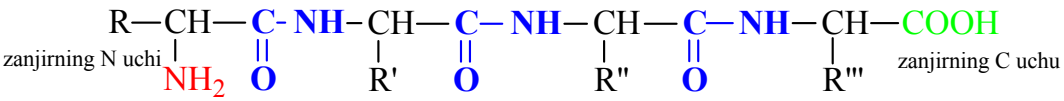
Oqsillar tarkibiga ko‘ra 2 ga bo‘linadi:

1) Proteinlar.
2) Proteidlar.

Proteinlar faqat aminokislotalar qoldig‘idan tuzilgan. Ular albuminlar (ular suvda eriydi, sut, tuxum va qon oqsili kiradi), globulinlar (suvda erimaydi, qon globilinlari va mushak oqsili – miozin kiradi), skleroproteinlar (suvda erimaydi, keratin, teri oqsili va fibroin kiradi)ga bo‘linadi.

Proteidlar – murakkab oqsillar, aminokislotalar va oqsil bo‘lmagan qoldiqlardan tuzilgan. Ularga fosfoproteidlar (fosfat kislota qoldig‘i tutgan oqsil, masalan, sut oqsili kazein), glikoproteidlar (uglevod qoldig‘i tutgan oqsillar), xromoproteidlar (rangli moddalar, masalan, gemoglobin), nukleoproteidlar (nuklein kislota qoldig‘i tutgan oqsillar) kiradi.

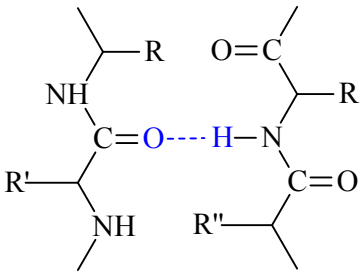
Oqsillar faqat α-aminokislotalar qoldig‘idan tuzilgan:



Oqsillar 4 xil strukturada mavjud bo‘ladi:

1) Birlamchi;
2) Ikkilamchi;
3) Uchlamchi;
4) To‘rtlamchi.

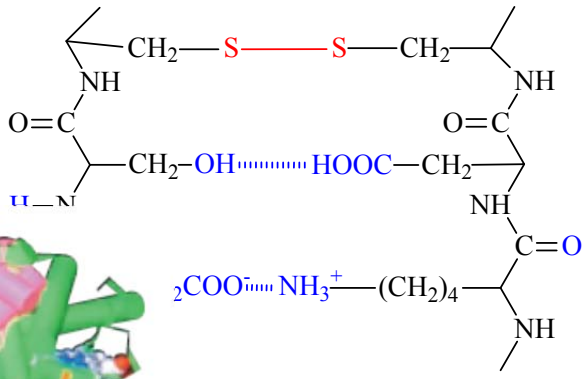
1) Oqsillarning birlamchi strukturasi aminokislotalarning chiziqli zanjiridir:



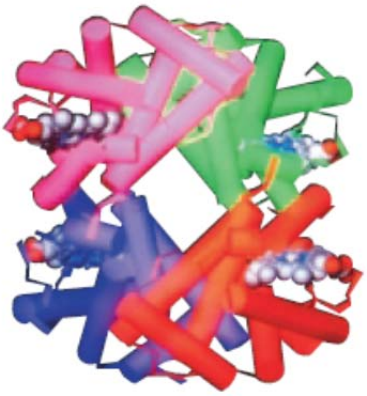
Phe-Val-Asn-Gln-His-Leu-Cys-Gly-Ser-His-Leu-Val-Glu-Ala-Leu-Tyr-Leu-Val-**Cys**

2) Oqsillarning ikkilamchi strukturasida aminokislotalar molekulasidagi karbonil va amino guruhlar orasida vujuga kelgan vodorod bog‘lari tufayli spiral fazoviy shaklga keladi:

3) Oqsilning uchlamchi strukturasi polipeptid zanjiridagi funksional guruhlari o‘zaro ta’sridan vujudga keladi. Bunda karboksil va aminoguruhdan tuz ko‘prigi, karboksil va gidroksil guruhdan murakkab efir ko‘prigi, oltingugurt atomlari o‘zaro bog‘lanishidan disulfid ko‘prigi, shuningdek gidrofob ta’sirlar natijasida hosil bo‘ladi.



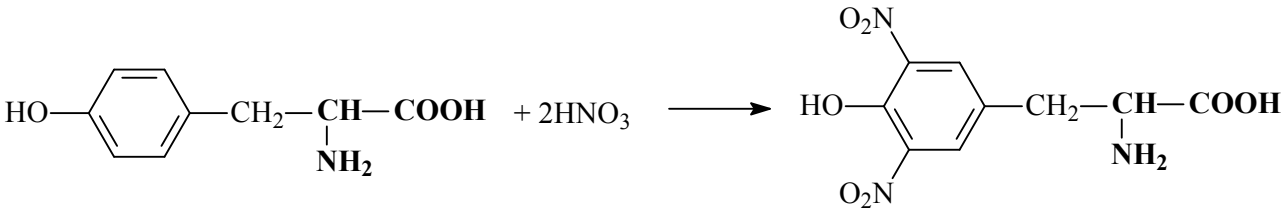
4) Oqsilning to‘rtlamchi strukturasida bir nechta oqsil molekulalari yig‘ilib, murakkab tuzsilishni hosil qiladi:



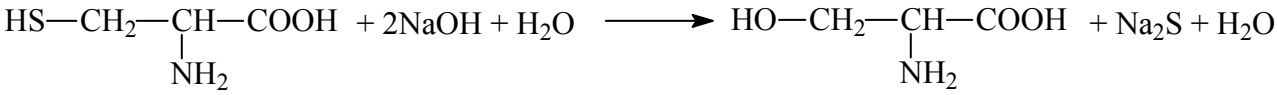
Oqsillarning barqarorligi turlicha kislotali yoki ishqoriy muhitda aminokislotalarni hosil qiladi.

Oqsillar tarkibiga turli funksional guruhlarning kirganligi rangli reaksiyalar yordamida aniqlanadi.

1) *Biuret* reaksiyasi – oqsilga ishqoriy muhitda $CuSO_4$ eritmasi qo‘shilganda binafsha rang hosil bo‘ladi. Bu peptid bog‘ga sifat reaksiya hisoblanadi. Masalan, dipeptide – ko‘k, tripeptid – binafsha, yuqori peptidlar esa qizil rangga kiradi.
2) *Ksantoprotein* reaksiyasi – aromatik va geteroatomli xalqali oqsillarga kons.HNO_3 qo‘shilganda, sariq rangga kiradi (xalqaning nitrolanishi). Ishqor qo‘shilganda sariq rang zarg‘aldoq rangga kiradi (fenilalanin va tirozin).



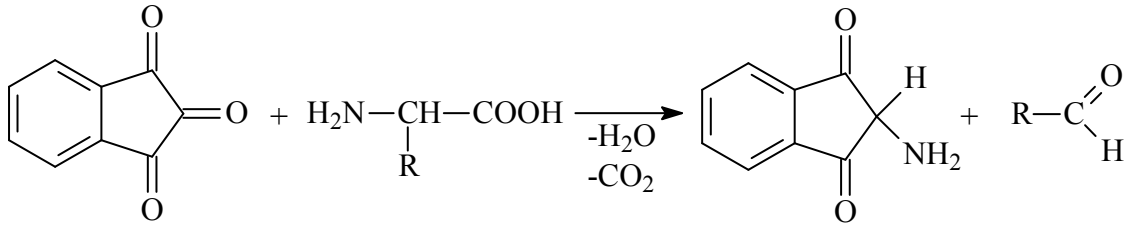
3) *Millon* reaksiyasi – oqsilga $Hg(NO_3)_2$, nitrit va nitrat kislota ta’sirida qizil-qo‘ng‘ir cho‘kma hosil bo‘ladi. Bu reaksiya tirozin va triptofanlar uchun xos.
4) *Foli reaksiyasi* – agar oqsil tarkibida oltingugurt tutsa, qo‘rg‘oshin tuzlari ta’sirida eritmada qora PbS cho‘kmasi hosil bo‘ladi.



sistein serin

$$Na_2S + Na_2PbO_2 + 2H_2O \rightarrow PbS\downarrow + 4NaOH$$

5) *Ningidrid reaksiyasi* – ningidrin eritmasi bilan α-aminokislota dezaminlanadi va dekarboksillanadi. Natijada ko‘k bo‘yalish ro‘y beradi.



ningidridn — aminodiketogidrinden (diketogidrindamin)

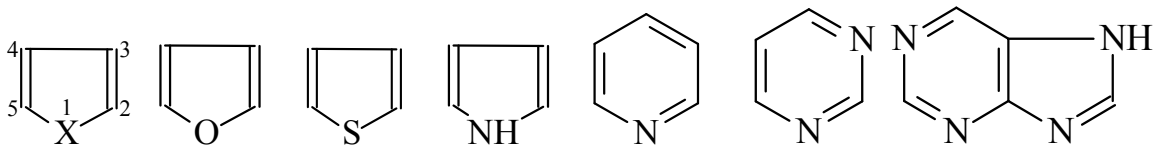
Oqsillar hayotning asosi hisoblanadi. Masalan, gemoglobin oqsili $(C_{738}H_{1166}O_{208}S_2Fe)_4$, insulin gormoni $C_{254}H_{377}N_{65}O_{75}S_6$ oqsillar shular jumlasiga kiradi.

Mavzu: Geterosiklik birikmalar

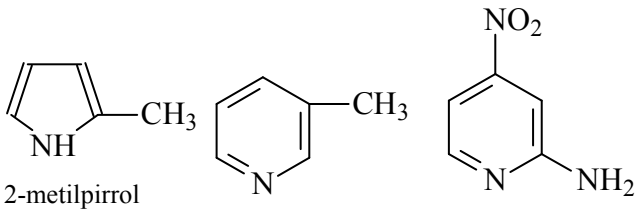
Ta'rif: *Xalqa tarkibida uglerod atomidan boshqa element atomlari (N, S, O) tutgan moddalarga geterosiklik birikmalar deyiladi.*

Nomlanishi va izomeriyasi:

Geterosiklda geteroatom 1 deb raqamlanib, sikl nomi aytiladi (ilovaga qarang):



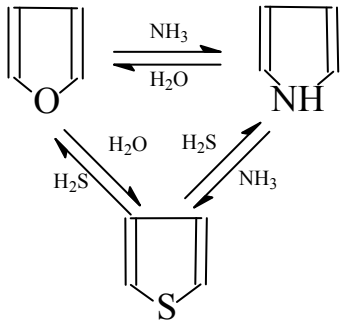
C_4H_4O furan; C_4H_4S tiofen; C_4H_5N pirrol; C_5H_5N piridin; $C_4H_4N_2$ pirimidin; $C_5H_4N_4$ purin



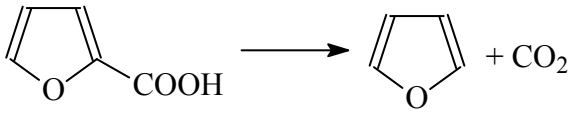
2-metilpirrol; β-metilpiridin; 4-nitro-2-aminopiridin

Olinishi:

1) Al_2O_3 katalizatori sihtirokida ularning bir-biriga aylanishini quyidagicha tasvirlash mumkin:

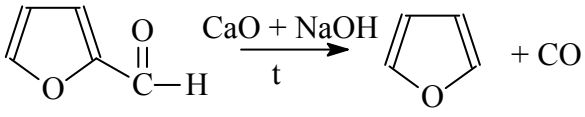


2) Furanni birinchi marta furilkarbon ksilota quruq haydab olingan:



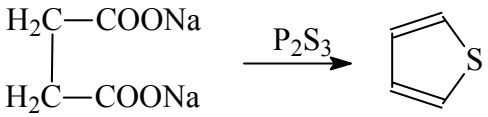
α-furilkarbon kislota

3) Furanni furfuroldan ham olish mumkin:

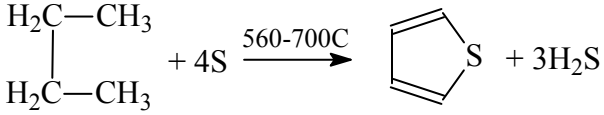


furfurol

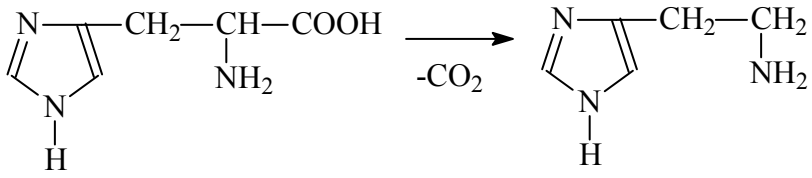
4) Tiofen qahrabo kislotaning natriyli tuziga P_2S_3 ta'sir ettirib olinadi:



5) Sanoatda tiofen butan va oltingugurt bug‘idan olinadi:

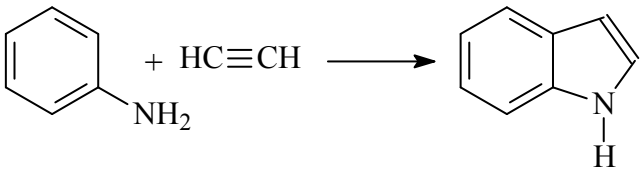


6) Gistamin gistidinni dekarboksillab olinadi:



gistidin gistamin

7) Indol anilinga atsetilen ta’siridan olish mumkin (Chichibabin reaksiyasi):

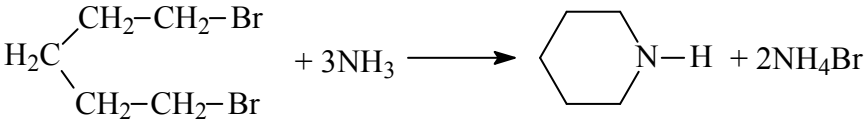


indol

8) Piriding atsetilen va sianid kislotadan olinishi mumkin:

$$2CH{\equiv}CH + HCN \rightarrow C_5H_5N$$

9) Piperidin 1,5-dibrompentanga ammiak ta’siridan olinadi:

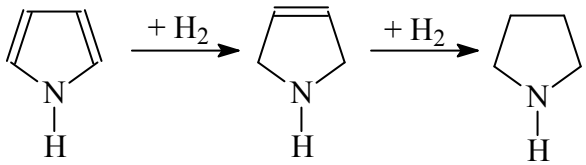


Fizikaviy xossalari:

Pirrol, tiofen va furan yoqimli hidli rangsiz suyuqliklardir.

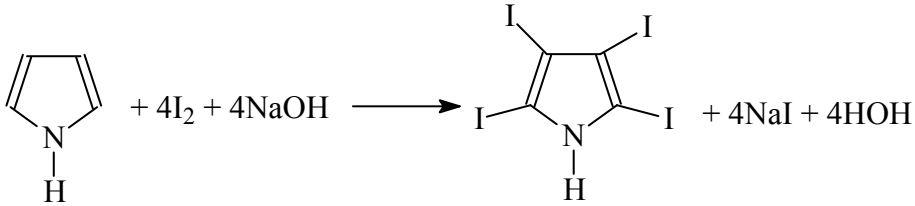
Kimyoviy xossalari:

1) Ularning barchasi gidrogenlanganda qo‘shbog‘ uziladi:

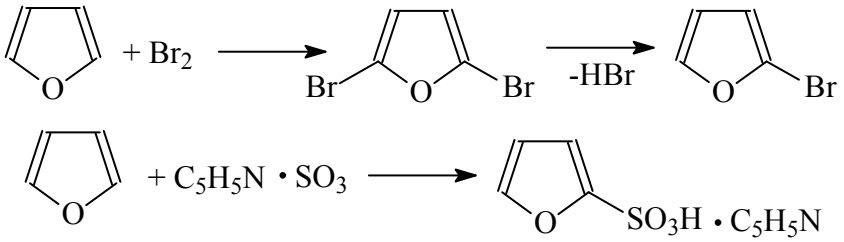


pirrolin pirrolidin

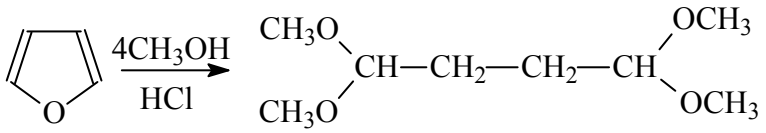
2) Pirrol va uning hosilalari aromatic xossani namoyon qiladi va xossalari jihatidan fenolga o‘xshaydi. U elektrofuil o‘rin olish reaksiyalariga oson kirishadi. Ishqoriy uhitda yodlanganda tetrayodli hosilaga aylanadi:



3) Furanda o‘rin olish reaksiyalari α-holatdagi uglerodga ro‘y beradi:

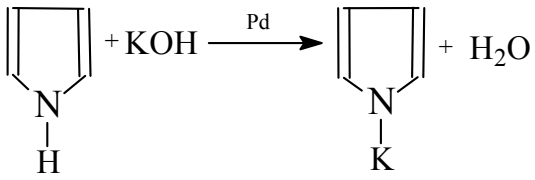


4) Furan xlorid kislota bilan to‘yintirilgan metanolda qizdirilganda xalqa ochiladi:

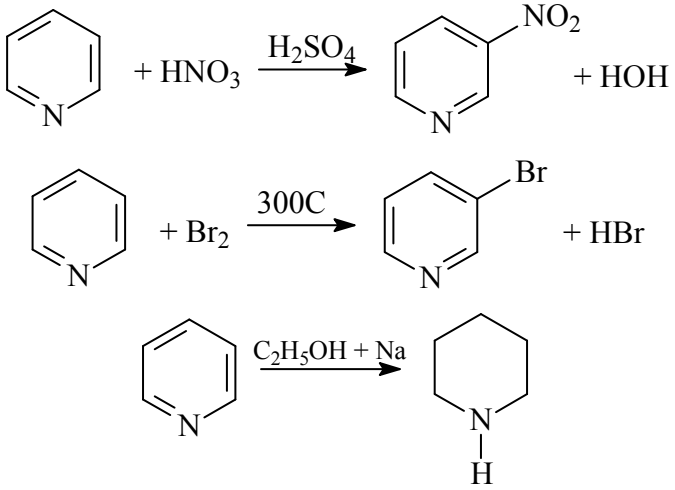


qahrabo dialdegid asetati

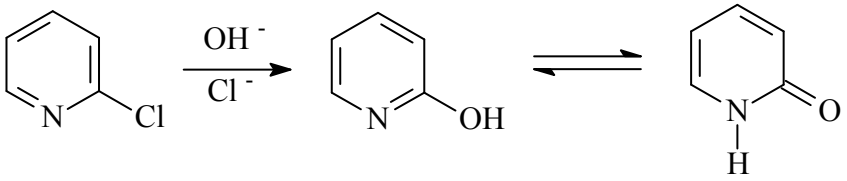
5) Pirrolning vodorodi nisbatan erkin. Shuning uchun u kuchsiz kislota xossasini namoyon qiladi:



6) Piridin S_E reaksiyalariga benzolga nisbatan qiyin kirishadi:

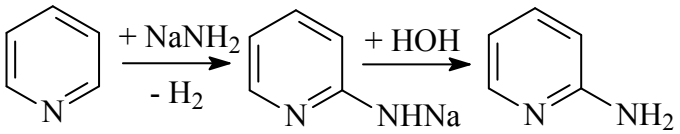


7) Piridin aksincha S_N reaksiyalariga oson kirishadi:

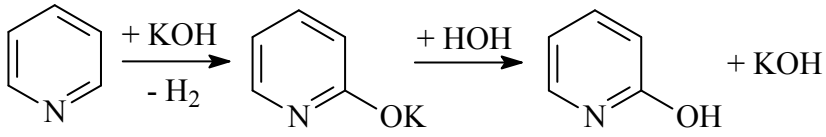


2-oksipiridin
(laktim shakli)

(laktam shakli)

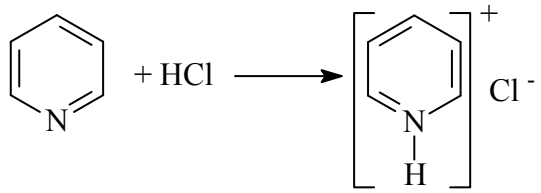


α-aminopiridin

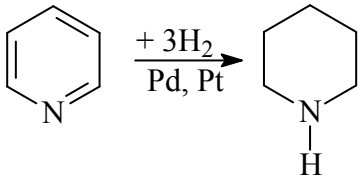


α-oksipiridin

8) Piridin kuchli mineral va organik kislotalar bilan yaxshi kristallanadigan tuzlar hosil qiladi:

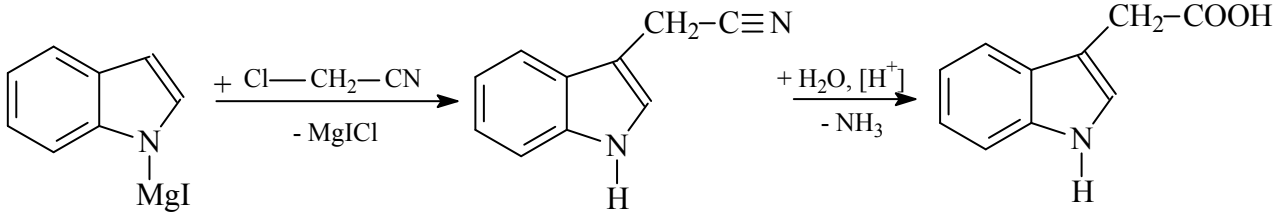


9) Piridin qaytarilganda piperidin hosil bo‘ladi:

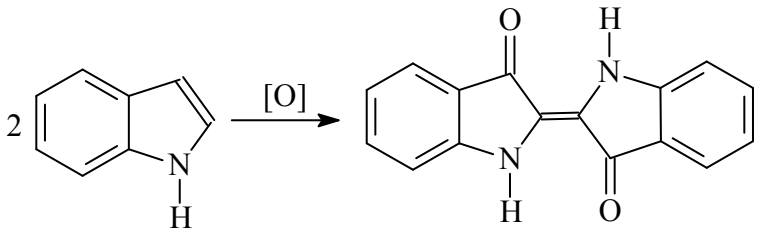


piperidin

10) *p*-indolil sirka kislota quyidagicha olinadi:

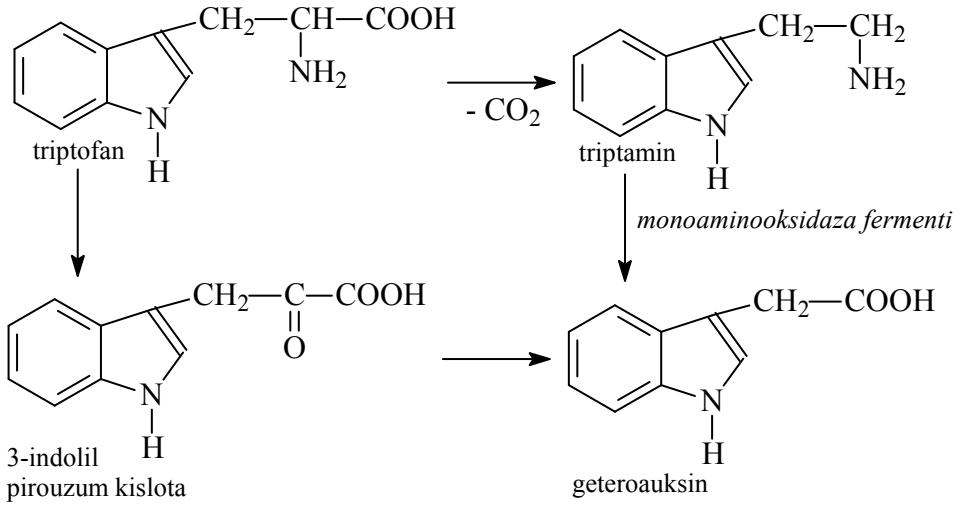


11) Indol oson oksidlanib indigo bo‘yog‘iga aylanadi:



indigo

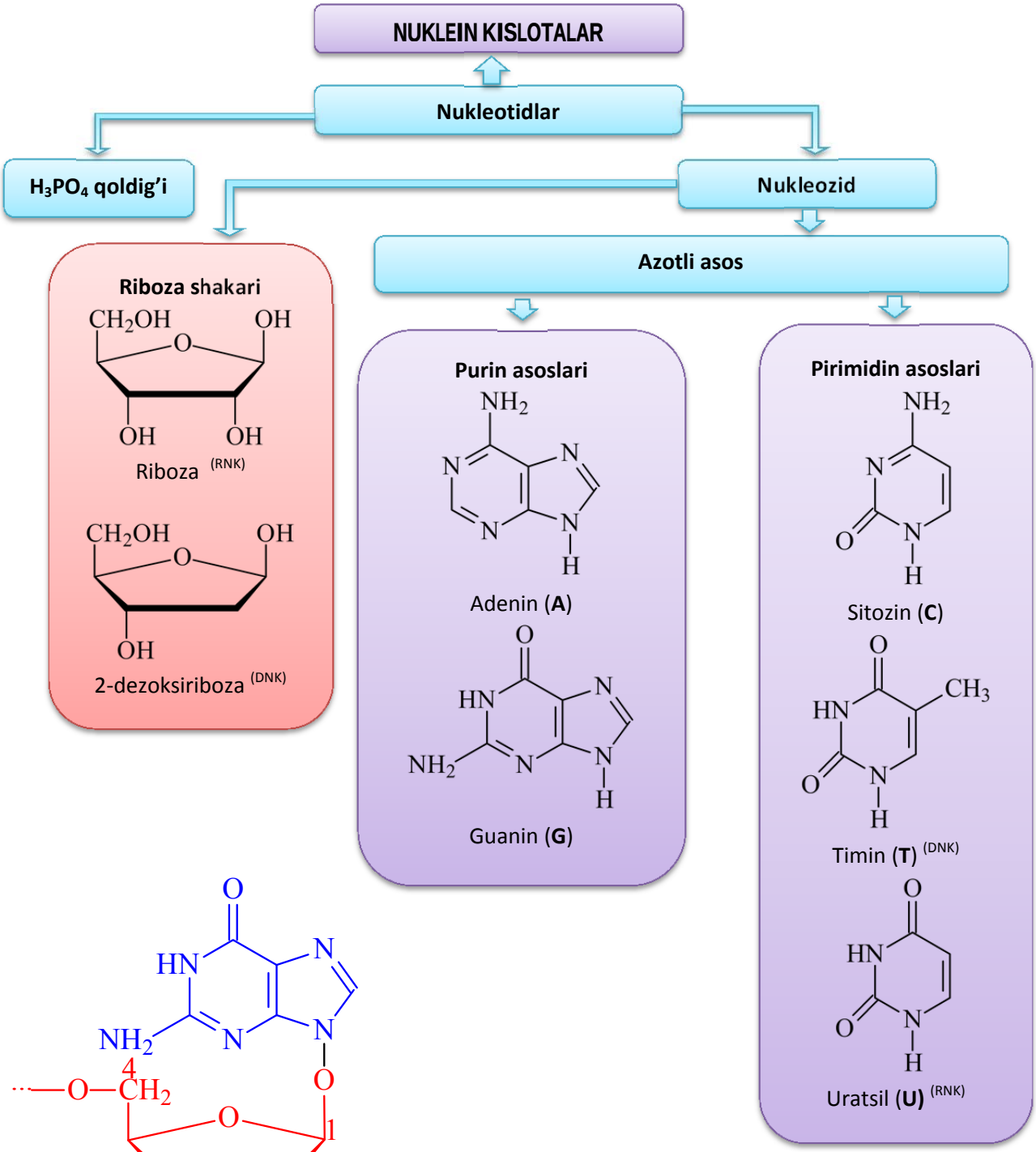
12) Tirik organizmdagi triptofan metabolizmini quyidagicha tasvirlash mumkin:



Ishlatilishi:
Pirrol va furan organik sintezda ishlatiladi. Piridin organik erituvchi sifatida ishlatiladi.

Mavzu: Nuklein kislotalar

Ta'rif: *Nukleotid monomerlarining makromolekulasiga nuklein kislotalar deyiladi.*



Nukleozidlar – bu purin va prirmidin asoslarining riboza yoki dezoksiriboza bilan birikmasidir.

Ribonuklein kislota molekulasini quyidagicha tasvirlash mumkin:

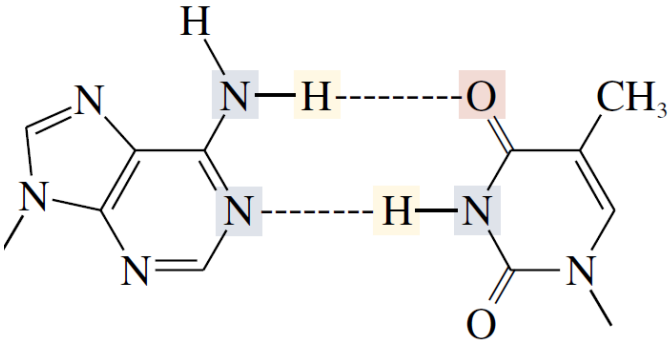
Zanjirda azotli asos bilan pentozaning 1’-uglerodi, fosfat kislota qoldig‘i bilan 3’-uglerodi va keyingi nukleozid bilan 5’-ulerod orqali bog‘langan.

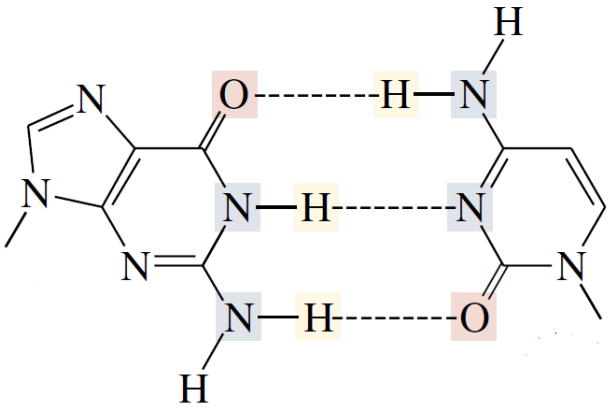
Hujayra tarkibida ribonuklein kislota (RNK) va dezoksiribonuklein kislota (DNK) farqlanadi.

RNK tarkibida *riboza*, fosfat kislota qoldig‘i, adenin, guanin, sitozin va *uratsil* bo‘ladi. DNK tarkibida esa *dezoksiriboza*, fosfat kislota qoldig‘i , adenin, guanin, sitozin va *timin* bo‘ladi.

DNK zanjiri qo‘shaloq spiral tuzilishga ega. Buni 1953 yilda (1962 yilgi Nobel mukofoti sovrindorlari) D.Uotson va F.Krik ochishgan. Bu ikki spiral bir-birlari bilan purin va pirimidin asoslari orasida vujudga keladigan *vodorod bog‘lanish* orqali bog‘langan bo‘ladi. Molekulalararo vodorod bog‘lanish *komplementar* (mos) juftlarni hosil qiladi.

Ya’ni adenin – guanin (A – T) jufti va sitozin – guanin (C – G) juftlari.





Adenin – timin orasida 2 ta, sitozin – guanin orasida 3 ta vodorod bog‘i mavjud.

Inson DNK si tarkibida purin va pirimidin asoslarining ulushi quyidagicha:

Purin	*Pirimidin*	*Asos nisbati*
Adenin (A) 30,3%	Timin (T) 30,3%	A/T=1,00
Guanin (G) 19,5%	Sitozin (C) 19,9%	G/C=0,98
Jami purinlar: 49,8%	Jami pirimidinlar: 50,1%	

RNK da timin asosiga uratsil asosi mos keladi.

V BOB. ELEMENT-ORGANIK BIRIKMALAR

Ta'rif: *Molekulasida uglerod atomi bilan bevosita bog'langan metal yoki metalmas atomiga ega birikmalar element-organik birikmalar deyiladi.*

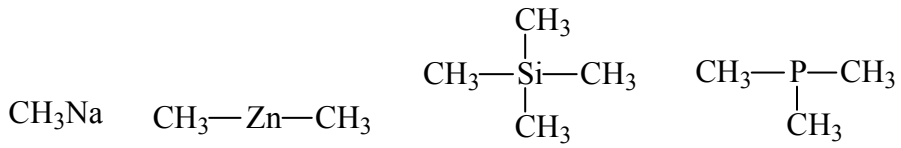
Element-organik birikmalarni 1-marta 1849-yil ingliz olimi E.Frankland sintez qilib, uglerod atomlari metallar bilan bog'lanishini ko'rsatdi:

$$C_2H_5{-}I + 2Zn + C_2H_5{-}I \rightarrow C_2H_5{-}Zn{-}C_2H_5 + ZnI_2$$

Element-organik birikmalar metal- va metalmas-organik birikmalarga bo'linadi.

Tuzilishiga ko'ra esa ular ikkiga: sof va aralash element-organik birikmalarga bo'linadi.

1. Sof element-organik birikmalarda element atomlari faqat uglevodorod radikali bilan bog'langan bo'ladi:



metil natriy — dimetil rux — tetrametil silan — trimetil fosfin

2. Aralash element-organik birikmalarda uglevodorod radikali bilan boshqa element ham birikkan bo'ladi:

magniy metilyodid — xlordimetil fosfin

Metal-organik birikmalarning eng muhimlari quyidagilar:

Magniy-organik birikmalar - R−MgX.

Birinchi bo'lib 1861-yil fransuz kimyogari F.Grinyar tomonidan ochilganligidan Grinyar reaktivi deyialdi. U yuqidagicha olingan:

$$RX + Mg \rightarrow R{-}MgX$$

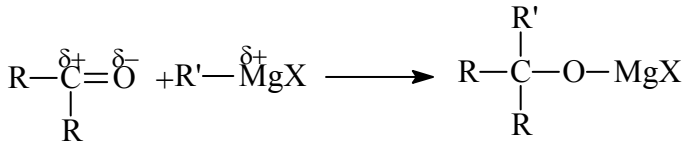
Tarkibida harakatchan vodorod bo'lgan moddalar (spirtlar, suv. aminlar va h.k.) Grinyar reaktivi bilan o'rin olish reaksiyalariga kirishib, alkanlar hosil bo'ladi:

$$HOH + R{-}MgX \rightarrow R{-}H + HO{-}MgX$$

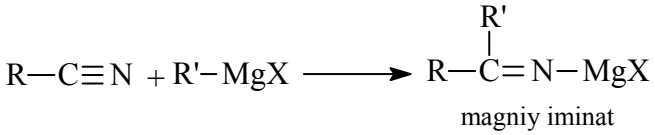
$$C_2H_5OH + R{-}MgX \rightarrow R{-}H + C_2H_5O{-}MgX$$

$$CH_3{-}NH_2 + R{-}MgX \rightarrow R{-}H + CH_3{-}NH{-}MgX$$

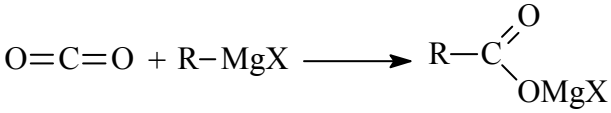
Magniy-organik birikmalar qutblangan qo'sh bog'li va uch bog'li moddalar bilan oson birikish reaksiyasiga kirishadi:



magniy alkoksid



magniy iminat



karbon kislotaning magniyli tuzi

Alyumiy-organik birikmalar.

Alyuminiy-organik birikmalar litiy yoki magniy-organik birimalar asosida olinadi:

$$3R{-}Li + AlCl_3 \rightarrow R_3Al + 3LiCl$$

Nemis olimi K.Sigler vodorod ishtirokida alkenlarga alyuminiy ta'sir ettirib olgan:

$$3CH_2{=}CH_2 + Al + 1{,}5H_2 \rightarrow (C_2H_5)_3Al$$

Oraliq metallarning hosil qilgan metal-organi birikmalarining Me−C σ-bog‘li birikmalari beqaror. Lekin π-kompleksli birikmalari ma’lum. Masalan, Pt(II) ning π-kompleksi 1827-yilda S.Seyze tomonidan olingan:

$$CH_2{=}CH_2 + K_2[PtCl_4] + H_2O \rightarrow K[C_2H_4PtCl_3]\cdot H_2O + KCl$$

Kremniy-organik birikmalar.

Silanlar SiO_2 bilan magniy qotishmasini kislota bilan parchalab olinadi:

$$4Mg + SiO_2 \rightarrow 2MgO + SiMg_2$$
$$SiMg_2 + 4HCl \rightarrow SiH_4 + 2MgCl_2$$

Silanlar suv ta’sirida parchalanadi:

$$SiH_4 + 2H_2O \rightarrow SiO_2 + 4H_2$$

Galogenlar ta’sirida silanlar metan kabi o‘rin olish reaksiyalariga kirishadi:

$$SiH_4 + nCl_2 \rightarrow SiH_{4-n}Cl_n + nHCl$$

Alkinsilanlar va ularning galogenli hosilalari barqaror bo‘lib, ular quyidagicha olinadi:

$$CH_3Cl + Si \xrightarrow{Cu} CH_3SiCl_3 + (CH_3)_2SiCl_2 + (CH_3)_3SiCl + (CH_3)_4Si$$

Alkilxlorsilanlar oson gidrolizlanadi:

$$(CH_3)_3SiCl + H_2O \rightarrow (CH_3)_3SiOH + HCl$$
$$2(CH_3)_3SiOH \rightarrow (CH_3)_3Si{-}O{-}Si(CH_3)_3$$

geksametildisiloksan

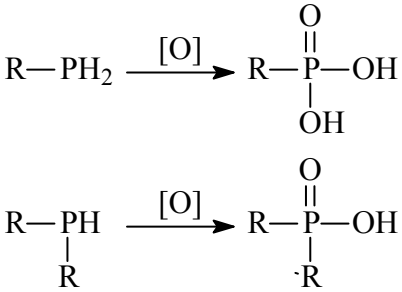
Fosfor- va mishyak-organik birimalar

Fosfinlar asos xossasoiga ega bo‘lib, kislotalar bilan aminlar kabi tuzlar hosil qiladi:

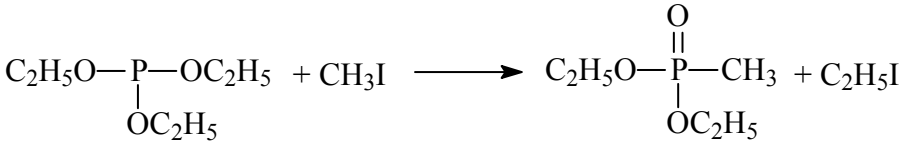
$$CH_3PH_2 + HCl \rightarrow [CH_3PH_3]^+Cl^-$$

metilfosfoniy xlorid

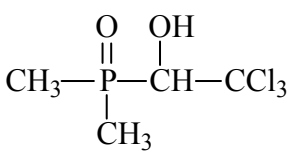
Birlamchi va ikkilamchi fosfor-organik birikmalar oksidlanib, tegishli alkil va dialkil fosfat kislotalarni hosil qiladi:



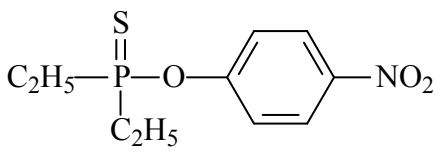
A.E.Arbuzov 1–marta uchlamchi aklikfosfatga galoid alkil ta’sir ettirib, alkilfosfin kislota efirini hosil qiladi (Arbuzov reaksiyasi):



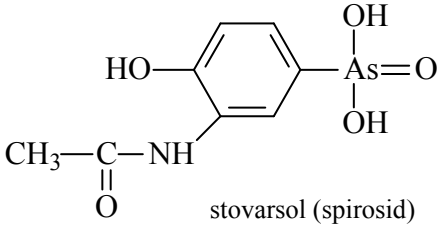
Muhim fosfor va mishyak organik birikmalar quyidagilar:



xlorofos



tiofos



stovarsol (spirosid)

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4-Qism

ILOVALAR

*Ma'lumotlar

*Jadvallar

*Kattaliklar

ILOVALAR

VALENTLIK

O‘zgarmas valentli elementlar:

I	Li, Na, K, Rb, Cs, H, F, Ag
II	Be, Mg, Ca, Sr, Ba, Zn, Cd, O
III	B, Al

O‘zgaruvchan valentli elementlar:

II-IV	C, Si, Sn, Pb
III-V	P, As
II-IV-VI	S, Se, Te
I-III-V-VII	Cl, Br, J
I-II-III-IV	N
II-III-VI	Cr, Mo
II-III-IV-VI-VII	Mn
II-III	Fe, Co, Ni
I-II	Cu, Hg
I-III	Au, Tl

Guruh valentliklari:

I valentli

-OH	Gidroksil
$-NO_2$	Nitrit
$-NO_3$	Nitrat
-Г (F, Cl, Br, J)	Galogenid
-ГО (Cl, Br, J)	Gipo+Г+it
$-ГO_2$ (Cl, Br, J)	Г+it
$-ГO_3$ (Cl, Br, J)	Г+at
$-ГO_4$ (Cl, Br, J)	Per+Г+at
-CN	Sianid
$-MnO_4$	Permanganat
$-NH_4$	Ammoniy

II valentli

=S	Sulfid
$=SO_3$	Sulfit
$=SO_4$	Sulfat
$=CO_3$	Karbonat
$=SiO_3$	Silikat
$=CrO_4$	Xromat
$=Cr_2O_7$	Bixromat, dixromat
$=MnO_4$	Manganat
$=B_4O_7$	Tetraborat
$=HPO_3$	Fosfit
$=S_2O_3$	Tiosulfat

III valentli

≡N	Nitrid
≡P	Fosfid
$≡PO_4$	Fosfat
$≡AsO_3$	Arsenit
$≡AsO_4$	Arsenat
$≡BO_3$	Borat

IV valentli

P_2O_7	Pirofosfat
SiO_4	Ortosilikat

ANORGANIK BIRIKMALARNING ASOSIY SINFLARI

Valentligi	Oksidlar	Asoslar	Kislotalar	Tuzlar
	E_2O_x	$Me(OH)_n$	H_nAc	Me_nAc_m
I	E_2O *(Na_2O)*	MeOH *(NaOH)*		
II	EO *(CaO)*	$Me(OH)_2$ *($Ca(OH)_2$)*		
III	E_2O_3 *(Al_2O_3)*	$Me(OH)_3$ *($Al(OH)_3$)*		
IV	EO_2 *(NO_2)*			
V	E_2O_5 *(N_2O_5)*			
VI	EO_3 *(SO_3)*			
VII	E_2O_7 *(Cl_2O_7)*			

VALENTLIK ASOSIDA FORMULALAR TUZISH

Me* I valentli, Ac** I valentli – hech qanday indeks qo‘yilmaydi.
MeAc - *NaCl, $KMnO_4$, $AgNO_3$;*

Me I valentli, Ac II valentli – metaldan so‘ng 2 indeksi qo‘yiladi.
Me_2Ac – *Na_2SO_4, Li_2CO_3, K_2MnO_4;*

Me I valentli, Ac III valentli – metaldan so‘ng 3 indeksi qo‘yiladi.
Me_3Ac – *Na_3PO_4, Li_3BO_3, Cs_3AsO_3;*

Me II valentli, Ac I valentli – kislota qoldig‘idan so‘ng 2 indeksi qo‘yiladi.
$MeAc_2$ – *$CaCl_2$, $Mg(ClO_4)_2$, $Fe(CN)_2$;*

Me II valentli, Ac II valentli – hech qanday indeks qo‘yilmaydi.
MeAc – *$CaSO_4$, $MgCO_3$, CdS;*

Me II valentli, Ac III valentli – valentliklar almashtirilib indeksga qo‘yiladi.
Me_3Ac_2 – *$Ca_3(PO_4)_2$, Mg_3P_2, $Sr_3(AsO_3)_2$;*

Me III valentli, Ac I valentli – kislota qoldig‘idan so‘ng 3 indeksi qo‘yiladi.
$MeAc_3$ – *$AlCl_3$; $Fe(CN)_3$, $Al(JO_3)_3$;*

Me III valentli, Ac II valentli – valentliklar almashtirilib indeksga qo‘yiladi.
Me_2Ac_3 – *$Al_2(SO_4)_3$, Cr_2S_3, $Al_2(CO_3)_3$;*

Me III valentli, Ac III valentli – hech qanday indeks qo‘yilmaydi.
MeAc – *$AlPO_4$, $FeAsO_3$, AlN;*

KIMYODA QO‘LLANILADIGAN O‘ZGARMAS KATTALIKLAR

$\mathbf{N_A}=6{,}02\cdot10^{23}$	Avogadro soni
$\mathbf{m_{\bar{e}}}=9{,}11\cdot10^{-31}$ kg	Elektronning absolyut massasi
$\mathbf{q_{\bar{e}}}=1{,}6\cdot10^{-19}$ Kl	Elektronning kulonlardagi zaryadi
1 u.b.=$1{,}66\cdot10^{-24}$ g	u.b. = uglerod birligi
F=96500 Kl	Faradey soni
R=8,314 J/mol·K	Universal gaz doimiysi
$\mathbf{T_0}$=273K	Normal sharoitdagi absolyut temperatura
$\mathbf{P_0}$=101,325 KPa	Normal sharoitdagi bosim
$\mathbf{V_M}$=22,4 L	Gazning molyar hajmi

KIMYOVIY TENGLAMALAR BOYICHA PROPORTSIYALAR TUZISH*

Massa va hajm bo‘yicha hisoblashlarda

Gramm Kg	litr m^3

Hajmlar bo‘yicha hisoblashlarda

Litr m^3 Hajm	litr m^3 hajm

Massa va modda miqdori bo‘yicha

mol	Gramm

Massalar bo‘yicha hisoblashlarda

gramm kg	Gramm Kg

Hajm va modda miqdori bo‘yicha

mol	Litr

*proportsiyada ayni birlik tagidan o‘sha birlik yozilishiga e’tibor beriladi.

ELEMENTLARNING ELEKTRON KONFIGURATSIYASINI TUZISH

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 5f^{14}\ 6d^{10}\ 7p^6$

BIRLIKLARGA QO‘SHILADIGAN O‘NLIK QO‘SHIMCHALAR

Birlikka ko‘paytiriladi	Ma’nosi	Old qo‘shimcha	Birlikka ko‘paytiriladi	Ma’nosi	Old qo‘shimcha
10^{12}	tera	T	10^{-1}	detsi	d
10^{9}	giga	G	10^{-2}	santi	s
10^{6}	mega	M	10^{-3}	milli	m
10^{3}	kilo	k	10^{-6}	mikro	mk
10^{2}	gekto	g	10^{-9}	nano	n
10	deka	da	10^{-12}	piko	p

KIMYODA QO‘LLANILADIGAN BELGILASHLAR

Belgisi	Ma’nosi	Birligi*
m	Massa	[**g**, kg, t, mg]
V	Hajm	[**l**, ml. m^3]
ρ	Zichlik	[**g/ml**]
n	Modda miqdori	[**mol**]
$\mathbf{A_r}$	Nisbiy atom massa	[**m.a.b**]
$\mathbf{M_r}$	Nisbiy molekulyar massa	[**m.a.b**]
M	Molyar massa	[**g/mol**]
τ	Reaksiya vaqti	[**sek**, min, soat]
$\mathbf{K_M}$	Muvozanat konstantasi	
$\mathbf{C_N}$	Normal konsentratsiya	[**N**, mol-ekv/l]
T	Eritma titri	[**g/ml**]
α	Dissosilanish darajasi	[**%**]
k	Moddaning elektrokimyoviy ekvivalenti	[**mg/Kl**]
t	Elektroliz vaqti	[**sekund**]
E	Kimyoviy ekvivalent	
Q	Issiqlik miqdori	[**J**]

Belgisi	Ma’nosi	Birligi
$\mathbf{D_X}$	Biror gazning X gazga nisbatan zichligi	
t	Selsiy shkalasida temperatura	[**°C**]
T	Absolyut temperatura	[**K**]
P	Bosim	[**KPa**, atm, sim.ustuni]
ω	Massa ulush	[**%**]
φ	Hajmiy ulush	[**%**]
υ	Reaksiya tezligi	[**mol/l·sek**]
γ	Reaksiya tezligining temperatura koeffitsienti	
$\mathbf{C_M}$	Molyar konsentratsiya	[**mol/l, M**]
$\mathbf{C_m}$	Molyal konsentratsiya	[**m**]
$\mathbf{K_D}$	Dissosilanish konstantasi	
pH	Vodorod ko‘rsatkich	
q	Tok miqdori	[**Kl**]
I	Tok kuchi	[A]
η	Reaksiya unumi	[**%**]
ΔH	Entalpiya o‘zhgarishi	**KJ/mol**

* birliklarning asosiy qo‘llaniladigani qalin shriftda berilgan

AYRIM MINERAL KISLOTALARNING KISLOTALIK KO‘RSATKICHI – pK_a (25°).

No	Kislota	K_a	pK_a	No	Kislota	K_a	pK_a
1	HJ	10^{11}	-11	8	H_2SO_3	$1.5\cdot10^{-2}$	1.81
2	$HClO_4$	10^{10}	-10	9	H_3PO_4	$7.5\cdot10^{-3}$	2.12
3	HBr	10^{9}	-9	10	HF	$3.5\cdot10^{-4}$	3.45
4	HCl	10^{7}	-7	11	HCOOH	$1.8\cdot10^{-4}$	3.75
5	H_2SO_4	10^{2}	-2	12	H_2CO_3	$4.3\cdot10^{-7}$	6.37
6	HNO_3	10^{2}	-2	13	H_2S	$9.1\cdot10^{-8}$	7.04
7	$HClO_3$	10^{-1}	1	14	HCN	$4.9\cdot10^{-10}$	9.31

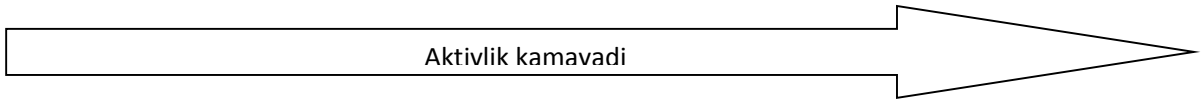
KIMYOVIY REAKSIYA TENGLAMALARINI TUZISH

Kimyoviy reaksiyalar tenglamalarini tuzishda quyidagi hollar inobatga olinadi:

1. Birikish reaksiyalarida oddiy moddalar o‘zaro valentliklariga muvofiq murakkab moddani hosil qiladi:
   $H_2+Cl_2=2HCl$ $4Al+3O_2=2Al_2O_3$
2. Oddiy moddalar kislorodda yonganda metallardan faqat **1** ta oksid(Na va K da peroksid va nadperoksid) hosil bo‘ladi:
   $4Li+O_2=2Li_2O$ $3Fe+2O_2=Fe_3O_4$ $2Na+O_2=Na_2O_2$
3. Metalmaslar yonganda kislorod kam bo‘lsa quyi oksid(chala yonish), kislorod mo‘l bo‘lsa yuqori oksid(to‘la yonish) hosil bo‘ladi:
   $2C+O_2=2CO$ $C+O_2=CO_2$
4. Vodorod bilan ko‘pchilik metalmaslar va faqat ishqoriy/ishqoriy-yer metallari kirishib gidridlar hosil qiladi. (EH_x-x element valentligi):
   $C+2H_2=CH_4$ $2Na+H_2=2NaH$ $N_2+3H_2=2NH_3$
5. Suvdan odatdagi sharoitda faqat ishqoriy va ishqoriy-yer metallari vodorodni siqib chiqarib tegishli asoslarni hosil qiladi. Qolgan metallar odatdagi sharoitda suv bilan ta’sirlashmaydi(erimaydi):
   $2Na+2HOH=2NaOH+H_2$ $Ca+2HOH=Ca(OH)_2+H_2$
6. Qolgan metal va metalmaslar faqat qizdirilgandagina suv bilan ta’sirlashib tegishli oksid va vodorodni hosil qiladi:
   $C+H_2O=CO+H_2$ $3Fe+4H_2O=Fe_3O_4+4H_2$
7. Aktiv metallar (elektrod potensiallar qatorida H_2 dan chapda joylashgan) kislotalar bilan ta’sirlashganda vodorodni siqib chiqaradi va tegishli tuzlar hosil bo‘ladi:
   $2Na+H_2SO_4=Na_2SO_4+H_2$ $Fe+2HCl=FeCl_2+H_2$
8. Nitrat kislotadan va kons.H_2SO_4 dan hech qaysi metal vodorodni siqib chiqara olmaydi. Bunday reaksiyalarda tuz, suv va metalmas oksidi hosil bo‘ladi:
   $2Fe+6H_2SO_{4(kons)}=Fe_2(SO_4)_3+3SO_2+6H_2O$
   $3Cu+8HNO_{3(suyult)}=3Cu(NO_3)_2+2NO+4H_2O$
9. O‘rin olish reaksiyalarida tegishli metal yoki metalmasning o‘rni boshqasiga almashinadi:
   $Fe+CuSO_4=FeSO_4+Cu$ $2KJ+Cl_2=2KCl+J_2$
10. Almashinish reaksiylarini tenglamalarini tuzishda musbat qism musbat qismga, manfiy qism ham manfiyga o‘zaro almashtiriladi. Bunda funksional guruh tarkibi o‘zgarmaydi:
    $Al_4C_3+12HOH=4Al(OH)_3+3CH_4$ $BaCl_2+Na_2SO_4=BaSO_4+2NaCl$
11. Kislotali oksidlar suvda erib tegishli kislotalarni hosil qiladi, bunda metalmas valentligi o‘zgarmaydi:
    $CO_2+H_2O=H_2CO_3$ $SO_3+H_2O=H_2SO_4$ $Cl_2O_7+H_2O=2HClO_4$
12. Asosli oksidlardan faqat ishqoriy va ishqoriy yer metallari odatdagi sharoitda suvda erib tegishli ishqorlarni hosil qiladi:
    $Na_2O+H_2O=2NaOH$ $CaO+H_2O=Ca(OH)_2$
13. Murakkab modda yonganda (oksidlanganda) uning tarkibiy qismlari yonib tegishli oksidlarni hosil qiladi:
    $CH_4+2O_2=CO_2+2H_2O$ $2ZnS+3O_2=2ZnO+2SO_2$

Metallar elektrod potensiallar qatori

Li, K, Ba, Ca, Na, Mg, Al, Mn, Zn, Cr, Fe, Cd, Co, Ni, Sn, Pb (H_2) Cu, Hg, Ag, Pt, Au



KIMYOVIY MASALALAR YECHISHDA ENG KO‘P UCHRAYDIGAN REAKSIYALAR TENGLAMALARI

1. Suv gazining hosil bo‘lishi:
$$C+H_2O=CO+H_2$$
2. Kaliy permanganatning parchalish reaksiyasi:
$$2KMnO_4=K_2MnO_4+MnO_2+O_2$$
3. Ammiakning katalizatorsiz oksidlanishi:
$$4NH_3+3O_2=2N_2+6H_2O$$
4. Ammiakning katalizator (Fe/Pt) ishtirokida oksidlanishi:
$$4NH_3+5O_2=4NO+6H_2O$$
5. Temir(II)sulfatning kislotali muhitda kaliy permanganat bilan oksidlanishi:
$$10FeSO_4+2KMnO_4+8H_2SO_4=5Fe_2(SO_4)_3+2MnSO_4+K_2SO_4+8H_2O$$
6. Temir(II)sulfatning kislotali muhitda kaliy bixromat bilan oksidlanishi:
$$6FeSO_4+K_2Cr_2O_7+7H_2SO_4=3Fe_2(SO_4)_3+Cr_2(SO_4)_3+K_2SO_4+7H_2O$$
7. Xlorning sovuq ishqor eritmasida erishi:
$$Cl_2+2NaOH=NaCl+NaClO+H_2O$$
8. Xlorning qaynoq ishqor eritmasida erishi:
$$3Cl_2+6NaOH=5NaCl+NaClO_3+3H_2O$$
9. Vodorod peroksidning ishqoriy muhitda kaliy permanganat bilan oksidlanishi:
$$H_2O_2+KMnO_4+KOH=K_2MnO_4+O_2+H_2O$$
10. Ozonning kaliy yodid eritmasi bilan ta’siri:
$$O_3+2KJ+H_2O=J_2+O_2+2KOH$$
11. Oltinning “zar suvi”(“shox arog‘i”)da erishi:
$$Au+HNO_3+3HCl=AuCl_3+NO+2H_2O$$
12. Oltinning “zar suvi”(“shox arog‘i”)da erishi(kompleks kislota hosil bo‘lishi):
$$Au+HNO_3+4HCl=H[AuCl_4]+NO+2H_2O$$
13. Qo‘rg‘oshin(IV)oksidning sirka kislota ishtirokida vodorod peroksid bilan reaksiyasi:
$$PbO_2+H_2O_2+2CH_3COOH=(CH_3COO)_2Pb+O_2+2H_2O$$
14. Natriy okslataning sulfat kislota ishtirokida kaliy permanganat bilan oksidlanishi:
$$5Na_2C_2O_4+2KMnO_4+8H_2SO_4=10CO_2+5Na_2SO_4+K_2SO_4+2MnSO_4+8H_2O$$
15. Azot(IV)oksidning kislorod ishtirokisiz suvda erishi:
$$2NO_2+H_2O=HNO_2+HNO_3$$
16. Azot(IV)oksidning kislorod ishtirokida suvda erishi:
$$4NO_2+O_2+2H_2O=4HNO_3$$
17. Metanolning sulfat kislota ishtirokida kaliy permanganat bilan oksidlanishi:
$$5CH_3OH+4KMnO_4+6H_2SO_4=5HCOOH+2K_2SO_4+4MnSO_4+11H_2O$$
18. Kaliy xloratning MnO_2 katalizatori ishtirokida parchalanishi(150°C):
$$2KClO_3=2KCl+3O_2$$
19. Kaliy xloratning katalizatorsiz termik parchalanishi(400°C):
$$4KClO_3=KCl+3KClO_4$$
20. Ammoniy bixromatning parchlanishi:
$$(NH_4)_2Cr_2O_7=N_2+Cr_2O_3+4H_2O$$
21. Misning konsentrlangan nitrat kislotada erishi:
$$Cu+4HNO_3=Cu(NO_3)_2+2NO_2+2H_2O$$

22. Misning suyultirilgan nitrat kislotada erishi:

$$3Cu+8HNO_3=3Cu(NO_3)_2+2NO+4H_2O$$

23. Oltin(III)xloridning ishqoriy muhitda vodorod peroksid bilan ta'siri:

$$2AuCl_3+3H_2O_2+6KOH=2Au+3O_2+6KCl+6H_2O$$

24. Oltin(III)xloridning ishqoriy muhitda metanal bilan ta'siri:

$$2AuCl_3+3HCOH+9NaOH=2Au+3HCOONa+6NaCl+6H_2O$$

25. Glyukozaning spirtli bijg'ishi:

$$C_6H_{12}O_6=2C_2H_5OH+2CO_2$$

26. Alyuminiy karbidning gidrolizi reaksiyasi:

$$Al_4C_3+12H_2O=4Al(OH)_3+3CH_4$$

27. Kalsiy karbidning gidrolizi reaksiyasi:

$$CaC_2+2H_2O=Ca(OH)_2+C_2H_2$$

28. Oltingugurt(VI)oksidning bromli suv bilan oksidlanishi:

$$SO_2+Br_2+2H_2O=2HBr+H_2SO_4$$

29. Kaliy permanganatning xlorid kislota bilan ta'siri:

$$2KMnO_4+16HCl=2KCl+2MnCl_2+5Cl_2+8H_2O$$

30. Marganes(IV)oksidning xlorid kislotada erishi:

$$MnO_2+4HCl=MnCl_2+Cl_2+2H_2O$$

31. Atsetilenning Hg^{2+} katalizatori ishtirokida gidratlanishi (Kucherov reaksiyasi):

$$C_2H_2+H_2O=CH_3COH$$

32. Metanning 1500°C da pirolizi reaksiyasi:

$$2CH_4=C_2H_2+3H_2$$

33. Piritni kuydirish reaksiyasi:

$$4FeS_2+11O_2=2Fe_2O_3+8SO_2$$

34. Temir(II)gidroksidning nam havoda oksidlanib qo'ng'ir rangga kirishi:

$$4Fe(OH)_2+2H_2O+O_2=4Fe(OH)_3$$

35. Kalsiy fosfatdan fosfor olish reaksiyasi:

$$Ca_3(PO_4)_2+3SiO_2+5C=3CaSiO_3+2P+5CO$$

36. Alyuminiyning ishqor eritmasida erishi va tetragidroksoalyuminat tuzi hosil bo'lishi (H_2 ajralishi bilan boradi):

$$2Al+2NaOH+6H_2O=2Na[Al(OH)_4]+3H_2$$

37. Metilaminning yonish reaksiyasi:

$$4CH_3NH_2+9O_2=4CO_2+2N_2+10H_2O$$

38. Nitrobenzolning ammoniy sulfid bilan qaytarilishi(Zelinskiy reaksiyasi):

$$C_6H_5NO_2+3(NH_4)_2S=C_6H_5NH_2+6NH_3+3S+2H_2O$$

39. Sulfit kislota/oltingugurt(IV)oksid va vodorod sulfidning o'zaro ta'siridan cko'kma-S hosil bo'lishi:

$$SO_2+2H_2S=3S+2H_2O \qquad H_2SO_3+2H_2S=3S+3H_2O$$

40. Vodorod sulfidning chala va to'la yonish reaksiyalari:

$$2H_2S+O_2=2S+2H_2O \qquad 2H_2S+3O_2=2SO_2+2H_2O$$

41. Uglerodning konsentrlangan sulfat kislota bilan ta'siri:

$$C+2H_2SO_4=CO_2+2SO_2+2H_2O$$

42. Mis(II)oksidning ammiak ishtirokida qaytarilishi:

$$2NH_3+3CuO=N_2+3Cu+3H_2O$$

43. Ammoniy nitrit va nitrat tuzlarining parchalanish reaksiyalari:

$$NH_4NO_2=N_2+2H_2O \qquad NH_4NO_3=N_2O+H_2O$$

44. Chumoli kislotaning konsentrlangan sulfat kislota ta'siridan parchalanishi:

$$HCOOH=CO+H_2O$$

45. Xlorli ohakning hosil bo'lish reaksiyasi:

$$Cl_2+Ca(OH)_2=CaOCl_2+H_2O$$

46. Kaliy bixromatning xlorid kislotada erishi:

$$K_2Cr_2O_7+14HCl=2KCl+2CrCl_3+3Cl_2+7H_2O$$

47. Kalsiy karbidning olinishi:

$$3C+CaO=CaC_2+CO$$

48. Kalsiy karbonat suspenziyasi orqali CO_2 o'tkazilganda eritma tiniqlashishi:

$$CaCO_3+CO_2+H_2O=Ca(HCO_3)_2$$

49. Metal nitratlarning parchalanishi qonuniyati:

49.1. Me kuchlanishlar qatorida Mg dan chapda:

$$MeNO_3 \xrightarrow{t} MeNO_2+O_2$$

49.2. Me kuchlanishlar qatorida Mg bilan Cu orasida:

$$MeNO_3 \xrightarrow{t} MeO+NO_2+O_2$$

49.3. Me kuchlanishlar qatorida Cu dan o'ngda:

$$MeNO_3 \xrightarrow{t} Me+NO_2+O_2$$

50. Malaxitning parchlanish reaksiyasi:

$$CuCO_3 \cdot Cu(OH)_2 \rightarrow 2CuO+CO_2+H_2O$$

51. Fosforning suyultirilgan nitrat kislotada erishi:

$$3P+5HNO_3+2H_2O=3H_3PO_4+5NO$$

52. Fosforning konsentrlangan nitrat kislotada erishi:

$$P+5HNO_3=H_3PO_4+5NO_2+H_2O$$

IZOTOP ARALASHMALARIDAN MOLEKULA KOMBINATSIYALARINI HISOBLASH JADVALI*

Izotop / Indeks	1	2	3	4
1	1	2	3	4
2	1	3	6	10
3	1	4	10	20
4	1	5	15	35

*__Izoh.__ Masalan, bizdan uchta kislorod izotoplaridan ^{16}O, ^{17}O va ^{18}O hosil bo'lishi mumkin bo'lgan ozon molekulasi kombinatsiyalarini so'ralsin. Izotop qatoridan 3 va ozon indeksidagi 3 kesishgan joyda 10 kombinatsiya soni turibdi.

Murakkab moddada element kombinatsiyalari o'zaro ko'paytiriladi. Masalan, 3 ta vodorod va 2 ta kislorod izotopidan hosil bo'lgan suv molekulasi kombinatsiyalari soni 6x2=12 ga teng.

KIMYOVIY MASALALAR YECHISH FORMULALARI

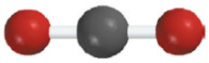
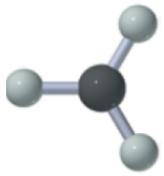
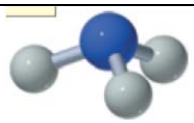
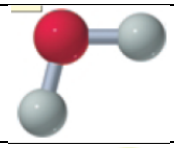
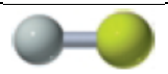
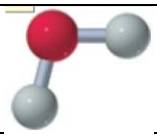
1	Atom/molekulaning absolyut massasini toppish	$m_a = A_r \cdot 1{,}66 \cdot 10^{-24}\ g$
2	Modda miqdorini hisoblash(massa bo‘yicha)	$n = \frac{m}{M}$
3	Modda miqdorini hisoblash(hajm bo‘yicha)	$n = \frac{V}{22{,}4}$
4	Modda miqdorini hisoblash(molekula soni bo‘yicha)	$n = \frac{N}{N_A}$
5	Modda zichligini topish	$\rho = \frac{m}{V}$
6	Birlashgan gaz qonuni	$\frac{P_0V_0}{T_0} = \frac{P_1V_1}{T_1}$
7	Ideal gazning holat trnglamasi	$PV = nRT$
8	Mendeleyev-Klapeyron tenglamasi	$PV = \frac{m}{M}RT$ $PM = \rho RT$
9	Gazlar aralashmasining hajmiy ulushini topish	$\bar{M} = \frac{M_1x + M_2(100 - x)}{100}$
10	Oddiy moddaning ekvivalentini topish	$E = \frac{A_r}{valentlik}$
11	Murakkab moddaning ekvivalentini topish	$E_{Oksid} = \frac{M_{Oksid}}{Um\ val}$ $E_{Asos} = \frac{M_{Asos}}{Val_{Metal}}$ $E_{Kislota} = \frac{M_{K-ta}}{Kislota\ negizi}$ $E_{Tuz} = \frac{M_{Tuz}}{Um\ val}$
12	Kimyoviy reaksiya tezligi	$v = \pm\frac{\Delta c}{\Delta t} = \pm\frac{\Delta n}{V\Delta t}$
13	Kimyoviy reaksiya tezligiga konsentratsiya ta’siri	$v = k \cdot C_A \cdot C_B$
14	Kimyoviy reaksiya tezligiga bosim ta’siri	$v = k \cdot P_A \cdot P_B$
15	Vant-Goff qoidasi	$\frac{v_{t_2}}{v_{t_1}} = \gamma^{\frac{t_2 - t_1}{10}}$ $\frac{v_{t_2}}{v_{t_2}} = \frac{t_1}{t_2}$
16	Kimyoviy muvozanat konstantasi	$K_M = \frac{C_C^c \cdot C_D^d}{C_A^a \cdot C_B^b}$
17	Eritma foiz konsentratsiyasini hisoblash	$\omega = \frac{m_{modda}}{m_{eritma}} \cdot 100\%$
18	Molyar konsentratsiyani hisoblash	$C_M = \frac{n}{V}$
19	Normal konsentratsiyani hisoblash	$C_N = \frac{m}{E\,V}$
20	Foiz konsentratsiyadan molyarlikka o‘tish	$C_M = \frac{10\ \omega\ \rho}{M}$
21	Foiz konsentratsiyadan normalikka o‘tish	$C_N = \frac{10\ \omega\ \rho}{E}$

22	Eruvchanlik va massa ulush bog‘liqligi	$\omega = \frac{S}{S+100}100\%$
23	Eritma titrini hisoblash	$T = \frac{N\,E}{1000}$
24	Dissosilanish darajasini hisoblash	$\alpha = \frac{n}{N}100\%$
25	Ostvaldning suyultirish qonuni	$K_D = \frac{\alpha^2 c}{1-\alpha}$ $\alpha = \sqrt{\frac{K_D}{c}}$
26	Vodorod ko‘rsatkichni hisoblash	$pH = -\lg[H^+]$
27	Faradeyning 1-qonuni	$m = \frac{E\,I\,t}{F}$

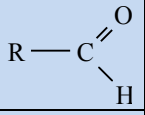
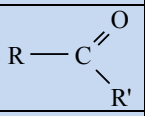
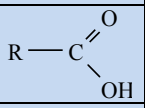
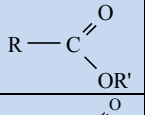
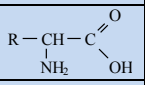
ANORGANIK KIMYODA SIFAT REAKSIYALAR

Kationlar				
№	***Kation***	***Reagent***	***Reaksiya tenglamasi***	***Kuzatilayotgan hodisa***
1	Ag^+	Cl^-	Ag+ + Cl- = AgCl↓	Oq cho‘kma
2	Ba^{2+}	SO_4^{2-}	$Ba^{2+} + SO_4^{2-} = BaSO_4\downarrow$	Oq cho‘kma
3	Fe^{2+}	$[Fe(CN)_6]^{3-}$	$Fe^{2+} + [Fe(CN)_6]^{3-} = Fe_3[Fe(CN)_6]_2$	Toq ko‘k cho‘kma (Turnbul ko‘ki)
4	Fe^{3+}	$[Fe(CN)_6]^{4-}$	$Fe^{3+} + [Fe(CN)_6]^{4-} = Fe_4[Fe(CN)_6]_3$	Toq ko‘k cho‘kma (Berlin zangorisi)
5	H^+ (k-ta)	Metiloranj	Indikator rangi sariqdan qizil rangga o‘tadi	
		Lakmus	Eritma rangi qizilga o‘zgaradi	
6	NH_4^+	Ishqorlar	$NH_4^+ + OH^- = NH_3\uparrow + H_2O$	Ammiak hidi
Anionlar				
1	Cl^-	Ag^+ ($AgNO_3$)	$Ag^+ + Cl^- = AgCl\downarrow$	Oq cho‘kma
2	CO_3^{2-}	Kislotalar	$CO_3^{2-} + 2H^+ = CO_2\uparrow + H_2O$	Gaz ajraladi
3	OH- (ishqor)	Fenolftalein	Indikator rangi malina rangga o‘tadi	
		Lakmus	Ertima rangi ko‘kka o‘zgaradi	
4	S^{2-}	Pb^{2+}	$Pb^{2+} + S^{2-} = PbS\downarrow$	Qora cho‘kma
5	SO_4^{2-}	Ba^{2+} ($BaCl_2$)	$Ba^{2+} + SO_4^{2-} = BaSO_4\downarrow$	Oq cho‘kma
Anorganik moddalar				
1	CO_2	$Ca(OH)_2$ eritmasi (ohakli suv)	$CO_2 + Ca(OH)_2 = CaCO_3\downarrow + H_2O$ yana davom ettirilsa $CaCO_3 + CO_2 + H_2O = Ca(HCO_3)_2$	Avval oq cho‘kma, keyin yana eriydi
2	NH_3	HCl	$NH_3 + HCl = NH_4Cl$	Oq tutun

ATOM ORBITALLARINING GIBRIDLANISHI

№	Gibridlanish turi	Xarakteristik belgisi	Molekula fazoviy tuzilishi	Molekula fazoviy shakli	Misollar
			Standart gibridlanish holati		
1	**sp**	Faqat 2 ta σ bog‘ **VB 180°**	Chiziqli		Alkinlar, $BeCl_2$, CO_2, (CO, N_2), HCN
2	**sp^2**	Faqat 3 ta σ bog‘ **VB 120°**	Uchburchakli		Alkenlar va diyenlar qo‘shbog‘ uglerodi, BF_3, $AlCl_3$, SO_3, NO_3^-, CO_3^{2-}
3	**sp^3**	Faqat 4 ta σ bog‘ **VB 109°28´**	Tetraedr		CH_4 va alkanlar, NH_4^+,SO_4^{2-}, PO_4^{3-}, ClO_4^-, MnO_4^{2-}, MnO_4^-, SiO_2
4	**sp^3d**	Faqat 5 ta σ bog‘ **VB 3x120° va 2x90°**	Trigonal bipiramida		PCl_5, SbF_5, XeO_3F_2
5	**sp^3d^2**	Faqat 6 ta σ bog‘ **VB 6x90°**	Oktaedrik		SF_6, XeO_2F_4
			Nostandart gibridlanish holati		
6	**sp^3**	3 ta σ bog‘ va 1 ta taqsimlanmagan elektron jufti **VB 107,3°**	Uchburchakli piramida		NH_3, H_3O^+, ClO_3^-, XeO_3
7	**sp^3**	2 ta σ bog‘ va 2 ta taqsimlanmagan elektron jufti **VB 104,5°**	Burchakli		H_2O, ClO_2^-, XeO_2
8	**sp^3**	1 ta σ bog‘ va 3 ta taqsimlanmagan elektron jufti **VB 100°**	Chiziqli		Galogenovodorodlar HГ (Г=F, Cl, Br, J)
9	**sp^2**	2 ta σ bog‘ va 1 ta taqsimlanmagan elektron jufti **VB 120°**	Burchakli		SO_2

ORGANIK BIRIKMALAR KLASSIFIKATSIYASI

№	Sinf nomi		Umumiy formulasi	Xarakteristik belgisi	Sifat reaksiya	Gibridla-nishi
1	Uglevodorodlar C_nH_m	Alkanlar	C_nH_{2n+2}	Faqat **σ** bog‘li to‘yingan ochiq zanjirli		sp^3
2		Alkenlar (Sikloalkanlar)	C_nH_{2n}	1 ta qo‘shbog‘li (=) ochiq zanjirli	Br_2 li suv	sp^2
3		Alkadiyenlar (Alkinlar)	C_nH_{2n-2}	2 ta qo‘shbog‘li (=) ochiq zanjirli	Br_2 li suv	sp^2
4		Alkinlar (Alkadiyenlar)	C_nH_{2n-2}	1 ta uchbog‘li (≡) ochiq zanjirli	Ag_2O/NH_3	sp
5		Arenlar	C_nH_{2n-6}	Aromatik xalqali yopiq zanjirli		sp^2
6		Sikloalkanlar (Alkenlar)	C_nH_{2n}	Faqat **σ** bog‘li to‘yingan yopiq zanjirli		sp^3
7	Spirtlar		R-OH	**OH** guruh alkil radikaliga bog‘langan		sp^3
	a) Bir aromli (Oddiy efirlar)		R-OH	1 ta **OH** guruh alkil radikaliga bog‘langan		sp^3
	b) Ko‘p atomli		$R(OH)_n$	1 dan ortiq **OH** guruh alkil radikaliga bog‘langan	$Cu(OH)_2$	sp^3
8	Oddiy efirlar (Bir atomli spirtlar)		R-O-R	Alkil radikallar **-O-** ko‘prigi orqali bog‘langan		sp^3
9	Fenollar		Ar-OH	**OH** guruh aromatik xalqa(benzol)ga bog‘langan	$FeCl_3$	sp^2
10	Galogen hosilalar		R-Г	Galogenlar(**F, Cl, Br, J**) radikalga bog‘langan		sp^3
11	Karbonil birikmalar					
	a) Aldegidlar (Ketonlar)			Tarkibida aldegid guruhi mavjud	Ag_2O/NH_3	sp^2
	b) Ketonlar (Aldegidlar)			Alkil yoki aromatik radikallar o‘zaro **-CO-** ko‘prigi orqali bog‘langan		sp^2
12	Karboksil birikmalar					
	a) Karbon kislotalar (Murakkab efirlar)			Radikallar karboksil guruhiga bog‘langan kislota xossasiga ega moddalar		sp^2
	b) Murakkab efirlar (Karbon kislotalar)			Karbon kislota vodorodi radikalga eterifikatsiya reaksiyasi orqali almashingan		sp^2
13	Aminokislotalar			Aminoguruh (**NH_2**) karbon kislota radikaliga bog‘langan kislota hosilalari		sp^2
14	Nitrobirikmalar		$R-NO_2$	Nitroguruh (**NO_2**) radikalga bog‘langan		sp^2
15	Aminlar		$R-NH_2$	Ammiak vodorodi bir yoki bir nechta radikalga almashingan		sp^3
16	Uglevodlar		$C_n(H_2O)_m$	Tarkibida gidroksil (**OH**) va karbonil (**C=O**) guruhi mavjud		
17	Geterosiklik birikmalar			Xalqada ugleroddan tashqari geteroatom (**N, O, S**) tutgan yopiq zanjirli		sp^2

Izoh: Sinfning yuqorisida o‘zaro izomer moddalar sinfi ko‘rsatilgan

BA'ZI KIMYOVIY MODDALARNING TARIXIY NOMI

1. **Akril kislota** = propen kislota – CH_2=CH-COOH
2. **Aktinoidlar** – Th-Lr
3. **Akrolein** = propenal – CH_2=CH-COH
4. **Alebastr** – $CaSO_4 \cdot 2H_2O$
5. **Alyumokaliyli achchiqtosh** – $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
6. **Amil spirt** – $C_5H_{11}OH$
7. **Ammiakli selitra** – NH_4NO_3
8. **Angidrit/o'lik gips** – $CaSO_4$
9. **Anilin** – $C_6H_5NH_2$
10. **Antixlor** – $Na_2S_2O_3 \cdot 5H_2O$
11. **Asbest** – $3MgO \cdot 2SiO_2 \cdot 2H_2O$
12. **Atsetilen** – C_2H_2
13. **Atseton** – CH_3-CO-CH_3
14. **Barit** – $BaSO_4$
15. **Berlin zangorisi** – $Fe_4[Fe(CN)_6]_3$
16. **Berolle tuzi** – $KClO_3$
17. **Boksit** – $Al_2O_3 \cdot nH_2O$
18. **Bura** – $Na_2B_4O_7 \cdot 10H_2O$
19. **Chili selitrasi** – $NaNO_3$
20. **Diammofos** – $(NH_4)_2HPO_4$
21. **Dolomit** – $CaCO_3 \cdot MgCO_3$
22. **Eruvchan shisha** – $K_2O \cdot CaO \cdot 6SiO_2$
23. **Etilenglikol** = etandiol-1,2 – CH_2(OH)-CH_2(OH)
24. **Fenolformaldegid smolasi** - Fenol+Metanal – C_6H_5-OH+HCOH
25. **Flyuorit** – CaF_2
26. **Fosfin** – PH_3
27. **Fosforit** – $Ca_3(PO_4)_2$
28. **Fosgen** – $COCl_2$
29. **Freonlar** – metan yoki etanning ftorli yoki ftorxlorli birikmalari
30. **Fumar kislota** – trans HOOC-CH=CH-COOH
31. **Generator gazi** - CO+N_2
32. **Glauber tuzi** – $Na_2SO_4 \cdot 10H_2O$
33. **Glinozyom** – Al_2O_3
34. **Glitserin** = propantriol-1,2,3 – CH_2(OH)-CH(OH)-CH_2(OH)
35. **Glitsin** = aminosirka kislota – NH_2-CH_2-COOH
36. **Glyukon kislota** – $C_6H_{12}O_7$
37. **Hind selitrasi** – KNO_3
38. **Ichimlik soda** – $NaHCO_3$
39. **Is gazi** - CO
40. **Ishqoriy metallar** – Li – Fr
41. **Ishqoriy yer metallari** – Ca – Ra
42. **Izopren** – CH_2=C(CH_3)-CH=CH_2
43. **Izosianat kislota** – HCNO
44. **Javel suvi** – KCl+KClO
45. **Kalomel** – Hg_2Cl_2
46. **Kalsit, bo'r, ohaktosh, marmar** – $CaCO_3$
47. **Kaolin** – $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
48. **Kapron kislota** = geksan kislota – C_5H_{11}-COOH
49. **Karbamid/mochevina** – $CO(NH_2)_2$
50. **Karbol kislota=fenol**
51. **Karborund** – SiC
52. **Kinovar** – HgS
53. **Korund** – Al_2O_3
54. **Kraxmal/sellyuloza** – $C_6H_{10}O_5$
55. **Krezollar** = metilfenollar – $C_6H_4(CH_3)OH$
56. **Kriolit** – $Na_3[AlF_6]$
57. **Kristall soda** – $Na_2CO_3 \cdot 10H_2O$
58. **Kroton aldegid** = buten-2-al – CH_3-CH=CH-COOH
59. **Ksilol**-o', m' va p'= dimetilbenzollar – $C_6H_4(CH_3)_2$
60. **Kuldiruvchi gaz** – N_2O
61. **Kumol** = izopropilbenzol – C_6H_5-CH(CH_3)$_2$
62. **Kuporos moyi** – kons.H_2SO_4
63. **Kvarts/qum** – SiO_2
64. **Labborak suvi** – NaCl+NaClO

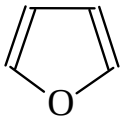
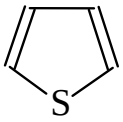
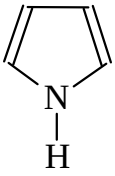
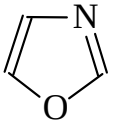
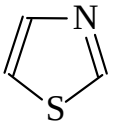
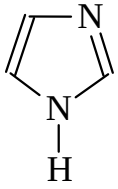
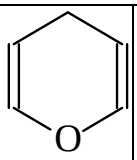
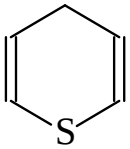
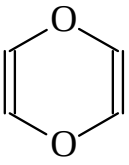
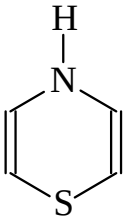
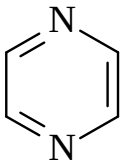
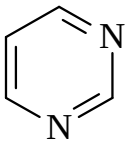
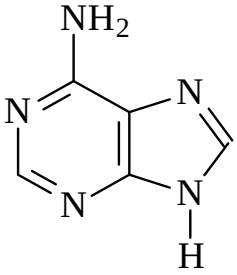
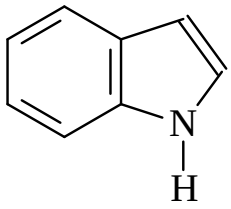
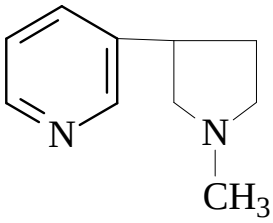
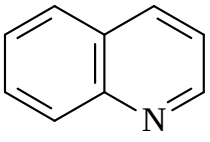
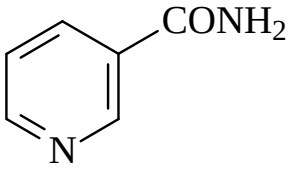
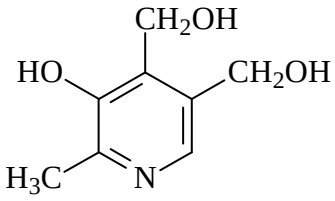
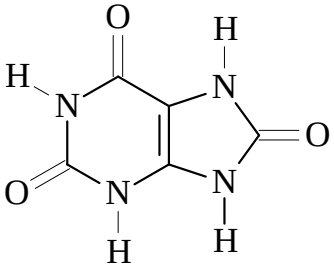
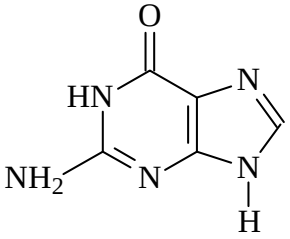
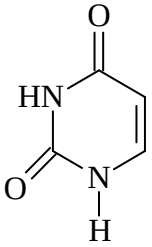
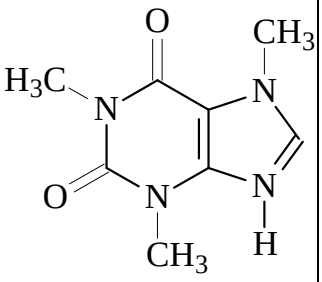
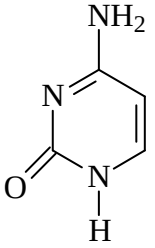
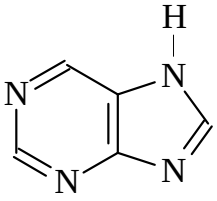
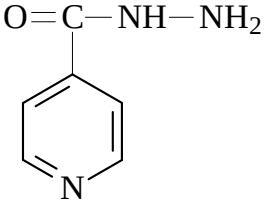
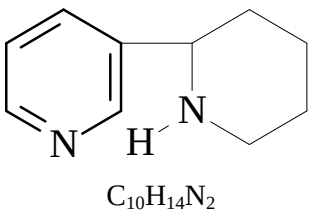
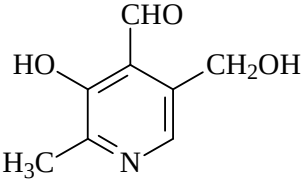
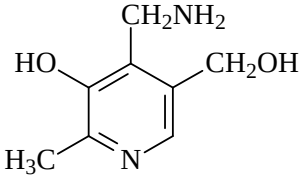
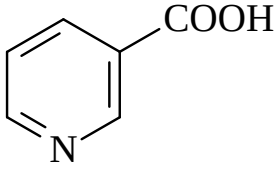
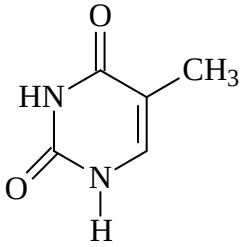
65. **Lantanoidlar** – Ce-Lu
66. **Lavsan** = Tereftal kislota +Etielnglikol – HOOC-C_6H_4-COOH+CH_2(OH)-CH_2(OH)
67. **Linol kislota** – $C_{17}H_{31}COOH$
68. **Linolen kislota** - $C_{17}H_{29}COOH$
69. **Magnezit** – $MgCO_3$
70. **Magnitli temirtosh** – Fe_3O_4
71. **Malaxit** – $CuCO_3 \cdot Cu(OH)_2$
72. **Malein kislota** - sis HOOC-CH=CH-COOH
73. **Metakril kislota** – $CH_2=C(CH_3)$-COOH
74. **Mis kuporosi** – $CuSO_4 \cdot 5H_2O$
75. **Mor tuzi** – $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$
76. **Nodir gazlar** – He, Ne, Ar, Kr, Xe, Rn
77. **Nodir metallar** – Ag, Au, Pt. Ru. Rh, Ir, Os
78. **Norvegiya selitrasi** – $Ca(NO_3)_2$
79. **Novshadil spirt** – NH_4OH
80. **O‘tish metallari** – *d*- va *f*-elementlar
81. **O‘yuvchi kaliy** – KOH
82. **O‘yuvchi natriy/kaustik soda** - NaOH
83. **Og‘ir metallar** (ρ>5 g/sm^3) – Mn, Fe, Co, Ni, Cu, Zn, Cd, Hg, Sn, Pb
84. **Oksalat kislota** – $H_2C_2O_4$
85. **Olein kislota** – $C_{17}H_{33}COOH$
86. **Oleum** – $H_2SO_4 \cdot nSO_3$
87. **Oson suyuqlanuvchan metallar** (t_s<1000°C) – Li-Cs, Mg,Ca, Al
88. **Palmitin kislota** – $C_{15}H_{31}COOH$
89. **Pikrin kislota** = 2,4,6-trinitrofenol - $C_6H_2(OH)(NO_2)_3$
90. **Piridin** - C_5H_5N
91. **Pirit/temir kolchedani** – FeS_2
92. **Pirogallol** =trigidroksibenzol – $C_6H_3(OH)_3$
93. **Pirolyuzit** – MnO_2
94. **Plavik kislota** – HF
95. **Qaldiroq gaz** – $2H_2+O_2$
96. **Qiyin suyuqlanuvchan metallar** (t_s>1000°C) – Ti, Ir, Hf, W, Nb, Ta, Cr, Re
97. **Qizil qon tuzi** – $K_3[Fe(CN)_6]$
98. **Qo‘rg‘oshin shakari** – $Pb(CH_3COO)_2 \cdot 3H_2O$
99. **Qora metallar** – Fe va uning qotishmalari
100. **Qo‘sh superfosfat** – $Ca(H_2PO_4)_2$
101. **Quruq muz** – CO_2
102. **Rangli metallar** – Ag, Au, Cu, Mn, Co, Ni
103. **Rux aldamasi** – ZnS
104. **Sariq qon tuzi** – $K_4[Fe(CN)_6]$
105. **Saxaroza/maltoza/laktoza** – $C_{12}H_{22}O_{11}$
106. **Shisha** – $Na_2O \cdot CaO \cdot 6SiO_2$
107. **Soda** – Na_2CO_3
108. **Sinil kislota** – HCN
109. **Sulema** _ $HgCl_2$
110. **Taxir tuz** – $MgSO_4 \cdot 7H_2O$
111. **Temir kuporosi** – $FeSO_4 \cdot 7H_2O$
112. **Zar suvi/Shox arog‘I**- HNO_3+3HCl

KIMYOVIY ELEMENTLARNING OCHILISH TARIXI

Z	Belgisi	Sana	Kashf etgan olim
1	**H**	1776	G.Kavendish
2	**He**	1868	J.Jansen, N.Loker
3	**Li**	1817	A.Arfvedson
4	**Be**	1798	N.L.Voklen
5	**B**	1808	Gey-Lyussak, Tenar va Devi
7	**N**	1772	D.Rezerford
8	**O**	1771	K.Sheele
9	**F**	1771	K.Sheele
10	**Ne**	1898	U.Ramzay, M.U.Travers
11	**Na**	1807	G.Devi
12	**Mg**	1755	J.Blek
13	**Al**	1825	X.K.Ersted
14	**Si**	1824	I.Bresellius
15	**P**	1669	X.Brand
17	**Cl**	1774	K.Sheele
18	**Ar**	1894	U.Ramzay, D.Reele
19	**K**	1807	G.Devi
20	**Ca**	1808	G.Devi
21	**Sc**	1879	L.F.Nilson
22	**Ti**	1791	U.Gregor
23	**V**	1801	A.M. del Rio
24	**Cr**	1797	N.L. Voklen
25	**Mn**	1774	K.Sheele, Yu.Gan
27	**Co**	1735	G.Brandt
28	**Ni**	1751	A.Kronstedt
31	**Ga**	1875	Lekok de Buabodran
32	**Ge**	1881	K.A.Vinkler
33	**As**	1789	A.Lavuaze
34	**Se**	1817	I.Berselius G.Gan
35	**Br**	1826	A.J.Balar S.Levig
36	**Kr**	1898	U.Ramzay U.Troyers
37	**Rb**	1861	R.V.Bunzen G.Kirxgof
38	**Sr**	1808	G.Devi
39	**Y**	1794	Yu.Gadolin
40	**Zr**	1798	M.G.Klaprot
41	**Nb**	1801	I.Xatchin
42	**Mo**	1778	K.Sheyele
43	**Tc**	1937	K.Pere E.Segre
44	**Ru**	1808	E.Snyandeski
45	**Rh**	1804	U.X.Vollaston
46	**Pd**	1803	U.Vollaston
48	**Cd**	-	F.Shtromeyer
49	**In**	1863	Rayx G.Rixter
52	**Te**	1782	F.I.Myuller Reyxenshteyn
53	**I**	1811	B.Kurtua
54	**Xe**	1898	U.Ramzay M.U.Trevers
55	**Cs**	1860	I.R.Bunzen M.U.Trevers
56	**Ba**	1774	K.Sheyele I.Gan
57	**La**	1839	K.Mosander
58	**Ce**	1803	I.Berselius V.Gizenger
59	**Pr**	1885	K.Auer fon Velbax
60	**Nd**	1885	K.Auer fon Velbax
61	**Pm**	1954	J.Mariinsk, L.Glenden, I.Koriell
62	**Sm**	1879	Lekok de Buabodran
63	**Eu**	1901	E.Demarse
64	**Gd**	1886	Lekok de Buabodran
65	**Tb**	1843	K.Mosander
66	**Dy**	1886	Lekok de Buabodran
67	**Ho**	1878	P.Kleve
68	**Er**	1843	K.Mosander
69	**Tm**	1879	P.Kleve
70	**Yb**	1794	Yu.Gadolin
71	**Lu**	1907	J.Urben
72	**Hf**	1923	D.Koster, D.Xeveshi
73	**Ta**	1802	A.Eksberg
74	**W**	1751	K.Sheele
75	**Re**	1925	V.Noddak
76	**Os**	1804	S.Tennat
77	**Ir**	1804	S.Tennat
81	**Tl**	1961	U.Kruks
84	**Po**	1898	Per va Mariya Kyuri
85	**At**	1940	D.R.Korson
86	**Rn**	1900	F.Dorn
87	**Fr**	1939	M.Perey
88	**Ra**	1829	Per va Mariya Kyuri
89	**Ac**	1899	A.Debern
90	**Th**	1828	I.Bersellius
91	**Pa**	1918	Otto Gan
92	**U**	1798	M.G.Klaprot
93	**Np**	1940	E.Makmillan, F.Abelson
94	**Pu**	1940	G.T.Siborg
95	**Am**	1944	G.T.Siborg
96	**Cm**	1944	G.T.Siborg
97	**Bk**	1949	S.Tompson
98	**Cf**	1950	S.Tompson
99	**Es**	1952	J.Choppin
100	**Fm**	1954	J.Choppin
101	**Md**	1955	A.Giorso
102	**No**	1958	A.Giorso
103	**Lr**	1961	A.Giorso
104	**Rf**		
105	**Db**		
106	**Sg**		
107	**Bh**		
108	**Hs**		
109	**Mt**		
110	**Ds**		
111	**Rg**		

C, S, Fe, Cu, Zn, Ag, Sn, Sb, Pt, Au, Hg, Pb va **Bi** qadimdan ma'lum

GETEROSIKLIK BIRIKMALAR

 C_4H_4O	 C_4H_4S	 C_4H_5N	 C_3H_3NO	 C_3H_3NS	 $C_3H_4N_2$	 C_5H_6O	 C_5H_6S
Furan	Tiofen	Pirrol	Oksazol	Tiazol	Imidazol	Piran	Tiopiran
 $C_4H_4O_2$	 C_4H_5NS	 $C_4H_4N_2$	 $C_4H_4N_2$		 C_8H_7N		
Dioksin	Tiazin	Pirazin	Pirimidin	Adenin– $C_5H_5N_5$	Indol		
 $C_{10}H_{14}N_2$	 C_9H_7N	 C_6H_6NO	 $C_8H_{11}NO_3$				
Nikotin	Xinolin	Vitamin PP	Vitamin B_6				
 $C_5H_4N_4O_3$	 $C_5H_5N_5O$	 $C_4H_4N_2O_2$	 $C_8H_{11}N_4O_2$				
Siydik kislota	Guanin	Uratsil	Kofein				
 Sitozin – $C_4H_5N_3O$	 $C_5H_4N_4$	 $C_6H_7N_3O$	 $C_{10}H_{14}N_2$				
Purin	Izoniazid	Anabazin					
 $C_8H_9NO_3$	 $C_8H_{12}N_2O_2$	 $C_6H_5NO_2$	 Timin – $C_5H_6N_2O_2$				
Piridoksal	Piridoksamin	Nikotin kislota					

КИМЁВИЙ МАСАЛАЛАР ЕЧИШДА ҚЎЛЛАНИЛАДИГАН БАЪЗИ МАТЕМАТИК ИФОДАЛАР ВА ТЕНГЛАМАЛАР

1. 10^x функциясининг хоссалари:

   a) $10^x \cdot 10^y = 10^{x+y}$ *b*) $\frac{10^x}{10^y} = 10^{x-y}$ *c*) $(10^a)^b = 10^{ab}$

   d) $10^{-x} = \frac{1}{10^x}$ *e*) $10^0 = 1$

2. Ўнли логарифмнинг хоссалари:

   a) $\lg(xy) = \lg(x) + \lg(y)$ *b*) $\lg\frac{x}{y} = \lg(x) - \lg(y)$ *c*) $\lg(10^x) = x$

   d) $\lg 1 = 0$ *e*) $10^{\lg(x)} = x$ *f*) $\lg 10 = 1$

3. Квадрат тенгламанинг ечимлари:

   $$ax^2 + bx + c = 0 \qquad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

4. Содда арифметик ифодалар:

   a) $a(b + c) = ab + ac$ *d*) $(a + b)(c + d) = ac + ad + bc + bd$

   b) $(a + b)^2 = a^2 + 2ab + b^2$ *e*) $(a - b)^2 = a^2 - 2ab + b^2$

   c) $(a + b)(a - b) = a^2 - b^2$

5. Кубнинг ҳажми:

   $$V = a^3$$

6. Тўғри бурчакли параллелипеднинг ҳажми:

   $$V = a \cdot b \cdot c$$

7. Шарнинг ҳажми:

   $$V = \frac{4}{3}\pi r^3$$

8. Касрлар билан ишлаш:

   a) Қўшиш: $\frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}$

   b) Айириш: $\frac{a}{b} - \frac{c}{d} = \frac{ad-bc}{bd}$

   c) Кўпайтириш: $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$

   d) Бўлиш: $\frac{a}{b} : \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$

9. Даражалар билан ишлаш:

   a) $a^n \cdot a^m = a^{n+m}$ *b*) $a^n : a^m = a^{n-m}$ *c*) $(a^n)^m = a^{n \cdot m}$ *d*) $a^{-1} = \frac{1}{c}$

   e) $a^{-n} = \frac{1}{a^n}$ *f*) $\frac{x^{-n}}{y^{-m}} = \frac{y^m}{x^n}$ *g*) $(ab)^n = a^n \cdot b^n$

КИМЁВИЙ ҚАЙДЛАР

1. ***Гидролиз сони*** – 1 г ёғ билан реакцияга киришадиган КОН массаси (мг).
2. ***Фреонларни номлаш*** – (C-1) (H+1) (F)
3. **σ *боғлар сони*** (органик молекулада) – (C-1) + H
4. ***Орбиталлар сони*** (органик молекулада) – 4C + 2O + H
5. ***Диссоциланиш константаси ва* pH *орасидаги боғлиқлик:***

$$\mathrm{K_D} = \frac{[\mathrm{H}]^2}{\mathrm{C}}$$

6. ***Сувсиз туз ва кристаллогидрат эрувчанлик коэффициентлари орасидаги боғлиқлик:***

$$\omega = \frac{M(\text{туз}) \cdot x}{100 + M(\text{кристаллогидрат}) \cdot x}$$

7. ***Грахамнинг эффузия қонуни:***

$$\frac{\text{тезлик}_A}{\text{тезлик}_B} = \frac{\sqrt{M_B}}{\sqrt{M_A}}$$

8. ***Сувсиз туз ва кристаллогидрат чўкмаси орасидаги боғлиқлик:***

$$\omega = \frac{m_{\text{туз}} - M_{\text{туз}} \cdot x}{m_{\text{эритма}} - M_{\text{кристаллогидрат}} \cdot x}$$

9. ***Иод сони*** – 100 г мой билан реакцияга кириша оладиган иод массаси (г).
10. ***Буфер эритма* pH *и:***

$$\mathrm{pH} = -\lg \mathrm{K_D} + \lg \frac{\mathrm{C_{туз}}}{\mathrm{C_{кислота}}}$$

11. ***Боғнинг ионлилик даражаси:***

$$ID = \left(1 - e^{-0{,}25(X_A - X_B)^2}\right) \cdot 100\%$$

12. ***Кристалл панжара параметрлари асосида назарий зичлик:***

$$\rho = \frac{n \cdot M}{V \cdot N_A}$$

13. ***Эритма титри тенгламалари орасидаги боғлиқлик:***

$$\frac{m_{\text{модда}}}{V_{\text{эритма}}} = \frac{\mathrm{C}_N \cdot E}{1000}$$

14. ***Моляль концентрацияни ҳисоблаш:***

$$C_{\text{моляль}} = \frac{m_{\text{модда}}}{M \cdot m_{\text{сув}}} = \frac{n}{m_{\text{сув}}}$$

15. ***Гидролиз константаси ва диссоциланиш константаси орасидаги боғлиқлик:***

$$\mathrm{K_{гид}} = \frac{\mathrm{K_W}}{\mathrm{K_D}}$$

16. ***Углеводородлардаги C–C боғлар:***

Алканларда:	n-1
Алкенларда:	n
Алкин/алкадиенларда:	n+1

MUNDARIJA

UMUMIY KIMYO

ANORGANIK KIMYO REAKSIYALARDA

ORGANIK KIMYO

ILOVALAR

Conversion Factors and Relationships

Length

SI unit: meter (m)

$1\ \text{m} = 1.0936\ \text{yd}$
$1\ \text{cm} = 0.39370\ \text{in}$
$1\ \text{in} = 2.54\ \text{cm (exactly)}$
$1\ \text{km} = 0.62137\ \text{mi}$
$1\ \text{mi} = 5280\ \text{ft}$
$= 1.6093\ \text{km}$
$1\ \text{Å} = 10^{-10}\ \text{m}$

Temperature

SI unit: kelvin (K)

$0\ \text{K} = -273.15\ ^\circ\text{C}$
$= -459.67\ ^\circ\text{F}$
$\text{K} = {}^\circ\text{C} + 273.15$
$^\circ\text{C} = \dfrac{(^\circ\text{F} - 32)}{1.8}$
$^\circ\text{F} = 1.8\ (^\circ\text{C}) + 32$

Energy (derived)

SI unit: joule (J)

$1\ \text{J} = 1\ \text{kg} \cdot \text{m}^2/\text{s}^2$
$= 0.23901\ \text{cal}$
$= 1\ \text{C} \cdot \text{V}$
$= 9.4781 \times 10^{-4}\ \text{Btu}$
$1\ \text{cal} = 4.184\ \text{J}$
$1\ \text{eV} = 1.6022 \times 10^{-19}\ \text{J}$

Pressure (derived)

SI unit: pascal (Pa)

$1\ \text{Pa} = 1\ \text{N/m}^2$
$= 1\ \text{kg}/(\text{m} \cdot \text{s}^2)$
$1\ \text{atm} = 101{,}325\ \text{Pa}$
$= 760\ \text{torr}$
$= 14.70\ \text{lb/in}^2$
$1\ \text{bar} = 10^5\ \text{Pa}$
$1\ \text{torr} = 1\ \text{mmHg}$

Volume (derived)

SI unit: cubic meter (m^3)

$1\ \text{L} = 10^{-3}\ \text{m}^3$
$= 1\ \text{dm}^3$
$= 10^3\ \text{cm}^3$
$= 1.0567\ \text{qt}$
$1\ \text{gal} = 4\ \text{qt}$
$= 3.7854\ \text{L}$
$1\ \text{cm}^3 = 1\ \text{mL}$
$1\ \text{in}^3 = 16.39\ \text{cm}^3$
$1\ \text{qt} = 32\ \text{fluid oz}$

Mass

SI unit: kilogram (kg)

$1\ \text{kg} = 2.2046\ \text{lb}$
$1\ \text{lb} = 453.59\ \text{g}$
$= 16\ \text{oz}$
$1\ \text{amu} = 1.66053873 \times 10^{-27}\ \text{kg}$
$1\ \text{ton} = 2000\ \text{lb}$
$= 907.185\ \text{kg}$
$1\ \text{metric ton} = 1000\ \text{kg}$
$= 2204.6\ \text{lb}$

Geometric Relationships

$\pi = 3.14159\ldots$
Circumference of a circle $= 2\pi r$
Area of a circle $= \pi r^2$
Surface area of a sphere $= 4\pi r^2$
Volume of a sphere $= \dfrac{4}{3}\pi r^3$
Volume of a cylinder $= \pi r^2 h$

Fundamental Constants

Atomic mass unit	1 amu 1 g	$= 1.66053873 \times 10^{-27}\ \text{kg}$ $= 6.02214199 \times 10^{23}\ \text{amu}$
Avogadro's number	N_A	$= 6.0221421 \times 10^{23}/\text{mol}$
Bohr radius	a_0	$= 5.29177211 \times 10^{-11}\ \text{m}$
Boltzmann's constant	k	$= 1.38065052 \times 10^{-23}\ \text{J/K}$
Electron charge	e	$= 1.60217653 \times 10^{-19}\ \text{C}$
Faraday's constant	F	$= 9.64853383 \times 10^4\ \text{C/mol}$
Gas constant	R	$= 0.08205821\ (\text{L} \cdot \text{atm}/(\text{mol} \cdot \text{K})$ $= 8.31447215\ \text{J}/(\text{mol} \cdot \text{K})$
Mass of an electron	m_e	$= 5.48579909 \times 10^{-4}\ \text{amu}$ $= 9.10938262 \times 10^{-31}\ \text{kg}$
Mass of a neutron	m_n	$= 1.00866492\ \text{amu}$ $= 1.67492728 \times 10^{-27}\ \text{kg}$
Mass of a proton	m_p	$= 1.00727647\ \text{amu}$ $= 1.67262171 \times 10^{-27}\ \text{kg}$
Planck's constant	h	$= 6.62606931 \times 10^{-34}\ \text{J} \cdot \text{s}$
Speed of light in vacuum	c	$= 2.99792458 \times 10^8\ \text{m/s (exactly)}$

SI Unit Prefixes

a	f	p	n	μ	m	c	d	k	M	G	T	P	E
atto	femto	pico	nano	micro	milli	centi	deci	kilo	mega	giga	tera	peta	exa
10^{-18}	10^{-15}	10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^3	10^6	10^9	10^{12}	10^{15}	10^{18}

Selected Key Equations

Density (1.6)
$$d = \frac{m}{V}$$

Solution Dilution (4.4)
$$M_1V_1 = M_2V_2$$

Ideal Gas Law (5.4)
$$PV = nRT$$

Dalton's Law (5.6)
$$P_{total} = P_a + P_b + P_c + \ldots$$

Mole Fraction (5.6)
$$\chi_a = \frac{n_a}{n_{total}}$$

Average Kinetic Energy (5.8)
$$KE_{avg} = \frac{3}{2}RT$$

Root Mean Square Velocity (5.8)
$$u_{rms} = \sqrt{\frac{3\,RT}{\mathcal{M}}}$$

Effusion (5.9)
$$\frac{\text{rate A}}{\text{rate B}} = \sqrt{\frac{\mathcal{M}_B}{\mathcal{M}_A}}$$

Van der Waals Equation (5.10)
$$\left[P + a\left(\frac{n}{V}\right)^2\right] \times [V - nb] = nRT$$

Kinetic Energy (6.1)
$$KE = \frac{1}{2}mv^2$$

Internal Energy (6.2)
$$\Delta E = q + w$$

Heat Capacity (6.3)
$$q = m \times C_s \times \Delta T$$

Pressure-Volume Work (6.3)
$$w = -P\,\Delta V$$

Change in Enthalpy (6.5)
$$\Delta H = \Delta E + P\,\Delta V$$

Standard Enthalpy of Reaction (6.8)
$$\Delta H^\circ_{rxn} = \sum n_p\,\Delta H^\circ_f\,(\text{products}) - \sum n_r\,\Delta H^\circ_f\,(\text{reactants})$$

Frequency and Wavelength (7.2)
$$\nu = \frac{c}{\lambda}$$

Energy of a Photon (7.2)
$$E = h\nu$$

$$E = \frac{hc}{\lambda}$$

De Broglie Relation (7.4)
$$\lambda = \frac{h}{m\nu}$$

Heisenberg's Uncertainty Principle (7.4)
$$\Delta x \times m\,\Delta v \geq \frac{h}{4\pi}$$

Energy of Hydrogen Atom Levels (7.5)
$$E_n = -2.18 \times 10^{-18}\,\text{J}\left(\frac{1}{n^2}\right) \quad (n = 1, 2, 3\ldots)$$

Coulomb's Law (9.2)
$$E = \frac{1}{4\,\pi\epsilon_o}\frac{q_1q_2}{r}$$

Dipole Moment (9.6)
$$\mu = q\,r$$

Clausius-Clapeyron Equation (11.5)
$$\ln P_{vap} = \frac{-\Delta H_{vap}}{RT} + \ln\beta$$

$$\ln\frac{P_2}{P_1} = \frac{-\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Henry's Law (12.4)
$$S_{gas} = k_H P_{gas}$$

Raoult's Law (12.6)
$$P_{solution} = \chi_{solvent} P^\circ_{solvent}$$

Freezing Point Depression (12.7)
$$\Delta T_f = m \times K_f$$

Boiling Point Elevation Constant (12.7)
$$\Delta T_b = m \times K_b$$

Osmotic Pressure (12.7)
$$\prod = MRT$$

The Rate Law (13.3)
$$\text{Rate} = k[A]^n \quad \text{(single reactant)}$$
$$\text{Rate} = k[A]^m[B]^n \quad \text{(multiple reactants)}$$

Integrated Rate Laws and Half-Life (13.4)

Order	Integrated Rate Law	Half-Life Expression
0	$[A]_t = -kt + [A]_0$	$t_{1/2} = \frac{[A]_0}{2k}$
1	$\ln[A]_t = -kt + \ln[A]_0$	$t_{1/2} = \frac{0.693}{k}$
2	$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$	$t_{1/2} = \frac{1}{k[A]_0}$

Arrhenius Equation (13.5)
$$k = A\,e^{\frac{-E_a}{RT}}$$

$$\ln k = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln A \quad \text{(linearized form)}$$

$$k = p\,z\,e^{\frac{-E_a}{RT}} \quad \text{(collision theory)}$$

K_c and K_p (14.4)
$$K_p = K_c(RT)^{\Delta n}$$

pH Scale (15.5)
$$\text{pH} = -\log[H_3O^+]$$

Henderson-Hasselbalch Equation (16.2)
$$\text{pH} = \text{p}K_a + \log\frac{[\text{base}]}{[\text{acid}]}$$

Entropy (17.3)
$$S = k\ln W$$

Change in the Entropy of the Surroundings (17.4)
$$\Delta S_{surr} = \frac{-\Delta H_{sys}}{T}$$

Change in Gibb's Free Energy (17.5)
$$\Delta G = \Delta H - T\,\Delta S$$

The Change in Free Energy: Nonstandard Conditions (17.8)
$$\Delta G_{rxn} = \Delta G^\circ_{rxn} + RT\ln Q$$

ΔG°_{rxn} and K (17.9)
$$\Delta G^\circ_{rxn} = -RT\ln K$$

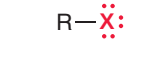
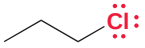
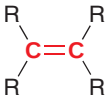
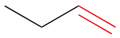
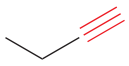
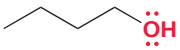
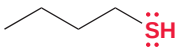
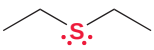
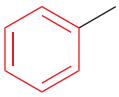
ΔG° and E°_{cell} (18.5)
$$\Delta G^\circ = -nF\,E^\circ_{cell}$$

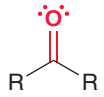
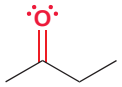
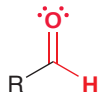
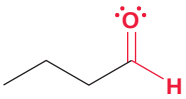
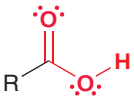
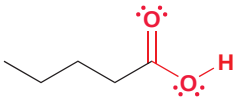
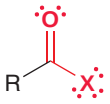
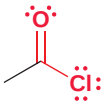
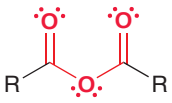
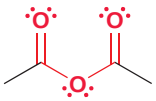
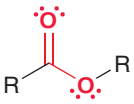
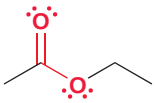
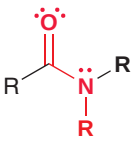
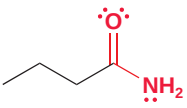
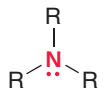
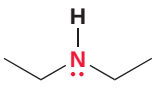
E°_{cell} and K (18.5)
$$E^\circ_{cell} = \frac{0.0592\,\text{V}}{n}\log K$$

Nerst Equation (18.6)
$$E_{cell} = E^\circ_{cell} - \frac{0.0592\,\text{V}}{n}\log Q$$

Einstein's Energy-Mass Equation (19.8)
$$E = mc^2$$

EXAMPLES OF COMMON FUNCTIONAL GROUPS

FUNCTIONAL GROUP*	CLASSIFICATION	EXAMPLE	CHAPTER
 (X = Cl, Br or I)	Alkyl halide	 *n*-Propyl chloride	7
	Alkene	 1-Butene	8, 9
	Alkyne	 1-Butyne	10
	Alcohol	 1-Butanol	13
	Ether	 Diethyl ether	14
	Thiol	 1-Butanethiol	14
	Sulfide	 Diethyl sulfide	14
	Aromatic (or arene)	 Methylbenzene	18, 19

FUNCTIONAL GROUP*	CLASSIFICATION	EXAMPLE	CHAPTER
	Ketone	 2-Butanone	20
	Aldehyde	 Butanal	20
	Carboxylic acid	 Pentanoic acid	21
	Acyl halide	 Acetyl chloride	21
	Anhydride	 Acetic anhydride	21
	Ester	 Ethyl acetate	21
	Amide	 Butanamide	21
	Amine	 Diethylamine	23

* The "R" refers to the remainder of the compound, usually carbon and hydrogen atoms.

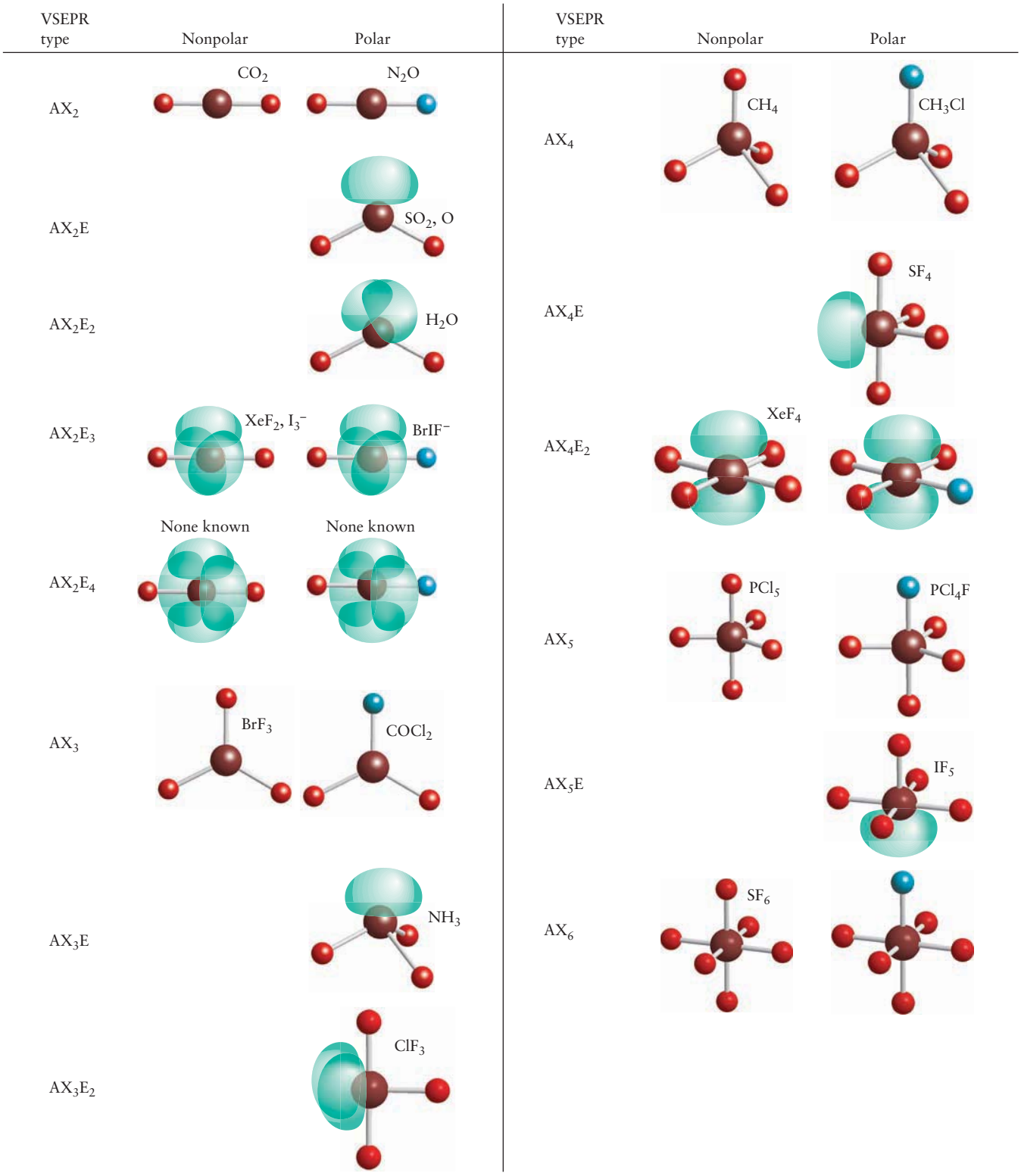


FIGURE 4.7 Arrangements of atoms that give rise to polar and nonpolar molecules. In the VSEPR formulas, A stands for a central atom, X for an attached atom, and E for a lone pair. Identical atoms are the same color; attached atoms colored differently belong to different elements. The green lobes represent lone pairs of electrons.