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ANORGANIK MODDALARNING KIMYOVIIY XOSSALARI

I-qism

s- va p- elementlar kimyosi
prof. R.A. Lidin tahriri ostidagi
uchinchi to'ldirilgan nashrining
tarjimasi

Samarqand – 2014

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Л 55 Химические свойства неорганических веществ: Учеб. пособие для вузов. 3-е изд., испр./Р.А. Лидин, В.А. Молочко, Л.Л. Андреева; Под ред. Р.А. Лидина. - М.: Химия, 2000. 480 с.: ил. ISBN 5-7245-И63-0

Davriy sistemadagi 105 ta element va noorganik birikmalarining kimyoviy xossalari bo'yicha qo'llanma. U axborot ma'lumotnoma xarakterida bo'lib, 3500 ta modda haqidagi ma'lumotlarni o'z ichiga oladi va aniq ishlab chiqilgan tuzilishga ega hamda kerakli birikmani yoki reaksiya tenglamasini oson topish imkonini beradigan ko'rsatkichlar bilan ta'minlangan.

Ushbu qollanma oliy o'quv yurtlarining kimyo mutaxassisligi talabalari uchun mo'ljallangan. Kimyo bo'yicha andozaviy darsliklarga ajoyib to'ldiruvchi bo'la oladi.

Qo'llanma o'qituvchilar, magistrilar, doktorantlar talabalar, abituriyentlar hamda kimyo sanoatida ishlaydigan ilmiy va muxandis-texnik xodimlar uchun foydali bo'ladi.

Uning birinchi qismida s- va p- elementlar qamrab olingan.

Ushbu uslubiy qo'llanma A.Navoiy nomidagi Samarqand davlat universiteti o'quv-uslubiy kengashining 2014-yil 18-fevraldagi 6-sonli yig'ilish qarori bilan nashr qilishga tavsiya etilgan.

SO‘Z BOSHI

Hozirgi zamon oily maktabi talabalarning individual – yakka, alohida ishlashlariga katta miqdorda orentirlangan. Mustaqillikni birdaniga I-kursdanoq, jumladan umumiy va anorganik kimyoni o‘rganishda eslash muhimdir. Mustaqil ish xox u ma’ruza konspektlarini uyda qayta ishlashmi, xox laboratoriya jurnalini tayyorlashmi, xullas maruza kursi bilan amaliyoti orasidagi bog‘lovchi zveno sifatidagi o‘rni beqiyosdir.

Ushbu qo‘llanma axborot-ma’lumotnoma tavsifida bo‘lib, kimyo adabiyotlari orasida o‘xshashi yo‘q va u anorganik kimyoning xamma bo‘limlarini o‘z ichiga olgan. Vodoroddan nilsboriygacha bo‘lgan elementlarning muhim birikmalarining (reaksiyalarining tenglamalari bilan) fizik va kimyoviy xossalari berilgan bo‘lib 1000 ga yaqin anorganik moddalar batafsil yoritilgan. Moddalarni tanlash ularning sanoatdagi ahamiyatiga ko‘ra Joylashish tartibi va izlash algoritmi “Qo‘llanma tuzilishi” bo‘limida batafsil yozilgan.

Ushbu qo‘llanmani yaratgan mualliflar M.V. Lomonosov nomidagi Moskva davlat inozik kimyoviy texnologiya akademiyasining anorganik kimyo kafedrasidagi olimlarning o‘zlarining ko‘p yillik ilmiy pedagogik tajribalariga tayanganlar. Mualliflar jamoasi RFA akademigi N.T.Kuznesovga va prof. B.D. Stepinga bergan konsultasiyalari va e’tiborlari uchun minnatdorchilik bildiradi, dos. L.Yu. Alikberovga va N.S. Rukkga, katta o‘qituvchi G.P. Loginov va boshqa hamkasblarining qo‘llab quvvatlaganliklari va qator muhim fikr muloxazalari uchun hamda taqrizchilar- MISiS ning umumiy va anorganik kimyo kafedراسi jamoasiga (kafedra mudiri prof. G.M. Kurdyumov) va MIXM ning umumiy va fizikaviy kimyo kafedراسi mudiri prof. V. S. Pervovaga o‘zlariga qiyin mexnatni olib, qo‘lyozmani e’tibor bilan o‘qiganliklari va tuzilishiga takliflar kiritgani va ularni xisobga olib, qo‘llanma sezilarli yaxshilangani uchun minnatdorchilik bildiradilar.

Mualliflar ushbu kitob umumiy va anorganik kimyo kafedراسi o‘qituvchilari va talabalari uchun axborot ma’lumotlar bazasi o‘quv qo‘llanmasi sifatida foydali bo‘ladi deb umid qiladilar. O‘quvchilarning hamma fikr muloazalarini va takliflarini minnatdorchilik bilan qabul qiladilar. Tarjimonlar ushbu qo‘llanma tarjimasining sifati va kamchiliklari xamda uni yanada takomillashtirish to‘g‘risidagi taklif va mulohazalarni quyidagi manzilda minnatdorchilik bilan qabul qiladilar.

Manzil: Samarqand shahri, universitet xiyoboni 15,
Samarqand davlat universiteti
Organik va noorganik kimyo kafedراسi

QO‘LLANMANING TUZILISHI

Davriy sistemaning guruhlari bo'yicha joylashgan elementlar anorganik moddalarining kimyoviy xossalari yozilgan, A-guruh (s va p elementlar), B-guruh elementlari (d-elementlar) va III B guruhga mansub lantanidlar va aktinidlar oilalari ketma-ket keltirilgan. Har bir guruh ichida elementlarning tartib raqamlarining ortib borishi bo'yicha joylashgan: I A guruh elementlarining xossalari quyidagi tartibda berilgan: litiy, natriy, kaliy, rubidiy, seziy, fransiyning xossalari. Xech bir guruhga mansub bo'lmagan, davriy sistemaning birinchi elementi sifatida vodorodning xossalari alohida keltirilgan. Har bir element xossasi shu element tarkibiga kiradigan moddaning xossasi bilan tavsiflangan. Ko'p elementli moddalar ayni elementning shunday bo'limiga kiritilganki, u hamma moddaning bosh kimyoviy xossasini aniqlaydi. Masalan, $K_2Cr_2O_7$ va $KMnO_4$ moddalarining kimyoviy xossalari xrom va marganes birikmalariga bag'ishlangan bo'limda tasvirlangan (kaliy birikmalari bo'limida emas), modomiki bu moddalarning ko'pchilik reaksiyalarida qaliy kationi ishtirok etmaydi, oddiy reagentdan mahsulotga o'tadi, bu vaqtda dixromat ioni $Cr_2O_7^{2-}$ va permanganat ioni MnO_4^- bu moddalar uchun bosh bo'lgan kuchli oksidlovchi xossalarini aniqlaydi. Elementlarning vodorodli birikmalari tegishli elementlarning bo'limlarida bo'ladi, bu oksidlar va gidrokksidlarga ham mansub. U yoki bu element kimyosiga bag'ishlangan bo'limlar, qator raqamlangan qismlarni (bo'lim, grafa) o'z ichiga oladi, ularning har biri bitta moddaga javob beradi. Axborot materiallaridan foydalanish qulay bo'lishi uchun qo'llanmada qismlar boshidan oxirigacha ma'lum ketma-ketlikda raqamlangan:

- bo'lim ichida qismlarning joylanish tartibi quyidagicha;
- oddiy modda (hamma vaqt bo'lim qismlarida birinchi);
- vodorodli birikmalari;
- oksidlari;
- gidroksidlari (asoslar, kislotalar, amfoter gidroksidlari);
- metallarning tuzlari (eng ko'p tarqalgani karbonatlar, nitratlar, sul'fatlar, xloridlar va boshqalar);
- binar birikmalar;
- kompleks birikmalar.

Kamroq ma'lum va kam tarqalgan kislotalarning tuzlari kislota hosil qiluvchi elementlar bo'limida tegishli kislotalardan keyin turadi. Bunday tuzlarning tarkibiy qismlarini topish uchun qo'llanma oxiridagi formulali ko'rsatkichdan foydalanish lozim. Moddani ifodalash qisqacha so'zli tavsiflashdan boshlanadi, unda rangi (odatda uy temperaturasidagi agregat holati uchun) ayrim sifatli fizik xossalari (qattiqligi, mo'rtligi, termik barqarorligi, fazaviy o'tishlari), tuzilishining o'ziga xosligi, havoda barqarorligi, suvda eruvchanligi, tarqalgan oddiy va murakkab moddalar bilan ta'sir etishi yoki etmasligi, laboratoriya va sanoatda olinish usullariga ko'rsatmalar, adabiyotda uchraydigan texnik, qadimgi va mineralogik terminlar. Yozma tavsiflar oxirida moddaning asosiy konstantalari keltirilgan nisbiy molekulyar massa M_r , zichlik

(d yoki p), suyuqlanish temperaturasi (t_c), qaynash temperaturasi (t_q), suvda eruvchanlik koeffitsiyenti (k_s yoki v_s).

Moddalarning olinish usullarida boshqa qismlarga tayanish ko'rsatilgan, u yerda ayni modda bir yoki bir nechta reaksiyalarda mahsulot sifatida hozir bo'ladi (tayanishda qismi raqami keltiriladi va yuqoridagi indeks bilan reaksiya tenglamasi raqami beriladi).

Keyin ayni moddaning bosh kimyoviy xossalarini aks ettiruvchi kimyoviy reaksiyalarning raqamlangan to'plami keladi. Reaksiya tenglamalarining joylashish tartibi umumiy holda quyidagicha:

- moddaning termik parchalanishi;

- kristollogidratlarning tabiati, ularni suvsizlantirish yoki parchalanishi;

- suvga munosabati aynan: elektrolitik dissosiasiyalanishi, protoliz, qaytar yoki qaytmas gidroliz, sovuq va issiq suvga munosabati;

- tarqalgan kislotalar bilan ta'siri – xlorid, sul'fat va nitrat (kislota bilan reaksiyalarning bir tipligida faqat xlorid kislota bilan reaksiyasi keltirilgan);

- ishqorlar bilan ta'sirlari (qoida bo'yicha faqat natriy gidroksidi bilan reaksiya tenglamasi keltirilgan);

- vodorod, kislorod va boshqa metalmaslar va metallar bilan ta'siri;

- murakkab moddalar bilan almashinish ta'sirlari;

- oksidlanish-qaytarilish ta'sirlari;

- kompleks hosil qilishi;

- elektroliz.

tenglamalarida reaksiyalarning borishi va o'tkazish shartlari ko'rsatilgan, bundan kimyoviy ta'sir va qaytarlik darajasini tushinish oson.

Reaksiya sharoitlarga quyidagilar kiradi:

- reagentlar va mahsulotlarning agregat holatlari, rangi, eritma holati (suyultirilgan, konsentrlangan, to'yingan, aniq tarkibi);

- reaksiyaning davomiyligi;

- temperaturalar oralig'i, bosim, katalizator;

- cho'kma yoki gaz hosil bo'lishi;

- erituvchi.

Formulalar ko'rsatkichda modda qismi, ya'ni qo'llanmaning asosiy matni keltirilgan.

Qisqartmalar va shartli belgilar ro'yxati

(g)- gazsimon holat	K_a -asoslik konstantasi (25^0S da)
(s) –suyuq holat (suyuqlik yoki suyuqlanma)	$pK_a = -\lg(K_a)$
iss-issiq	K_{bar} -kompleksning barqarorlik konstantasi bosqichlari (25^0S da)
kat. – katalizator	K_m -muvozanat konstantasi, molyar konsentrasiya orqali ifodalanadi (uy temperaturasida) $pK_m = -\lg(K_m)$
kons- konsentrlangan	K_s -erituvchining ionli ko'paytmasi (yuqoridagi indeks temperatura) $pK_s = -\lg(K_s)$
to'yi. – to'yingan	k_s -massali. Eruvchanlik koeffisienti (yuqoridagi indeks- temperatura, g/100 g suvda)
n.sh- normal sharoit	M_r - molekulyar massa
j.s-juda suyultirilgan	P_q - qizil fosfor
nam- namlik	P - bosimning yuqori ekanligi
(er) – eritmada	pH - vodorod ko'rsatkich $pH = -\lg(H_3O^+)$
sov- sovuqda	t_q – qaynash temperaturasi
suyul-suyultirilgan	t_s – suyuqlanish temperaturasi
qayn. –qaynoq	$t_{subl.}$ – sublimasiyalanish temperaturasi
(q) – qattiq holat	$t_{(d \rightarrow \beta)}$ – polimorf aylanish temperaturasi
uy- uy haroratida	v_s – gazni eruvchanlik hajmiy koeffisiyenti (yuqorigi indeks – temperatura), ml (n.sh.)/100g suvda
EK-eruvchanlik ko'paytmasi	β_b – kompleksning beqarorlik umumiy konstantasi (25^0), $p\beta_b = -\lg(\beta_b)$
pEK - $-\lg(EK)$	ρ - gaz holatining zichligi
er. –eritma	τ – reaksiyaning sekin borishi
d-qattiq va suyuq holatlar uchun nisbiy zichlik (yuqoridagi indeks-t, indeksning yo'qligi - $18-25^0S$) suv bo'yicha ($1 g/sm^3$, 4^0S)	
K_s -suvning ion ko'paytmasi	
K_k - kislotalik konstantasi (25^0S da) $rK_k = -\lg(K_k)$	
K_b - kompleksning barqarorlik konstantasi bosqichlari (25^0C da) $pK_b = -\lg(K_b)$	

I – BO'LIM

S – ELEMENTLAR KIMYOSI

Vodorod

1. H₂ –divodorod

Yengil vodorod-diprotiy. Tabiiy vodorod tarkibida asosan ¹H (protiy) izotopi bo'lib, yana barqaror izotop ²H (deyteriy D, ko'proq) aralashgan va radioaktiv izotopi ³H ham (tritiy T, izlari) bor. Metalmas. Rangsiz, juda qiyin suyuqlanadigan gaz. Suvda juda kam, organik erituvchilarda ancha yaxshi eriydi. Metallar (Fe, Ni, Pt, Pd) bilan xemosorbsiyalanadi. Yuqori temperaturalarda kuchli qaytaruvchi, metallar, metalmaslar va metall oksidlari bilan ta'sirlashadi. Atomar vodorodning H⁰ qaytaruvchanlik qobiliyati ayniqsa yuqori, u molekulyar vodorodni H₂ termik parchalanishidan yoki to'g'ridan – to'g'ri qaytaruvchanlik jarayoni o'tkaziladigan muhitida hosil bo'ladi. Olinishi; qarang: 5^{12,14,15,17,21,36}¹¹, 424¹³, 484^{8*}

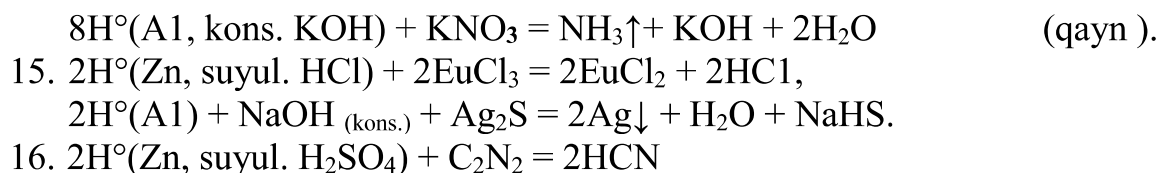
$$Mr = 2,016; d_{(g)} = 0,08667^{(-260)}; d_{(s)} = 0,07108^{(-235)};$$

$$\rho = 0,08988 \text{ g/l (n.sh.)}; t_s = -259,19^\circ \text{ C}; t_q = -252,87^\circ \text{ C};$$

$$v_s = 2,15^{(0)}, \quad 1,82^{(20)}, \quad 1,60^{(60)}.$$

1. $\text{H}_2 \leftrightarrow 2\text{H}^\circ$ (2000-3500° C).
2. $\text{H}_2 + \text{F}_2 = 2\text{HF}$ (-250° C dan uy t⁰ gacha.),
 $\text{H}_2 + \text{Cl}_2 = 2\text{HCl}$ (yoqish, uy t⁰, yorug'likda)
Elementar aktlari: $\text{Cl}_2 = 2\text{Cl}^0$, $\text{Cl}^0 + \text{H}_2 = \text{HCl} + \text{H}^0$, $\text{H}^0 + \text{Cl}_2 = \text{HCl} + \text{Cl}^0$.
 $\text{H}_2 + \text{E}_2 = 2\text{HE}$ (E = Br, I; 350-500° C, kat. Pt).
3. $2\text{H}_2 + \text{O}_2 = 2\text{H}_2\text{O}$ (550° C, havoda yonishi)
Elementar aktlari: $\text{H}_2 + \text{O}_2 = 2\text{OH}^\circ$, $\text{OH}^0 + \text{H}_2 = \text{H}_2\text{O} + \text{H}^\circ$,
 $\text{H}^\circ + \text{O}_2 = \text{OH}^0 + \text{O}^0$, $\text{O}^0 + \text{H}_2 = \text{OH}^0 + \text{H}^\circ$.
4. $\text{H}_2 + \text{S} = \text{H}_2\text{S}$ (150-200° C),
 $3\text{H}_2 + \text{N}_2 = 2\text{NH}_3$ (500° C, p, kat. Fe).
5. $2\text{H}_2 + \text{C}_{(\text{koks})} = \text{CH}_4$ (600° C, p, kat. Pt),
 $\text{H}_2 + 2\text{C}_{(\text{koks})} = \text{C}_2\text{H}_2$ (1500-2000° C).
6. $\text{H}_2 + 2\text{Na} = 2\text{NaH}$ (300° C)
 $\text{H}_2 + \text{Ca} = \text{CaH}_2$ (500-700° C).
7. $4\text{H}_2 + (\text{Fe}^{\text{II}}\text{Fe}_2^{\text{III}})\text{O}_4 = 3\text{Fe} + 4\text{H}_2\text{O}$ (570° C dan yuqori).
8. $\text{H}_2 + \text{Ag}_2\text{SO}_4 = 2\text{Ag} + 4\text{H}_2\text{SO}_4$ (200 °C dan yuqorida)
 $4\text{H}_2 + 2\text{Na}_2\text{SO}_4 = \text{Na}_2\text{S} + 4\text{H}_2\text{O}$ (550-600° C, kat. Fe₂O₃).
9. $3\text{H}_2 + 2\text{BCl}_3 = 2\text{B} + 6\text{HCl}$ (800-1200° C),
 $\text{H}_2 + 2\text{EuCl}_3 = 2\text{EuCl}_2 + 2\text{HCl}$ (270° C).
10. $4\text{H}_2 + \text{CO}_2 = \text{CH}_4 + 2\text{H}_2\text{O}$ (200° C, kat. Cu₂O).
11. $\text{H}_2 + \text{CaC}_2 = \text{Ca} + \text{C}_2\text{H}_2$ (2200° C dan yuqori).
12. $\text{H}_2 + 2\text{C}_{(\text{koks})} + \text{N}_2 = 2\text{HCN}$ (1800° C dan yuqori).
13. $\text{H}_2 + \text{BaH}_2 = \text{Ba}(\text{H}_2^-)_2$ (0° C, p).
14. $2\text{H}^\circ(\text{Zn, suyul.HCl}) + \text{KNO}_3 = \text{KNO}_2 + \text{H}_2\text{O}$,

* Bu yerda va keyingi satrdagi son-qism raqami, yuqori indeks shu qismdagi reaksiya tenglamasi raqami



2. D₂ – dideyteriy

Og‘ir vodorod. Rangsiz qiyin siqiluvchan gaz. Tabiiy vodorod tarkibida 0,012–0,016 % (massa bo‘yicha) D₂ bo‘ladi (qolgani ¹H₂ va T₂ izlari). H₂ bilan yuqori temperaturalarda izotop almashinish sodir bo‘ladi. Odatdagi va og‘ir suvda juda kam eriydi. Odatdagi suv bilan izotop almashinish kuchsiz sodir bo‘ladi. Kimyoviy xususiyatlari jixatidan H₂ ga o‘xshash, ammo reaksiya qobiliyati ancha sust. Olinishi; qarang: 6^{3,4,17}

$$M_r=4,028; d_{\text{suyuq.}}=0,17^{(-253)}; t_s=-254,5^\circ\text{C}; t_q=-249,49^\circ\text{C}$$

3. T₂ – ditritiy

O‘ta og‘ir vodorod. Rangsiz gaz. Radioaktiv (β – nurlanuvchi), yarim yemirilish davri 12,34 yil. Kimyoviy xossalari jixatidan H₂ ga o‘xshash. ¹⁴N yadrolarini kosmik nurlanuvchi neytronlar bilan atmosferada bombordimoni natijasida hosil bo‘ladi; Tabiiy suvlarda uning izlari uchraydi. Olinishi; – yadro reaktorlarida litiyni sust neytronlar bilan bombordimon qilish yo‘li bilan.

$$M_r=6,032; t_s=-252,52^\circ\text{C}; t_q=-248,12^\circ\text{C}$$

4. HD – deyteriovodorod

Rangsiz gaz. Oddiy va og‘ir suvda amalda erimaydi. Kimyoviy xususiyatlari jixatidan H₂ ga o‘xshash. Olinishi; qarang: 6¹⁶

$$M_r=3,022; d_{(q)}=0,146^{(-257)}; \rho=0,135 \text{ g/l (n.sh)}; t_s=-256,5^\circ\text{C}; t_q=-257,02^\circ\text{C}$$

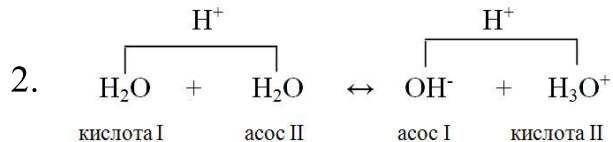
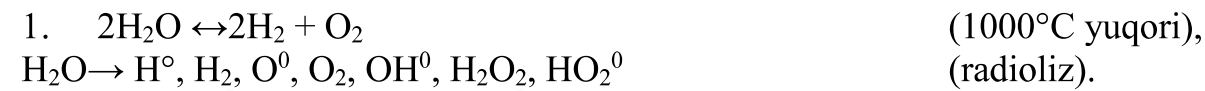
5. H₂O – Suv

Rangsiz suyuqlik (qalin qatlamda havorang – moviy) uchuvchan; kristal suv (muz) oson sublimasiyalanadi. Kislorodning izotop tarkibi bo‘yicha tabiiy suv asosan H₂¹⁶O, H₂¹⁸O va H₂¹⁷O aralashmalari bilan, vodorodni izotopik tarkibi bo‘yicha esa asosan ¹H₂O HDO aralashmalari bilan uchraydi. Suyuq suv avtoprotolizga (H₃O⁺ va OH⁻ mahsulotlari) uchraydi: oksoniy kationi H₃O⁺ - eng kuchli kislota va gidroksid ion – OH⁻ - suvli eritmada eng kuchli asos, suvning o‘zi esa eng kuchsiz – bog‘langan protolit (kislota va asoslarni proton nazaryasida). Suv ko‘plab moddalar bilan kristallgidratlar hosil qiladi. Kimyoviy aktiv; metallar, metalmaslar, oksidlar bilan ta’sirlashadi, ko‘plab binar birikmalar va tuzlarni gidrolizlaydi. Noorganik birikmalar uchun deyarli universal suyuq erituvchi. Kimyoviy maqsadlar uchun tabiiy suv odatda haydash usuli bilan tozalanadi (distillangan suv). Maxsus usullar bilan yuqori darajada toza bo‘lgan suv olinadi. Shuningdek 1³ ga qarang.

$$M_r = 18,02; d_{\text{muz}}=0,917^{(0)}; d_{(s)}=0,999841^{(0)}, 0,998203^{(20)}, 0,997044^{(25)},$$

$$0,97180^{(80)}, 0,95835^{(100)}; d(\text{H}_2^{18}\text{O})=1,11^{(20)}; \rho=0,8652 \text{ g/l (n. sh.)}, 0,5977 \text{ g/l}$$

$$(\rho_0, 100^\circ \text{C}); t_s=0,00^\circ \text{C}; t_q=100,00^\circ \text{C}; t_q(\text{H}_2^{18}\text{O})=100,13^\circ \text{C}; K_s^{25}=1,008 \cdot 10^{-14}.$$



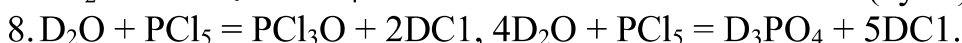
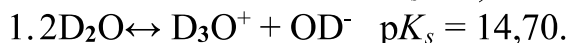
3. $\text{H}_2\text{O} + \text{HClO}_4 = \text{ClO}_4^- + \text{H}_3\text{O}^+$, $\text{H}_2\text{O} + \text{HCN} \leftrightarrow \text{CN}^- + \text{H}_3\text{O}^+$.
 4. $4\text{H}_2\text{O} + \text{NaOH} = [\text{Na}(\text{H}_2\text{O})_4]^+ + \text{OH}^-$, $\text{H}_2\text{O} + \text{NH}_3 \leftrightarrow \text{NH}_4^+ + \text{OH}^-$.
 5. $4\text{H}_2\text{O} + \text{NaClO}_4 = [\text{Na}(\text{H}_2\text{O})_4]^+ + \text{ClO}_4^-$
 6. $4\text{H}_2\text{O} + \text{Zn}(\text{ClO}_4)_2 = [\text{Zn}(\text{H}_2\text{O})_4]^{2+} + 2\text{ClO}_4^-$
 $\text{H}_2\text{O} + [\text{Zn}(\text{H}_2\text{O})_4]^{2+} \leftrightarrow [\text{Zn}(\text{H}_2\text{O})_3(\text{OH})]^+ + \text{H}_3\text{O}^+$.
 7. $4\text{H}_2\text{O} + \text{NaCN} = [\text{Na}(\text{H}_2\text{O})_4]^+ + \text{CN}^-$, $\text{H}_2\text{O} + \text{CN}^- \leftrightarrow \text{HCN} + \text{OH}^-$.
 8. $6\text{H}_2\text{O} + \text{Al}_2\text{S}_3 = 2\text{Al}(\text{OH})_3 \downarrow + 3\text{H}_2\text{S} \uparrow$,
 $2\text{H}_2\text{O} + \text{SiCl}_4 = \text{SiO}_2 \downarrow + 4\text{HCl}$,
 $6\text{H}_2\text{O}_{(\text{qayn.})} + \text{Mg}_3\text{N}_2 = 3\text{Mg}(\text{OH})_2 \downarrow + 2\text{NH}_3 \uparrow$,
 $2\text{H}_2\text{O} + \text{CaC}_2 = \text{Ca}(\text{OH})_2 + \text{C}_2\text{H}_2 \uparrow$.
 9. $\text{H}_2\text{O} + \text{Na}_2\text{O} = 2\text{NaOH}$, $\text{H}_2\text{O} + \text{CaO} = \text{Ca}(\text{OH})_2$, $3\text{H}_2\text{O} + \text{La}_2\text{O}_3 = 2\text{La}(\text{OH})_3$
 10. $\text{H}_2\text{O} + \text{Cl}_2\text{O}_7 = 2\text{HClO}_4$, $\text{H}_2\text{O} + \text{SO}_3 = \text{H}_2\text{SO}_4$, $6\text{H}_2\text{O} + \text{P}_4\text{O}_{10} = 4\text{H}_3\text{PO}_4$,
 11. $n\text{H}_2\text{O} + \text{Cl}_2 = \text{Cl}_2 \cdot n\text{H}_2\text{O}$, $\text{Cl}_2 \cdot n\text{H}_2\text{O} \leftrightarrow \text{HCl} + \text{HClO} + (n-1)\text{H}_2\text{O}$.
 12. $2\text{H}_2\text{O} + \text{CaH}_2 = \text{Ca}(\text{OH})_2 + 2\text{H}_2 \uparrow$.
 13. $2\text{H}_2\text{O} + 2\text{M} = 2\text{MOH} + \text{H}_2 \uparrow$ (M = Li, Na, K, Rb, Cs),
 $2\text{H}_2\text{O} + \text{M} = \text{M}(\text{OH})_2 + \text{H}_2 \uparrow$ (M = Ca, Sr, Ba, Ra).
 14. $4\text{H}_2\text{O}_{(\text{bug})} + 3\text{Fe} = (\text{Fe}^{\text{II}}\text{Fe}_2^{\text{III}})\text{O}_4 + 4\text{H}_2$ (570° C gacha).
 15. $6\text{H}_2\text{O}_{(\text{issiq.})} + 2\text{NaOH}_{(\text{kons.})} + 2\text{Al} = 2\text{Na}[\text{Al}(\text{OH})_4] + 3\text{H}_2 \uparrow$.
 16. $2\text{H}_2\text{O} + 2\text{CrSO}_4 \xrightarrow{\tau} \text{H}_2 \uparrow + 2\text{Cr}(\text{SO}_4)\text{OH}$.
 17. $\text{H}_2\text{O} + \text{C}_{(\text{koks})} \leftrightarrow \text{CO} + \text{H}_2$ (800-1000° C),
 $\text{H}_2\text{O} + \text{CO} \leftrightarrow \text{CO}_2 + \text{H}_2$ ($t^0 > 230^\circ \text{C}$, kat. Fe_2O_3).
 18. $\text{H}_2\text{O} + \text{F}_2 = 2\text{HF} + \text{O}^0$ (uy., O_3 aralashma)
 $\text{H}_2\text{O} + \text{O}^0 = \text{H}_2\text{O}_2$, $\text{H}_2\text{O} + \text{O}_3 = \text{H}_2\text{O}_2 + \text{O}_2$ (UB-nurlanish).
 19. $2\text{H}_2\text{O}_{(\text{issiq.})} + 2\text{XeF}_2 \xrightarrow{\tau} \text{O}_2 \uparrow + 2\text{Xe} \uparrow + 4\text{HF}$.
 20. $2\text{H}_2\text{O} + 2\text{Co}_2(\text{SO}_4)_3 = 4\text{CoSO}_4 + \text{O}_2 \uparrow + 2\text{H}_2\text{SO}_4$,
 $2\text{H}_2\text{O} + 4\text{KMnO}_4 \xrightarrow{\tau} 4\text{MnO}_2 \downarrow + 3\text{O}_2 \uparrow + 4\text{KOH}$.
 21. $2\text{H}_2\text{O} \xrightarrow{\text{электролиз}} 2\text{H}_2 \uparrow (\text{katod}) + \text{O}_2 \uparrow (\text{anod})$.
 Neytral eritmada (elektrolit Na_2SO_4):
 (katodda) $2\text{H}_2\text{O} + 2\bar{e} = \text{H}_2 \uparrow + 2\text{OH}^-$
 (anodda) $2\text{H}_2\text{O} - 4\bar{e} = \text{O}_2 \uparrow + 4\text{H}^+$ (aniqrog'i, H_3O^+),
 (eritmada) $\text{OH}^- + \text{H}^+ = \text{H}_2\text{O}$.

Kislotali eritmada (elektrolit H_2SO_4):
 (katodda) 2H^+ (aniqrog'i, H_3O^+) $+ 2\bar{e} = \text{H}_2 \uparrow$.
 (anodda) $2\text{H}_2\text{O} - 4\bar{e} = \text{O}_2 \uparrow + 4\text{H}^+$ (aniqrog'i, H_3O^+)
 Ishqoriy eritmada (elektrolit KOH):
 (katodda) $2\text{H}_2\text{O} + 2\bar{e} = \text{H}_2 \uparrow + 2\text{OH}^-$,
 (anodda) $4\text{OH}^- - 4\bar{e} = \text{O}_2 \uparrow + 2\text{H}_2\text{O}$.

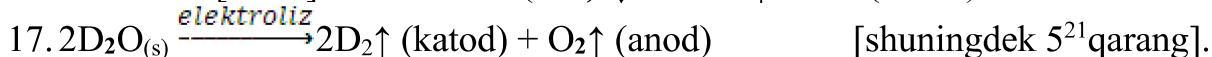
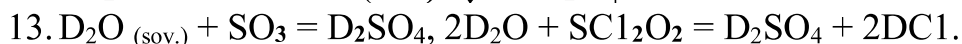
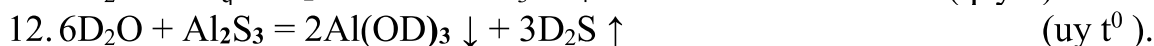
6. D₂O – Deyteriy oksidi

Og‘ir suv. Rangsiz gigroskopik suyuqlik; oddiy suvga nisbatan ancha qovushqoq. Avtoionlanish H₂O ga nisbatan ancha kam. Oddiy suv bilan cheksiz aralashadi, izotop almashinishi yarim og‘ir suvni HDO hosil bo‘lishiga olib keladi. Erituvchanlik xususiyati oddiy suvga nisbatan past. Ularning kimyoviy xossalari bir xil, lekin D₂O ishtirokidagi hamma ta’sirlar H₂O ga nisbatan ancha sust amalga oshadi. Tabiiy suvlar tarkibida uchraydi (D₂O: H₂O ning massa nisbati 1:5500). Tabiiy suvni ko‘p marotaba elektroliz qilib olinadi (og‘ir suv elektrolit qoldig‘ida to‘planadi.).

$$M_r = 20,03; d_{(s)} = 1,1071^{(11,6)}, \quad 1,1042^{(25)};$$
$$t_s = 3,813^\circ \text{C}; t_q = 101,43^\circ \text{C}.$$



(qayn).



7. T₂O – tritiy oksidi

O‘ta og‘ir suv. Rangsiz suyuqlik, H₂O va D₂O ga nisbatan ancha qovushqoq. Oddiy va og‘ir suv bilan cheksiz aralashadi. H₂O va D₂O bilan izotop almashinish HTO va DTO hosil bo‘lishiga olib keladi. Erituvchanlik qobiliyati H₂O va D₂O larga nisbatan kam. Kimyoviy xossalari jixatidan H₂O va D₂O dan farq qilmaydi, ammo barcha reaksiyalari sekin boradi. T₂O ning izlari tabiiy suvlarda va atmosferadagi namliklarda uchraydi. Olinishi; T₂ ni qizib turgan CuO ustidan o‘tkazib olinadi.

$$M_r = 22,03; t_s = 4,5^\circ \text{C}$$

8. Li – Litiy

Ishqoriy metall. Kumushsimon oq rangda. Metallardan eng yengili, yumshoq, oson suyuqlanuvchan. Reaksion qobiliyatli; havoda oksid – nitrid plyonkasi bilan qoplananadi. Asta – sekin qizdirilganda alangalanadi; gaz gorelkasi alangasini to‘q – qizil rangga bo‘yaydi. Kuchli qaytaruvchi; suv, kislota, metalmaslar, ammiak bilan reaksiyaga kirishadi. Olinishi; qarang: $9^{1,15}$, 10^{4-6} , $18^{10,12}$, 20^1 .

$Mr = 6,941$; $d = 0,534$; $t_s = 180,5^\circ \text{ C}$; $t_q = 1336,6^\circ \text{ C}$.

1. $2\text{Li} + 2\text{H}_2\text{O} = 2\text{LiOH} + \text{H}_2\uparrow$.
2. $2\text{Li} + 2\text{HCl}_{(\text{suyul.})} = 2\text{LiCl} + \text{H}_2\uparrow$
3. $2\text{Li} + 3\text{H}_2\text{SO}_4_{(\text{kons.})} = 2\text{LiHSO}_4 + \text{SO}_2\uparrow + 2\text{H}_2\text{O}$.
4. $3\text{Li} + 4\text{HNO}_3_{(\text{suyul.})} = 3\text{LiNO}_3 + \text{NO}\uparrow + 2\text{H}_2\text{O}$.
5. $2\text{Li} + \text{H}_2 = 2\text{LiH}$ (500-700° C).
6. $2\text{Li} + \text{E}_2 = 2\text{LiE}$ (uy t^0 , E = F, Cl, Br; 200° C dan yuqori, E = I).
7. $4\text{Li} + \text{O}_2 = 2\text{Li}_2\text{O}$ ($t^0 > 200^\circ \text{ C}$, aralashma Li_2O_2).
8. $2\text{Li} + \text{S} = \text{Li}_2\text{S}$ ($t^0 > 130^\circ \text{ C}$).
9. $6\text{Li} + \text{N}_{2(\text{nam})} = 2\text{Li}_3\text{N}$ (uy t^0),
 $6\text{Li} + \text{N}_2 = 2\text{Li}_3\text{N}$ (200-250° C, p)
10. $2\text{Li} + 2\text{C} = \text{Li}_2\text{C}_2$ ($t^0 > 200^\circ \text{ C}$, vak.).
11. $4\text{Li} + \text{Si} = \text{Li}_4\text{Si}$ (600--700° C, aralashma Li_2Si).
12. $2\text{Li} + 2\text{NH}_3 = 2\text{LiNH}_2 + \text{H}_2$ (220° C),
13. $2\text{Li} + \text{NH}_3 = \text{Li}_2\text{NH} + \text{H}_2$ (400° C).
14. $\text{Li} + 4\text{NH}_{3(\text{s})} = [\text{Li}(\text{NH}_3)_4]^0$ (ko‘k.) [-40° C]
15. $[\text{Li}(\text{NH}_3)_4]^0 + n\text{NH}_{3(\text{s})} \leftrightarrow [\text{Li}(\text{NH}_3)_4]^+ + \bar{e} \cdot n\text{NH}_3$.

9. LiH – Litiy gidridi

Oq, yengil, parchalanmasdan suyuqlanadi, qizdirish davom ettirilganda parchalanadi. Kuchli qaytaruvchi; suv, kislotalar, metalmaslar, metalmaslarni oksidlari bilan reaksiyaga kirishadi. Olinishi; qarang: 8^5 , 20^4 .

$Mr = 7,95$; $d = 0,82$; $t_s = 680^\circ \text{ C}$.

1. $2\text{LiH} = 2\text{Li} + \text{H}_2$ (850° C yoki vak., 450° C).
2. $\text{LiH} + \text{H}_2\text{O} = \text{LiOH} + \text{H}_2\uparrow$
3. $\text{LiH} + \text{HCl}_{(\text{suyul.})} = \text{LiCl} + \text{H}_2\uparrow$ (uy t^0).
4. $2\text{LiH} + \text{O}_2 = 2\text{LiOH}$ (500° C yuqori).
5. $\text{LiH} + \text{Cl}_2 = \text{LiCl} + \text{HCl}$ (400-450° C).
6. $2\text{LiH} + 2\text{S} = \text{Li}_2\text{S} + \text{H}_2\text{S}$ (300-350° C).
7. $3\text{LiH} + \text{N}_2 = \text{Li}_3\text{N} + \text{NH}_3$ (500-600° C).
8. $2\text{LiH} + 4\text{C}_{(\text{grafit})} = \text{Li}_2\text{C}_2 + \text{C}_2\text{H}_2$ (400° C).
9. $2\text{LiH} + 2\text{SO}_2 = \text{Li}_2\text{SO}_4 + \text{H}_2\text{S}$ (200° C).
10. $\text{LiH} + \text{CO}_2 = \text{Li}(\text{HCOO})$ [250° C, gacha, p].
11. $4\text{LiH} + 3\text{SiO}_2 = 2\text{Li}_2\text{SiO}_3 + \text{Si} + 2\text{H}_2$ (500° C).

12. $\text{LiH} + \text{NH}_3 = \text{LiNH}_2 + \text{H}_2$ (350° C).
13. $\text{LiH} + \text{NH}_{3(s)} = \text{LiNH}_2 \downarrow + \text{H}_2 \uparrow$ (- 40° C).
14. $4\text{LiH} + \text{AlCl}_3 = \text{Li}[\text{AlH}_4] + 3\text{LiCl} \downarrow$ (efirda).
15. $2\text{LiH}_{(s)} \xrightarrow{\text{elektroliz}} 2\text{Li (katod)} + \text{H}_2 \uparrow$ (anod).

10. Li_2O – Litiy oksidi

Oq, gigroskopik, qiyin suyuqlanuvchan, qizdirilganda parchalanmaydi. Asosli oksidlarning xossalarini namoyon qiladi, suv bilan shiddatli reaksiyaga kirishadi (ishqor eritmasi hosil bo'ladi), kislotalar, metallar, kislotali oksidlar bilan reaksiyaga kirishadi, havodan CO_2 ni yutadi. Olinishi; qarang: 8⁷, 12¹, 13^{1,3}, 14¹.

$$M_r = 29,88; d = 2,013; t_s = 1453^\circ \text{ C}; t_q \approx 2600^\circ \text{ C}.$$

1. $\text{Li}_2\text{O} + \text{H}_2\text{O} = 2\text{LiOH}$.
2. $\text{Li}_2\text{O} + 2\text{HCl}_{(s)} = 2\text{LiCl} + \text{H}_2\text{O}$.
3. $\text{Li}_2\text{O} + \text{H}_2\text{S} = \text{Li}_2\text{S} + \text{H}_2\text{O}$ (900-1000° C)
4. $2\text{Li}_2\text{O} + \text{Si} = 4\text{Li} + \text{SiO}_2$ (1000° C)
5. $\text{Li}_2\text{O} + \text{Mg} = 2\text{Li} + \text{MgO}$ ($t^0 > 800^\circ \text{ C}$).
6. $3\text{Li}_2\text{O} + 2\text{Al} = 6\text{Li} + \text{Al}_2\text{O}_3$ ($t^0 > 1000^\circ \text{ C}$).
7. $\text{Li}_2\text{O} + \text{CO}_2 = \text{Li}_2\text{CO}_3$ (500-600° C).
8. $2\text{Li}_2\text{O} + \text{SiO}_2 = \text{Li}_4\text{SiO}_4$ (1000-1300° C)
- $\text{Li}_2\text{O} + \text{SiO}_2 = \text{Li}_2\text{SiO}_3$ (1200-1300° C)

11. Li_2O_2 – Litiy peroksidi

Oq, qizdirilganda suyuqlanmasdan parchalanadi. Suv bilan to'liq gidrolizlanadi, kislotalar bilan ta'sirlashadi. Havodan CO_2 ni shiddatli yutadi. Olinishi; qarang: 12⁸.

$$M_r = 45.88; d = 2,363.$$

1. $2\text{Li}_2\text{O}_2 = 2\text{Li}_2\text{O} + \text{O}_2$ (200-400° C).
2. $\text{Li}_2\text{O}_2 \cdot \text{H}_2\text{O} = \text{Li}_2\text{O}_2 + \text{H}_2\text{O}$ ($t^0 > 0^\circ \text{ C}$).
3. $\text{Li}_2\text{O}_2 + 2\text{H}_2\text{O}_{(soy.)} = 2\text{LiOH} + \text{H}_2\text{O}_2$,
 $2\text{Li}_2\text{O}_2 + 2\text{H}_2\text{O}_{(issiq.)} = 4\text{LiOH} + \text{O}_2 \uparrow$
4. $\text{Li}_2\text{O}_2 + 2\text{HCl}_{(suyul., soy.)} = 2\text{LiCl} + \text{H}_2\text{O}_2$,
 $2\text{Li}_2\text{O}_2 + 2\text{H}_2\text{SO}_4_{(suyul., issiq.)} = 2\text{Li}_2\text{SO}_4 + 2\text{H}_2\text{O} + \text{O}_2 \uparrow$.
5. $2\text{Li}_2\text{O}_2 + 2\text{CO}_2 = 2\text{Li}_2\text{CO}_3 + \text{O}_2$ ($t^0 > 200^\circ \text{ C}$),
 $\text{Li}_2\text{O}_2 + \text{CO} = \text{Li}_2\text{CO}_3$ (40-70° C).

12. LiOH – Litiy gidroksid

Oq, parchalanmasdan suyuqlanadi, N_2 atmosferasida qizdirishni davom ettirilganda parchalanadi. Suvda yaxshi eriydi. Asosli gidroksidlar (ishqor) xossalarini namoyon qiladi, kislotalar, kislotali oksidlar, oksidlar bilan reaksiyaga kirishadi, havodan CO_2 ni yutadi. Olinishi; 8¹, 9^{2,4}, 10¹, 13⁹, 16⁶, 18¹¹, larga qarang.

$$M_r = 23,95; d = 1,46; t_s = 471^\circ \text{ C}; k_s = 12,8^{(20)}, 15,3^{(80)}.$$

1. $2\text{LiOH} = \text{Li}_2\text{O} + \text{H}_2\text{O}$ (800-1000° C, N_2 atmosferasida).

2. $\text{LiOH} \cdot \text{H}_2\text{O} = \text{LiOH} + \text{H}_2\text{O}$ (500° C, N_2 atmosferasida).
3. $\text{LiOH}_{(s.)} + 4\text{H}_2\text{O} = [\text{Li}(\text{H}_2\text{O})_4]^+ + \text{OH}^-$.
4. $\text{LiOH} + \text{HCl}_{(s.)} = \text{LiCl} + \text{H}_2\text{O}$.
5. $2\text{LiOH}_{(kons.)} + \text{CO}_2 = \text{Li}_2\text{CO}_3 \downarrow + \text{H}_2\text{O}$ (uy t^0)
6. $4\text{LiOH}_{(s.)} + \text{SiO}_2_{(q)} \leftrightarrow \text{Li}_4\text{SiO}_4_{(er)} + 2\text{H}_2\text{O}$ (uy t^0).
7. $2\text{LiOH}_{(to'yi.)} + \text{SO}_2 = \text{Li}_2\text{SO}_3 + \text{H}_2\text{O}$.
8. $2\text{LiOH} + \text{H}_2\text{O} + 2\text{H}_2\text{O}_2_{(issiq.)} = \text{Li}_2\text{O}_2 \cdot \text{H}_2\text{O}_2 \cdot 3\text{H}_2\text{O} \downarrow$ (etanolda),
 $\text{Li}_2\text{O}_2 \cdot \text{H}_2\text{O}_2 \cdot 3\text{H}_2\text{O} = \text{Li}_2\text{O}_2 + \text{H}_2\text{O}_2 + 3\text{H}_2\text{O}$ (P_4O_{10} ustida, vak.).
9. $2\text{LiOH}_{(sov.)} + \text{Cl}_2 = \text{LiClO} + \text{LiCl} + \text{H}_2\text{O}$,
 $6\text{LiOH}_{(issiq.)} + 3\text{Cl}_2 = \text{LiClO}_3 + 5\text{LiCl} + 3\text{H}_2\text{O}$.

13. Li_2CO_3 – Litiy karbonat

Oq, kuydirilganda suyuqlanish temperaturasidan yuqorida parchalanadi. Sovuq suvda o'rtacha, issiq suvda esa kamroq eriydi. Kristallogidratlar hosil qilmaydi. Kislotalar, metallar va ularning oksidlari bilan reaksiyaga kirishadi. Olinishi; qarang: 10⁷, 12⁵, 16⁴.

$$M_r = 73,89; d=2,11; t_s = 618^\circ\text{C}; k_s = 1,27^{(25)}, 0,85^{(75)}.$$

1. $\text{Li}_2\text{CO}_3 = \text{Li}_2\text{O} + \text{CO}_2$ (730-1270° C).
2. $\text{Li}_2\text{CO}_3 + 2\text{HCl}_{(s.)} = 2\text{LiCl} + \text{CO}_2 \uparrow + \text{H}_2\text{O}$.
3. $\text{Li}_2\text{CO}_3 + \text{C}_{(koks.)} = \text{Li}_2\text{O} + 2\text{CO}$ (800° C).
4. $\text{Li}_2\text{CO}_3 + \text{Mg} = 2\text{Li} + \text{MgO} + \text{CO}_2$ (500° C).
5. $\text{Li}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \xleftarrow[\text{кайнох}]{\text{совуқ}} 2\text{LiHCO}_3_{(ep)}$.
6. $2\text{Li}_2\text{CO}_3 + \text{SiO}_2 = \text{Li}_4\text{SiO}_4 + 2\text{CO}_2$ (800- 1000° C).
7. $\text{Li}_2\text{CO}_3 + 4\text{B}(\text{OH})_3 = \text{Li}_2\text{B}_4\text{O}_7 + \text{CO}_2 + 6\text{H}_2\text{O}$ (600° C).
8. $\text{Li}_2\text{CO}_3 + \text{Al}_2\text{O}_3 = 2\text{LiAlO}_2 + \text{CO}_2$ (800-900° C).
9. $\text{Li}_2\text{CO}_3 + \text{Ca}(\text{OH})_2 = 2\text{LiOH} + \text{CaCO}_3$ (600° C gacha).
10. $4\text{Li}_2\text{CO}_3 + 2\text{Cr}_2\text{O}_3 + 3\text{O}_2 = 4\text{Li}_2\text{CrO}_4 + 4\text{CO}_2$ (600-700° C).

14. LiNO_3 – Litiy nitrat

Oq, o'ta gigroskopik, parchalanmasdan suyuqlanadi, qizdirishni davom ettirilsa parchalanadi. Suvda yaxshi eriydi (gidrolizga uchramaydi). Qizdirilganda oksidlovchi. Eritmada faqatgina atomar vodorod bilan qaytariladi. Olinishi; qarang: 8⁴, 17³, 19⁴.

$$M_r = 68,95; d = 2,38; t_s = 253,0^\circ\text{C}; k_s = 74,5^{(20)}, 194,1^{(70)}.$$

1. $4\text{LiNO}_3 = 2\text{Li}_2\text{O} + 4\text{NO}_2 + \text{O}_2$ (475-650°C).
2. $\text{LiNO}_3 \cdot 3\text{H}_2\text{O} = \text{LiNO}_3 + 3\text{H}_2\text{O}$ (200°C, vak.).
3. $\text{LiNO}_3_{(s.)} + 4\text{H}_2\text{O} = [\text{Li}(\text{H}_2\text{O})_4]^+ + \text{NO}_3^-$ (pH 7).
4. $\text{LiNO}_3 + 2\text{H}^+(\text{Zn, suyul. HCl}) = \text{LiNO}_2 + \text{H}_2\text{O}$.
5. $\text{LiNO}_3 + \text{Pb} = \text{LiNO}_2 + \text{PbO}$ (400° C).

15. Li_3PO_4 – Litiy ortofosfat

Litiy ortofosfat. Oq, parchalanmasdan suyuqlanadi. Suvda yomon eriydi, ammiak gidrati ishtirokida eruchanlik ortadi. Kislotalarda parchalanadi. Olinishi qarang: 18^{7,8}

$$M_r = 115,79; d = 2,537; t_s = 837^\circ \text{ C}; k_s = 0,03^{(20)}.$$

1. $\text{Li}_3\text{PO}_4 \cdot 12\text{H}_2\text{O} = \text{Li}_3\text{PO}_4 + 12\text{H}_2\text{O}$ (120° C, vak.).
2. $\text{Li}_3\text{PO}_4 + 2\text{HCl}_{(\text{kons.})} = \text{LiH}_2\text{PO}_4 + 2\text{LiCl}$.
3. $2\text{Li}_3\text{PO}_4 + \text{H}_2\text{SO}_{4(\text{s})} = 2\text{Li}_2\text{HPO}_4 + \text{Li}_2\text{SO}_4$,
 $\text{Li}_3\text{PO}_4 + 3\text{H}_2\text{SO}_{4(\text{kons.})} = 3\text{LiHSO}_4 + \text{H}_3\text{PO}_4$.
4. $2\text{Li}_3\text{PO}_4 + 3\text{CaCl}_{2(\text{kons.})} = 6\text{LiCl} + \text{Ca}_3(\text{PO}_4)_2 \downarrow$.

16. Li_2SO_4 – Litiy sul'fat

Oq, parchalanmasdan suyuqlanadi. Suvda yaxshi eriydi (gidrolizga uchramaydi). Almashinish reaksiyasiga kirishadi. Olinishi; qarang: 9⁹, 19⁶

$$M_r = 109,94; d = 2,221; t_s = 859^\circ \text{ C}; k_s = 34,7^{(20)}, 31,9^{(75)}.$$

1. $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O} = \text{Li}_2\text{SO}_4 + \text{H}_2\text{O}$ (130-500° C).
2. $\text{Li}_2\text{SO}_{4(\text{s.})} + 8\text{H}_2\text{O} = 2[\text{Li}(\text{H}_2\text{O})_4]^+ + \text{SO}_4^{2-}$ (pH 7).
3. $\text{Li}_2\text{SO}_4 + \text{H}_2\text{SO}_{4(\text{kons.})} = 2\text{LiHSO}_4$.
4. $\text{Li}_2\text{SO}_{4(\text{kons.})} + \text{Na}_2\text{CO}_3 = \text{Li}_2\text{CO}_3 \downarrow + \text{Na}_2\text{SO}_4$ (qay.).
5. $\text{Li}_2\text{SO}_4 + \text{BaCl}_2 = \text{BaSO}_4 \downarrow + 2\text{LiCl}$.
6. $\text{Li}_2\text{SO}_4 + \text{Ba}(\text{OH})_2 = \text{BaSO}_4 \downarrow + 2\text{LiOH}$.
7. $\text{Li}_2\text{SO}_4 + \text{Ba}(\text{N}_3)_2 = 2\text{LiN}_3 + \text{BaSO}_4 \downarrow$.
8. $\text{Li}_2\text{SO}_4 + 4\text{C}_{(\text{koks})} = \text{Li}_2\text{S} + 4\text{CO}$ (800-900° C).
9. $\text{Li}_2\text{SO}_4 + 4\text{H}_2 = \text{Li}_2\text{S} + 4\text{H}_2\text{O}$ (600-700° C).

17. LiF – Litiy ftorid

Oq, suyuqlanadi va parchalanmasdan qaynaydi. Sovuq suvda yomon eriydi, issiq suvda va ammiak gidrati yoki ammoniy ftoridi ishtirokida eruvchanligi yana ancha pasayadi. Kristallogidratlar hosil qilmaydi. Konsentrlangan kislotalarda parchalanadi, ishqoriy-yer metallarining oksidlari va gidroksidlari bilan reaksiyaga kirishadi. Olinishi; qarang 8⁶, 18⁵

$$M_r = 25,94; d = 2,635; t_s = 845,1^\circ \text{ C}; t_q = 1676^\circ \text{ S}; k_s = 0,27^{(18)}, 0,135^{(35)}.$$

1. $\text{LiF}_{(\text{q})} + \text{HF}_{(\text{kons.})} = \text{Li}(\text{HF}_2)_{(\text{ep})}$.
2. $\text{LiF} + \text{H}_2\text{SO}_{4(\text{kons.})} = \text{LiHSO}_4 + \text{HF} \uparrow$
3. $\text{LiF} + \text{HNO}_{3(\text{kons.})} = \text{LiNO}_3 + \text{HF} \uparrow$
4. $2\text{LiF} + \text{CaO} = \text{Li}_2\text{O} + \text{CaF}_2$ (600-700° C).
5. $2\text{LiF} + \text{Ca}(\text{OH})_2_{(\text{to'yi, issiq.})} = 2\text{LiOH} + \text{CaF}_2 \downarrow$,

18. LiCl – Litiy xlorid

Oq, havoda uqalanadi. Suyuqlanadi va parchalanmasdan qaynaydi. Suvda yaxshi eriydi (gidrolizga uchramaydi). Konsentrlangan kislotalarda parchalanadi. Almashinish reaksiyasiga kirishadi. Olinishi; qarang: 8^{2,6}, 9^{3,5}, 10², 12⁴, 13², 16⁵.

$$M_r = 42,39; d = 2,068; t_s = 610^\circ \text{ C}; t_q = 1380^\circ \text{ C}; k_s = 84,5^{(25)}, 112,3^{(80)}.$$

1. $\text{LiCl} \cdot \text{H}_2\text{O} = \text{LiCl} + \text{H}_2\text{O}$ ($t^\circ > 98^\circ \text{ C}$).

2. $\text{LiCl}_{(s.)} + 4\text{H}_2\text{O} = [\text{Li}(\text{H}_2\text{O})_4]^+ + \text{Cl}^-$ (pH 7).
3. $2\text{LiCl}_{(q)} + \text{H}_2\text{SO}_{4 (kons.)} = \text{Li}_2\text{SO}_4 + 2\text{HCl} \uparrow$ (qay.).
4. $\text{LiCl} + \text{LiHSO}_4 = \text{Li}_2\text{SO}_4 + \text{HCl}$ (450-500° C).
5. $\text{LiCl}_{(kons.)} + \text{NH}_4\text{F}_{(kons.)} = \text{LiF} \downarrow + \text{NH}_4\text{Cl}$.
6. $\text{LiCl}_{(sov.)} + \text{AgNO}_2_{(to'yin.)} = \text{LiNO}_2 + \text{AgCl} \downarrow$.
7. $3\text{LiCl}_{(kons.)} + \text{K}_3\text{PO}_4 = \text{Li}_3\text{PO}_4 \downarrow + 3\text{KCl}$.
8. $3\text{LiCl}_{(kons.)} + \text{Na}_2\text{HPO}_4 + \text{NaOH} = \text{Li}_3\text{PO}_4 + \text{H}_2\text{O} + 3\text{NaCl}$.
9. $\text{LiCl}_{(kons.)} + 4(\text{NH}_3 \cdot \text{H}_2\text{O})_{[kons.]} = [\text{Li}(\text{NH}_3)_4\text{Cl}] + 4\text{H}_2\text{O}$.
10. $2\text{LiCl}_{(c)} \xrightarrow{\text{elektroliz}} 2\text{Li (katod)} + \text{Cl}_2 \uparrow \text{ (anod)}.$
11. $2\text{LiCl} + 2\text{H}_2\text{O} \xrightarrow{\text{elektroliz}} 2\text{LiOH} + \text{H}_2 \uparrow \text{ (katod)} + \text{Cl}_2 \text{ (anod)}.$
12. $2\text{LiCl}_{(er)} \xrightarrow[\text{Hg kamodda}]{\text{3.16KMPOMI3}} 2\text{Li (katod)} + \text{Cl}_2 \uparrow \text{ (anod)}.$

19. Li_2S – Litiy sulfid

Och – sariq, parchalanmasdan suyuqlanadi. Suvda yaxshi eriydi (anion bo'yicha kuchli gidroliz). Kristallogidratlar hosil qilmaydi. Qaytaruvchi, lekin nam holatda havo kislorodi - O_2 yordamida oksidlanadi. Kislotalar, metallaslar bilan reaksiyaga kirishadi. Olinishi; qarang: 8⁸, 9⁶, 10³, 16^{8,9}.

$$M_r = 45,95; d = 1,66; t_s = 950^\circ \text{C}.$$

1. $\text{Li}_2\text{S}_{(suyul.)} + 8\text{H}_2\text{O} = 2[\text{Li}(\text{H}_2\text{O})_4]^+ + \text{S}^{2-}$,
 $\text{S}^{2-} + \text{H}_2\text{O} \leftrightarrow \text{HS}^- + \text{OH}^-$; $\text{p}K_0 = 1,09$.
2. $\text{Li}_2\text{S} + 2\text{HCl}_{(s.)} = 2\text{LiCl} + \text{H}_2\text{S} \uparrow$
3. $\text{Li}_2\text{S} + 3\text{H}_2\text{SO}_{4 (kons.)} = 2\text{LiHSO}_4 + \text{SO}_2 \uparrow + \text{S} \downarrow + 2\text{H}_2\text{O}$.
4. $\text{Li}_2\text{S} + 4\text{HNO}_{3 (kons.)} = 2\text{LiNO}_3 + 2\text{NO}_2 \uparrow + \text{S} \downarrow + 2\text{H}_2\text{O}$.
5. $\text{Li}_2\text{S}_{(sov.)} + \text{H}_2\text{S}_{(to'yin.)} = 2\text{LiHS}$.
6. $\text{Li}_2\text{S} + 2\text{O}_2 = \text{Li}_2\text{SO}_4$ ($t^0 > 300^\circ \text{C}$).
7. $2\text{Li}_2\text{S} + 2\text{H}_2\text{O}_{(sov.)} + \text{O}_2 = \text{S} \downarrow + 4\text{LiOH}$.

20. Li_3N – trilitiy nitrid

To'q – qizil, yuqori bosim ostida suyuqlanadi, qizdirilganda parchalanadi. Suvda to'liq gidrolizlanadi, kislotalarda parchalanadi. Olinishi; qarang: 8⁹, 9⁷.

$$M_r = 34,83; d = 1,28; t_s = 813^\circ \text{C (r)}.$$

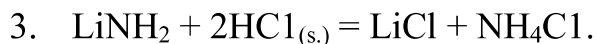
1. $2\text{Li}_3\text{N} = 6\text{Li} + \text{N}_2$ (300-500° C, vak.).
2. $\text{Li}_3\text{N} + 4\text{H}_2\text{O}_{(sov.)} = 3\text{LiOH} + \text{NH}_3 \cdot \text{H}_2\text{O}$.
3. $\text{Li}_3\text{N} + 4\text{HCl}_{(suyul.)} = 3\text{LiCl} + \text{NH}_4\text{Cl}$.
4. $\text{Li}_3\text{N} + 3\text{H}_2 = 3\text{LiH} + \text{NH}_3$ (300° C, aralashma Li_2NH).

21. LiNH_2 – Litiy amidi

Oq, parchalanmasdan suyuqlanadi, uzoq qizdirilganda parchalanadi. Suvda to'liq gidrolizlanadi. Kislotalar bilan reaksiyaga kirishadi. Olinishi; qarang: 8¹², 9^{12,13}.

$$M_r = 22,96; d = 1,178; t_s = 374^\circ \text{C}.$$

1. $2\text{LiNH}_2 = \text{Li}_2\text{NH} + \text{NH}_3$ (400-500° C).
2. $\text{LiNH}_2 + 2\text{H}_2\text{O}_{(sov.)} = \text{LiOH} + \text{NH}_3 \cdot \text{H}_2\text{O}$.



22. LiNH – litiy imid

Oq, qizdirilganda parchalanadi. Suvda to'liq gidrolizlanadi. Kislotalar, vodorod bilan reaksiyaga kirishadi. Olinishi;: qarang 8¹², 21¹

$$M_r = 28,90; d = 1,48.$$

1. $3\text{Li}_2\text{NH} = 2\text{Li}_3\text{N} + \text{NH}_3$ ($t^0 > 500^\circ \text{C}$).
2. $\text{Li}_2\text{NH} + 3\text{H}_2\text{O}_{(\text{sov.})} = 2\text{LiOH} + \text{NH}_3 \cdot \text{H}_2\text{O}.$
3. $\text{Li}_2\text{NH} + 3\text{HCl}_{(\text{s.})} = 2\text{LiCl} + \text{NH}_4\text{Cl}.$
4. $\text{Li}_2\text{NH} + \text{H}_2 = \text{LiNH}_2 + \text{LiH}$ (250-350° C).

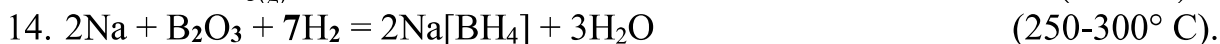
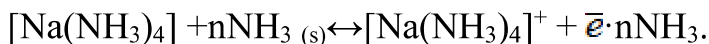
NATRIY

23. Na – natriy

Ishqoriy metall. Kumushsimon (yupqa qatlamda – binafsha tovlanadi) yengil, juda yumshoq, suyuqlanuvchanligi past. Natriyning toq-qizil bug'lari ko'proq Na atomlaridan va Na₂ molekulalaridan iborat. Maxsus shariotlarda efirda natriyni binafsha-ko'k rangli kolloidli eritmasi hosil bo'ladi. Suyuq NH₃ da (ko'k eritma) va NaOH suyuqlanmasida kimyoviy eriydi. Reaksion qobiliyati kuchli, havoda oksid qatlami bilan qoplanadi (xiralashadi), o'rtacha qizdirilganda alangalanadi. Argon va azot atmosferasida barqaror. Kuchli qaytaruvchi: suv, kislotalar, metalmalar bilan shiddatli reaksiyaga kirishadi. Azot bilan faqatgina qizdirilganda reaksiyaga kirishadi (Li dan farqli). Simob bilan amal'gama hosil qiladi: amal'gama kuchli qaytaruvchi, lekin (toza natriydan farqli) suv bilan boradigan reaksiyasi tinch boradi. Efir bilan reaksiyaga kirishmaydi, benzin yoki kerosin ostida yaxshi saqlanadi. Qaynok inert erituvchilarda (toluol, ksilol, geptan, oktan va boshq.) oson suspenziyalanadi. Inert atmosferada suyuqlangan natriy ba'zi bir qattiq moddalar (NaCl, Na₂CO₃, ko'mir, temir, Al₂O₃, SiC, ZrO₂) yuzasida tezlik bilan tarqaladi va kulrang-qora mono atomli qoplamalarni hosil qiladi. Gaz gorelkasi alangasini sariq rangga bo'yaydi. Dengiz suvida ancha keng tarqalgan metall. Olinishi; qarang: 28³², 29¹¹, 36^{10,11}.

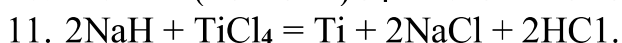
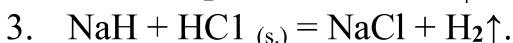
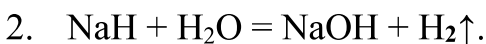
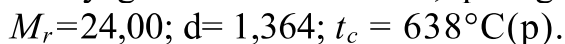
$$M_r = 22,990; d_{(q)} = 0,968; d_{(s)} = 0,927^{(98)}; t_s = 97,83^\circ \text{C}; t_q = 886^\circ \text{C}.$$

1. $2\text{Na} + 2\text{H}_2\text{O} = 2\text{NaOH} + \text{H}_2\uparrow.$
2. $2\text{Na} + 2\text{HCl}_{(\text{s.})} = 2\text{NaCl} + \text{H}_2\uparrow.$
3. $2\text{Na} + 2\text{NaOH} = 2\text{Na}_2\text{O} + \text{H}_2$ (600° C).
4. $2\text{Na} + \text{H}_2 = 2\text{NaH}$ (250-400° C, p).
5. $2\text{Na} + \text{O}_2_{(\text{havo})} = \text{Na}_2\text{O}_2$ (yonish, aralashma Na₂O),
 $2\text{Na} + \text{O}_2 = \text{Na}_2\text{O}_2$ (250-400° C).
6. $4\text{Na} + \text{O}_2 + 2\text{H}_2\text{O} = 4\text{NaOH}.$
7. $2\text{Na} + \text{E}_2 = 2\text{NaE}$ (uy t⁰, E = F, Cl; 150-250° C, E = Br, I).
8. $2\text{Na} + \text{E} = \text{Na}_2\text{E}$ (t⁰ > 130° C, E = S, Se, Te),
 $2\text{Na} + n\text{S} = \text{Na}_2(\text{S}_n)$ [- 40° S, suyuq. NH₃, n = 1, 2, 4, 5].
9. $6\text{Na} + \text{N}_2 = 2\text{Na}_3\text{N}$ (100° C, elektr. yoyi),
 $3\text{Na} + \text{P}_q = \text{Na}_3\text{P}_{(\text{yashil.})}$ [200° C, Ar atmosferasida].
10. $2\text{Na} + 2\text{C}_{(\text{grafit})} = \text{Na}_2\text{C}_2$ (150-200° C).
11. $2\text{Na} + 2\text{H}_2\text{S}_{(\text{to'vin.})} = 2\text{NaHS}\downarrow + \text{H}_2\uparrow$ (benzolda).
12. $\text{Na} + 4\text{NH}_3_{(\text{s.})} = [\text{Na}(\text{NH}_3)_4]_{(\text{ko'k})}$ [-40° C],



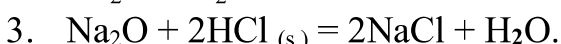
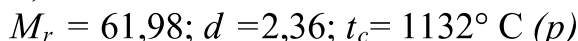
24. NaH – natriy gidrid

Oq, qizdirilganda parchalanadi, N_2 ning mo'1 bosimi ostida parchalanmasdan suyuqlanadi. Kuchli qaytaruvchi: suv, kislotalar, ammiak, kislorodlar bilan reaksiyaga kirishadi. Olinishi; qarang: 23⁴, 820¹.



25. Na₂O – natriy oksid

Oq, termik barqaror, qiyin suyuqlanuvchan. Kuchli asosli xossalarni namoyon qiladi: suv bilan (ishqoriy eritma hosil bo'ladi), kislotalar, kislotali va amfoter oksidlar, suyuq ammiaklar bilan shiddatli reaksiyaga kirishadi. Olinishi; qarang: 23^{3,5}, 26^{1,10} 28¹⁵, 29¹ 294⁸ 303⁹.



26. Na₂O₂ – natriy peroksid

Oq (NaO_2 aralashmasi bor bo'lganda ba'zida sarg'ish rang beradi). Havoda qizdirilganda sarg'ayadi va parchalanadi. O_2 mo'1 bosimi ostida suyuqlanadi. Ionli payti (Na^+)₂ (O_2^{2-}) tuzilishga ega. Havodan CO_2 ni yutadi. Suv, kislotalar ishtirokida to'liq parchalanadi. Kislorod, oltingugurt, natriy, uglerodni mono - va

dioksidlari bilan shiddatli reaksiyaga kirishadi. Oksidlovchilik – qaytaruvchilik xossalari namoyon qiladi. Olinishi; qarang: 23⁵, 25^{1,7}, 28³¹.

$$M_r = 77,98; d = 2,60; t_c = 596^\circ \text{C (p)}.$$

1. $2\text{Na}_2\text{O}_2 = 2\text{Na}_2\text{O} + \text{O}_2$ (400-675° C, vak.).
2. $\text{Na}_2\text{O}_2 + 8\text{H}_2\text{O}_{(\text{nam})} = \text{Na}_2\text{O}_2 \cdot 8\text{H}_2\text{O}$ (0° C).
3. $\text{Na}_2\text{O}_2 + 2\text{H}_2\text{O}_{(\text{sov.})} = \text{H}_2\text{O}_2 + 2\text{NaOH},$
 $2\text{Na}_2\text{O}_2 + 2\text{H}_2\text{O}_{(\text{issiq.})} = \text{O}_2\uparrow + 4\text{NaOH}.$
4. $\text{Na}_2\text{O}_2 + 2\text{HCl}_{(\text{suyul., sov.})} = 2\text{NaCl} + \text{H}_2\text{O}_2.$
5. $2\text{Na}_2\text{O}_2 + 2\text{H}_2\text{SO}_4_{(\text{suyul., issiq.})} = 2\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} + \text{O}_2\uparrow.$
6. $\text{Na}_2\text{O}_2 + \text{O}_2 = 2\text{Na}_2\text{O}$ (450-500° C, r).
7. $2\text{Na}_2\text{O}_2 + \text{S} = \text{Na}_2\text{SO}_3 + \text{Na}_2\text{O}$ (100° C),
 $2\text{Na}_2\text{O}_2 + \text{C}_{(\text{grafit})} = \text{Na}_2\text{CO}_3 + \text{Na}_2\text{O}$ (100° C),
 $3\text{Na}_2\text{O}_2 + 2\text{Al}_{(\text{kukun})} = 2\text{NaAlO}_2 + 2\text{Na}_2\text{O}$ (70-120° C).
8. $2\text{Na}_2\text{O}_2 + 2\text{CO}_2 = 2\text{Na}_2\text{CO}_3 + \text{O}_2,$
 $\text{Na}_2\text{O}_2 + \text{CO} = \text{Na}_2\text{CO}_3$ (uy t°).
9. $\text{Na}_2\text{O}_2 + \text{MnO}_2 = \text{Na}_2\text{MnO}_4$ (400- 500° C).
10. $\text{Na}_2\text{O}_2 + 2\text{Na} = 2\text{Na}_2\text{O}$ (130-200° C, Ar atmosferasida.)
11. $5\text{Na}_2\text{O}_2 + 8\text{H}_2\text{SO}_4_{(\text{suyul.})} + 2\text{KMnO}_4 = 5\text{O}_2\uparrow + 2\text{MnSO}_4 + 8\text{H}_2\text{O} + 5\text{Na}_2\text{SO}_4 + \text{K}_2\text{SO}_4.$
12. $\text{Na}_2\text{O}_2 + 2\text{H}_2\text{SO}_4_{(\text{suyul.})} + 2\text{NaI} = \text{I}_2\downarrow + 2\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}.$
13. $3\text{Na}_2\text{O}_2 + 2\text{Na}_3[\text{Cr}(\text{OH})_6]_{(\text{issiq.})} = 2\text{Na}_2\text{CrO}_4 + 8\text{NaOH} + 2\text{H}_2\text{O}.$
14. $\text{Na}_2\text{O}_2 + 2\text{H}_2\text{SO}_4_{(\text{suyul.})} + 2\text{FeSO}_4 = \text{Fe}_2(\text{SO}_4)_3 + \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O},$
 $\text{Na}_2\text{O}_2 + 2\text{Fe}(\text{OH})_{2(\text{suspenziya})} = 2\text{FeO}(\text{OH})\downarrow + 2\text{NaOH}.$

27. NaO₂ – natiriy nadperoksid

Zarg‘aldoq-sariq, qizdirilganda suyuqlanmasdan parchalanadi. Ion tuzilishga ega –(Na⁺)(O₂⁻). Suv, kislotalar uglerodning mono-va dioksidlari bilan reaksiyaga kirishadi. Kuchli oksidlovchi. Olinishi; qarang: 26⁶, 406⁹.

$$M_r = 54,99; d = 2,21.$$

1. $\text{NaO}_2 \xrightarrow{100-270^\circ \text{C}} \text{Na}_2\text{O}_2 \xrightarrow{400-675^\circ \text{C, vakum}} \text{Na}_2\text{O}.$
2. $2\text{NaO}_2 + \text{H}_2\text{O}_{(\text{sov.})} = \text{NaOH} + \text{NaHO}_2(\text{ep}) + \text{O}_2\uparrow$
 $2\text{NaHO}_2(\text{er}) \rightarrow 2\text{NaOH} + \text{O}_2\uparrow$ (uy t°).
3. $4\text{NaO}_2 + 2\text{H}_2\text{O}_{(\text{issiq.})} = 4\text{NaOH} + 3\text{O}_2\uparrow$
4. $2\text{NaO}_2 + 2\text{HCl}_{(\text{suyul., sov.})} = 2\text{NaCl} + \text{H}_2\text{O}_2 + \text{O}_2\uparrow.$
5. $4\text{NaO}_2 + 2\text{CO}_2 = 2\text{Na}_2\text{CO}_3 + 3\text{O}_2$ (uy t°).
6. $2\text{NaO}_2 + \text{CO} = \text{Na}_2\text{CO}_3 + \text{O}_2$ (100° C).
7. $4\text{NaO}_2 + 3\text{C}_{(\text{grafit})} = 2\text{Na}_2\text{CO}_3 + \text{CO}_2$ (100° C).
8. $\text{NaO}_2 + \text{Al}_{(\text{kukun})} = \text{NaAlO}_2$ (100° C).

28. NaOH – natriy gidroksid

O‘yuvchi natriy, kaustik soda, kaustik. Oq, gigroskopik, parchalanmasdan suyuqlanadi va qaynaydi. Suvda yaxshi eriydi (yuqori ekzo- effekt bilan), eritmada kuchli ishqoriy muhitni yuzaga keltiradi. Natriy tuzlarining suvda eruvchanligini kuchli darajada pasaytiradi. Suyuq ammiakda erimaydi. Asosli

gidroksidlar xossalarini namoyon qiladi (ishqorlarga mansub); kislotalar bilan neytrallanadi, kislotali oksidlar bilan reaksiyaga kirishadi. Havodan CO₂ ni yutadi. Metalmaslar, metallar, amfoter oksidlar va gidroksidlari bilan reaksiyaga kirishadi. Olinishi; qarang: 23^{1,6}, 25², 29⁸, 36¹¹.

$M_r = 40,00$; $d = 2,130$; $t_s = 321^\circ\text{C}$; $t_q = 1390^\circ\text{C}$; $k_s = 108,7^{(20)}$, $314^{(80)}$.

1. $\text{NaOH} \cdot \text{H}_2\text{O} = \text{NaOH} + \text{H}_2\text{O}$ (100-400° C, vak.).
2. $\text{NaOH}_{(\text{suyul.})} + 4\text{H}_2\text{O} = [\text{Na}(\text{H}_2\text{O})_4]^+ + \text{OH}^-$.
3. $\text{NaOH} + \text{HCl}_{(\text{suyul.})} = \text{NaCl} + \text{H}_2\text{O}$.
4. $2\text{NaOH} + \text{H}_2\text{SO}_{4(\text{suyul.})} = \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$,
 $\text{NaOH} + \text{H}_2\text{SO}_{4(\text{kons.}, \text{sov.})} = \text{NaHSO}_4 + \text{H}_2\text{O}$.
5. $\text{NaOH} + \text{HNO}_{3(\text{suyul.})} = \text{NaNO}_3 + \text{H}_2\text{O}$.
6. $\text{NaOH}_{(\text{suyul.})} + \text{H}_3\text{PO}_{4(\text{kons.})} = \text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$,
 $2\text{NaOH}_{(\text{suyul.})} + \text{H}_3\text{PO}_{4(\text{suyul.})} = \text{Na}_2\text{HPO}_4 + 2\text{H}_2\text{O}$,
 $3\text{NaOH}_{(\text{kons.})} + \text{H}_3\text{PO}_{4(\text{suyul.})} = \text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$.
7. $\text{NaOH} + \text{HF}_{(\text{suyul.})} = \text{NaF} + \text{H}_2\text{O}$
 $\text{NaOH} + 2\text{HF}_{(\text{kons.})} = \text{Na}(\text{HF}_2) + \text{H}_2\text{O}$.
8. $\text{NaOH}_{(\text{kons.})} + \text{HCN} = \text{NaCN} + \text{H}_2\text{O}$.
9. $6\text{NaOH}_{(\text{suyul.})} + 4\text{F}_2 = \text{OF}_2\uparrow + 6\text{NaF} + \text{O}_2\uparrow + 3\text{H}_2\text{O}$.
10. $2\text{NaOH}_{(\text{kons.}, \text{sov.})} + \text{E}_2 = \text{NaEO} + \text{NaE} + \text{H}_2\text{O}$ (E = Cl, Br, I),
 $6\text{NaOH}_{(\text{kons.}, \text{issiq.})} + 3\text{E}_2 = \text{NaEO}_3 + 5\text{NaE} + 3\text{H}_2\text{O}$.
11. $12\text{NaOH}_{(\text{kons.}, \text{issiq.})} + 5\text{Cl}_2 + \text{Br}_2 = 2\text{NaBrO}_3 + 10\text{NaCl} + 6\text{H}_2\text{O}$.
12. $20\text{NaOH}_{(\text{suyul.}, \text{issiq.})} + 7\text{Cl}_2 + \text{I}_2 = 2\text{Na}_3\text{H}_2\text{IO}_6\downarrow + 14\text{NaCl} + 8\text{H}_2\text{O}$,
 $24\text{NaOH}_{(\text{kons.}, \text{sov.})} + 7\text{Cl}_2 + \text{I}_2 = 2\text{Na}_5\text{IO}_6\downarrow + 14\text{NaCl} + 12\text{H}_2\text{O}$.
13. $6\text{NaOH} + 3\text{Br}_2 + 2(\text{NH}_3 \cdot \text{H}_2\text{O}) \rightarrow 6\text{NaBr} + \text{N}_2\uparrow + 8\text{H}_2\text{O}$ (uy t°).
14. $2\text{NaOH}_{(\text{issiq.})} + \text{I}_2 + \text{H}_2\text{O}_2 = 2\text{NaI} + \text{O}_2\uparrow + 2\text{H}_2\text{O}$,
 $2\text{NaOH}_{(\text{xon.})} + \text{I}_2 + \text{H}_2\text{S}_{(\text{g})} = 2\text{NaI} + \text{S}\downarrow + 2\text{H}_2\text{O}$.
15. $2\text{NaOH} + 2\text{Na} = 2\text{Na}_2\text{O} + \text{H}_2$ (600° C).
16. $4\text{NaOH} + 3\text{Ca} = 3\text{CaO} + \text{Na}_2\text{O} + 2\text{Na} + 2\text{H}_2$ (600° C).
17. $2(\text{NaOH} \cdot \text{H}_2\text{O}) + 2\text{Al} = 2\text{NaAlO}_2 + 3\text{H}_2$ (400-500° C),
 $2\text{NaOH}_{(\text{kons.})} + 6\text{H}_2\text{O}_{(\text{issiq.})} + 2\text{Al} = 2\text{Na}[\text{Al}(\text{OH})_4] + 3\text{H}_2\uparrow$
18. $2\text{NaOH}_{(\text{kons.})} + 2\text{H}_2\text{O} + \text{Zn} = \text{Na}_2[\text{Zn}(\text{OH})_4] + \text{H}_2\uparrow$.
19. $\text{NaOH}_{(\text{suyul.})} + \text{EO}_2 = \text{NaHEO}_3$ (E = C,
S), $2\text{NaOH}_{(\text{kons.})} + \text{EO}_2 = \text{Na}_2\text{EO}_3 + \text{H}_2\text{O}$.
20. $4\text{NaOH}_{(\text{kons.})} + \text{SiO}_2 \xrightarrow{\tau} \text{Na}_4\text{SiO}_4 + 2\text{H}_2\text{O}$,
 $2\text{NaOH} + \text{SiO}_2 = \text{Na}_2\text{SiO}_3 + \text{H}_2\text{O}$ (900-1000° C).
21. $4\text{NaOH} + 6\text{NO} = 4\text{NaNO}_2 + \text{N}_2 + 2\text{H}_2\text{O}$ (350-400° C).
22. $2\text{NaOH}_{(\text{sov.})} + \text{NO} + \text{NO}_2 = 2\text{NaNO}_2 + \text{H}_2\text{O}$,
 $4\text{NaOH}_{(\text{issiq.})} + 4\text{NO}_2 + \text{O}_2 = 4\text{NaNO}_3 + 2\text{H}_2\text{O}$.
23. $2\text{NaOH} + \text{Al}_2\text{O}_3 = 2\text{NaAlO}_2 + \text{H}_2\text{O}$ (900-1100° C),
 $\text{NaOH} + \text{Al}(\text{OH})_3 = \text{NaAlO}_2 + 2\text{H}_2\text{O}$ (1000° C).
24. $2\text{NaOH}_{(\text{kons.}, \text{issiq.})} + 3\text{H}_2\text{O} + \text{Al}_2\text{O}_3 = 2\text{Na}[\text{Al}(\text{OH})_4]$,
 $\text{NaOH}_{(\text{kons.})} + \text{Al}(\text{OH})_3 = \text{Na}[\text{Al}(\text{OH})_4]$.
25. $2\text{NaOH}_{(60\%\text{-li})} + \text{H}_2\text{O} + \text{ZnO} = \text{Na}_2[\text{Zn}(\text{OH})_4]$ (90° C),
 $2\text{NaOH}_{(\text{kons.})} + \text{Zn}(\text{OH})_2 = \text{Na}_2[\text{Zn}(\text{OH})_4]$ (uy t°).

26. $\text{NaOH}_{(\text{kons.})} + \text{NH}_4\text{Cl}_{(\text{kons.})} = \text{NaCl} + \text{NH}_3\uparrow + \text{H}_2\text{O}$
(qayn.).
27. $2\text{NaOH}_{(\text{suyul.})} + \text{FeI}_2 = 2\text{NaI} + \text{Fe}(\text{OH})_2\downarrow$ (N_2 atmosferasida),
 $2\text{NaOH}_{(\text{suyul.})} + 2\text{AgNO}_3 = \text{Ag}_2\text{O}\downarrow + \text{H}_2\text{O} + 2\text{NaNO}_3$.
28. $3\text{NaOH}_{(\text{suyul.})} + \text{AlCl}_3 = \text{Al}(\text{OH})_3\downarrow + 3\text{NaCl}$,
 $4\text{NaOH}_{(\text{kons.})} + \text{AlCl}_3 = \text{Na}[\text{Al}(\text{OH})_4] + 3\text{NaCl}$.
29. $2\text{NaOH}_{(\text{suyul.})} + \text{ZnCl}_2 = \text{Zn}(\text{OH})_2\downarrow + 2\text{NaCl}$,
 $4\text{NaOH}_{(\text{kons.})} + \text{ZnCl}_2 = \text{Na}_2[\text{Zn}(\text{OH})_4] + 2\text{NaCl}$.
30. $2\text{NaOH}_{(\text{suyul., sov.})} + \text{Zn} + 2\text{SO}_2 = \text{Na}_2\text{S}_2\text{O}_4 + \text{Zn}(\text{OH})_2\downarrow$.
31. $2\text{NaOH} + 2\text{H}_2\text{O} + 3\text{H}_2\text{O}_2_{(\text{kons.})} = \text{Na}_2\text{O}_2 \cdot 2\text{H}_2\text{O}_2 \cdot 4\text{H}_2\text{O}\downarrow$ (0°C),
 $\text{Na}_2\text{O}_2 \cdot 2\text{H}_2\text{O}_2 \cdot 4\text{H}_2\text{O} = \text{Na}_2\text{O}_2 + 2\text{H}_2\text{O}_2 + 4\text{H}_2\text{O}$ (uy t^0 , kons. H_2SO_4 stida).
32. $4\text{NaOH} \xrightarrow{\text{elektroliz}} 4\text{Na}(\text{katod}) + \text{O}_2\uparrow(\text{anod}) + 2\text{H}_2\text{O}$.

29. Na_2CO_3 – natriy karbonat

Soda (gidrat), kal'sinirlangan soda yoki kir sodasi (suvsiz). Oq, parchalanmasdan suyuqlanadi, qizdirish davom ettirilganda parchalanadi. Suvda yaxshi eriydi (anion bo'yicha kuchli gidroliz), kuchli ishqoriy muhitni yuzaga keltiradi. Kislotalar, metalmaslar va ularning oksidlari bilan reaksiyaga kirishadi. Uglerod bilan qaytariladi. Olinishi; qarang: 26⁸, 28¹⁹, 30^{1,4}, 32⁷.

$M_r = 105,99$; $d = 2,539$; 1,446 (10-gidrat); $t_s = 851^\circ \text{C}$; $k_s = 21,8^{(20)}, 45,1^{(80)}$.

- $\text{Na}_2\text{CO}_3 = \text{Na}_2\text{O} + \text{CO}_2$ ($t^0 > 1000^\circ \text{C}$).
- $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} = \text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$ (100-120° C, vak.).
- $\text{Na}_2\text{CO}_3_{(\text{suyul.})} + 8\text{H}_2\text{O} = 2[\text{Na}(\text{H}_2\text{O})_4]^+ + \text{CO}_3^{2-}$
 $\text{CO}_3^{2-} + \text{H}_2\text{O} \leftrightarrow \text{HCO}_3^- + \text{OH}^-$, $\text{pK}_0 = 3,67$.
- $\text{Na}_2\text{CO}_3 + 2\text{HCl}_{(\text{suyul.})} = 2\text{NaCl} + \text{CO}_2\uparrow + \text{H}_2\text{O}$.
- $\text{Na}_2\text{CO}_3_{(\text{to'yin.})} + \text{H}_2\text{O} + \text{CO}_2 = 2\text{NaHCO}_3\downarrow$ (30-40° C).
- $\text{Na}_2\text{CO}_3 + 2\text{HF}_{(\text{suyul.})} = 2\text{NaF} + \text{H}_2\text{O} + \text{CO}_2\uparrow$
 $\text{Na}_2\text{CO}_3 + 4\text{HF}_{(\text{kons.})} = 2\text{Na}(\text{HF}_2) + \text{CO}_2\uparrow + \text{H}_2\text{O}$.
- $3\text{Na}_2\text{CO}_3_{(\text{kons.})} + 2\text{H}_3\text{PO}_4_{(\text{suyul.})} = 2\text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O} + 3\text{CO}_2\uparrow$ (qayn.).
- $\text{Na}_2\text{CO}_3 + \text{M}(\text{OH})_{2(\text{to'yin.})} = \text{MCO}_3\downarrow + 2\text{NaOH}$ ($\text{M} = \text{Ca}, \text{Sr}, \text{Ba}$).
- $3\text{Na}_2\text{CO}_3 + 3\text{H}_2\text{O}_{(\text{sov.})} + 2\text{AlCl}_3 = 2\text{Al}(\text{OH})_3\downarrow + 3\text{CO}_2\uparrow + 6\text{NaCl}$.
- $\text{Na}_2\text{CO}_3_{(\text{kons., issiq.})} + 3\text{E}_2 = 5\text{NaE} + \text{NaEO}_3 + 3\text{CO}_2\uparrow$ ($\text{E} = \text{Cl}, \text{Br}, \text{I}$).
- $\text{Na}_2\text{CO}_3 + 2\text{C}_{(\text{koks})} = 2\text{Na} + 3\text{CO}$ (900-1000° C).
- $\text{Na}_2\text{CO}_3 + \text{C}_{(\text{koks})} + \text{CaCN}_2 = 2\text{NaCN} + \text{CaCO}_3$ (600-700° C).
- $\text{Na}_2\text{CO}_3_{(\text{kons.})} + \text{SO}_2 = \text{Na}_2\text{SO}_3 + \text{CO}_2\uparrow$

30. NaHCO_3 – natriy gidrokarbonat

Ichimlik sodasi. Bul'rix tuzi, **naxkolit**. Oq, kuchsiz qizdirilganda parchalanadi. Nam holatda uy temperaturasida parchalanish boshlanadi. Suvda o'rtacha eriydi (anion bo'yicha kuchsiz gidroliz). Kristallogidratlar hosil qilmaydi. Kislotalarda parchalanadi, ishqorlar bilan neytrallanadi. Almashinish reaksiyasiga kirishadi. Olinishi; qarang: 28¹⁹, 29⁵, 36⁸.

$M_r = 84,01$; $d = 2,24$; $k_s = 9,59^{(20)}, 20,2^{(80)}$.

- $2\text{NaHCO}_3 = \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$ (250-300° C).