S-Block

↳ G.F → ns^{1-2} | $(n-1)s^2p^6ns^{1-2}$

#Alkali Metal

→ Group IA | 1st group.

→ Highly electropositive metal.

→ G.F → ns^1 or $(n-1)s^2p^6ns^1$

Li :- $1s^2 2s^1$

Na → $1s^2 2s^2 2p^6 3s^1$

Q. The general formula of alkali metal is :-

(a) ns^1 (b) $(n-1)s^2p^6ns^1$ (c) $(n-1)s^2p^6d^{10}ns^1$ (d) ~~mor~~ --

• Atomic size :-

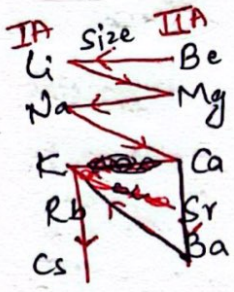
Distance from nucleus to valance shell.

alkali metal:
- Li 2s'
- Na 3s'
- K 4s' shell ↑es, size ↑es.
- Rb
- Cs
- Fr radioactive.

alkaline ~~meta~~ earth metal:
- Be
- Mg
- Ca
- Sr
- Ba

shell ↑es, size ↑es

→ Li > Be – size.



Size :- $\boxed{K > Ba}$

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size → Na (1) Mg^{+2} (2) Na^+ (3) Mg (4) → $\boxed{Na > Mg > Na^+ > Mg^{+2}}$

$1s^2 2s^2 2p^6$

• Ionization energy

→ Energy required to remove valence electron from gaseous state

→ Endothermic process

→ $Mg_{(g)} \xrightarrow[(I.E)_1]{I.E \text{ or}} M^+_{(g)} + e^-$ $\boxed{I.E \propto \frac{1}{size}}$

Li, Na, K, Rb, Cs — size ↑es, I.E ↓es

Be, Mg, Ca, Sr, Ba — size ↑es, I.E ↓es.

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IA < IIB IIA > IIIA (Boron family)

Li → size ↓es, I.E ↑es. Be ns^2 → full filled, stable $ns^2 np^1$ → partially filled

Be > B
Mg > Al

2nd period → Li Be B C N O F Ne

I.E order → ~~Li > B > Be > C > O > N > F > Ne~~

Li < B < Be < C < O < N < F < Ne

3rd period → Na < Al < Mg < Si < S < P < Cl < Ar

Note:- I.E ↑es abnormally when e⁻ lost from stable inert gas configuration.

$$Na \xrightarrow[(I.E)_1]{-e^-} Na^+ \xrightarrow[-e^-]{(I.E)_2} Na^{+2}$$

$1s^2 2s^2 2p^6 3s^1$ → 5 kJ. → $1s^2 2s^2 2p^6$ → 100 kJ.

Successive I.E always increase

$$Mg \xrightarrow[7.5\,kJ]{(I.E)_1} Mg^+ \xrightarrow[15\,kJ]{(I.E)_2} Mg^{+2} \xrightarrow[100\,kJ]{(I.E)_3} Mg^{+3}$$

$1s^2 2s^2 2p^6 3s^1$ $1s^2 2s^2 2p^6$ → inert gas: C

1. X atom. $(I.E)_1 = 10\,kJ$. $(I.E)_2 = 18$ (noble gas cof.) $(I.E)_3 = 300$ $(I.E)_4 = 320$.
   → alkaline earth metal होगा.

2. $(I.E)_1 = 50$ $(I.E)_2 = 300$ $(I.E)_3 = 350$ $(I.E)_4 = 400$ $(I.E)_5 = 450$
   → alkali metal
   एउटा e⁻ निकाले पछि inert gas cof. ∴ but not in Lithium
   → no $(I.E)_4$ & $(I.E)_5$.

   so, → alkali metal. (Na,).

3. I.E :- 1000 (I.E)₁, 1100 (II), 2000 (III), 2500 (IV) – M.
   → alkaline earth metal.

   (a) MO (b) M_2O (c) M_3N_2 ~~M_3O_2~~ ~~(d)~~ a & c.

- **Density**

depends upon
(a) packing of atom
(b) Inner shell configuration

- density of d-block > s-block
  - d-block: close packing
  - s-block: loose packing

$d = \frac{m}{V}$ → priority to mass.

Li
Na
K
Rb
Cs

size ↑ as, volume ↑ as, mass ↑ es. So, density ↑ es.

(IA) Li < Na < K < Rb < Cs → Density.

↳ Cs > Rb > Na > K > Li

IIA Be Mg Ca Sr Ba

↳ Ba > Sr > Mg > Ca > Be → density.

IIA > IA → Density.

Be > Li

Q. Decreasing order of density:-

(a) K > Na > Mg > Li
(b) Na > Mg > K > Li
(c) K > Mg > Na > Li
(d) Mg > K > Na > Li
(e) Mg > Na > K > Li

Q. Which metal is denser than water?

(a) Li (b) Na (c) K (d) Cs

↳ Lighter than water

Li → lightest metal of chemistry
H_2 → lightest element / gas of chemistry

→ Along the period, density also increases.

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Melting point

M.pt ∝ metallic bond strength ∝ $\frac{1}{\text{size}}$ ∝ Valance e⁻

Na^+ Na^+ metallic bond

more in alkaline earth metal than alkali metal.

IA IIA

Li < Be — M.pt.

Li
Na
K
Rb
Cs
Fr

→ Li > Na > K > Rb > Cs > Fr → mpt

→ IIA → Be > Mg > Ca > Sr > Ba

exception

↳ Be > Ca > Sr > Ba > Mg — mpt.

Note: M.pt of IIA metal > IA metal.
due to small size,
2 valence e⁻ involve in metallic bonding.

Q. order of Melting point
→ Na Mg Al.
↳ Al > Mg > Na

Hardness

Hardness ∝ metallic bond strength ∝ $\frac{1}{\text{size}}$.

Same as mpt

size ↓es, Hardness ↑es.

Li ⋮ Cs — Be ⋮ Ba — size ↑es. Hardness ↓es.

Be → Most hardest 's' block metal.

IA < IIA

Cs → softest.

Q. Correct statement for Be?

(a) Hardest 'S' block metal (b) Amphoteric oxide (BeO)

(c) Carbide is ionic (Be_2C) (d) All

→ Alkali metal (Na, K) are soft metal so, easily cut by knife.

Alkali metal
↳ large size result in weak metallic bond.

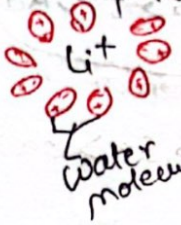
Hardness
↳ IIA > IA
Be > Li

- **Hydration**

Hydration ∝ $\frac{1}{\text{size}}$

H_2O → polar molecule → dipole δ+ δ−

H—OH



Hydration
↳ energy release
→ exothermic

→ Hydration ∝ charge density.
↳ $\frac{\text{charge}}{\text{size}}$

→ Li^+ < Na^+ but $Li^+_{(aq)} > Na^+_{(aq)}$ ← size.
↳ hydrated

→ Hydration ∝ hydrated size ∝ $\frac{1}{\text{ionic mobility}}$

→ $Be^{+2} > Mg^{+2} > Ca^{+2}$ ← hydrated size.

→ $Ca^{+2} > Mg^{+2} > Be^{+2}$ ← ionic mobility

→ $K^+ < Mg^{+2} < Al^{+3}$ → hydrated size.

Q. Which of the following interaction is responsible for hydratio of cation?
↳ ion-dipole interaction



Q. Which of the following has highest hydrated size?

(a) Be^{+2} (b) Li^+ (c) Mg^{+2} (d) Na^{+2}
↳ highest ionic mobility.

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Q. Which has highest molar conductance? (ionic mobility)

(a) Na^{+2} (b) Mg^{+2} (c) K^{+} (d) Al^{+3}

Hydration

(a) K^{+} (b) Sr^{+2} (c) Ca^{+2} (d) Cs^{+}

Hydration → $Li^{+} > Ca$ (charge density)

– $[Li(H_2O)_n]^{+} > [K(H_2O)_n]^{+}$ – size (hydrated)

Note:- smaller cation became larger in H_2O due to more hydration
∴ least conducting in H_2O.

size → $Li^{+} < Na^{+} < K^{+} < Rb^{+} < Cs^{+}$

Hydrated size → $Li^{+}_{(aq)} > Na^{+}_{(aq)} > K^{+}_{(aq)} > Rb^{+}_{(aq)} > Cs^{+}_{(aq)}$

- Reducing agent
- Action of O_2 & N_2

① Action of O_2:–

Q. Which compound used in space?

(a) K_2O (b) KOH (c) K_2CO_3 (d) KO_2

IA metal + O_2 ⟶ M_2O

IIA metal + O_2 ⟶ MO.

e.g $Li + O_2 \longrightarrow Li_2O$.

→ M_2O hydrolysis MOH

$Na_2O \xrightarrow{H_2O} NaOH$ caustic soda – corrosive effect, $K_2O \xrightarrow{H_2O} KOH$ caustic potash.

→ MO hydrolysis $M(OH)_2$ – basic oxide & hydroxide of IA & IIA

$CaO \xrightarrow{H_2O} Ca(OH)_2$

$MgO \xrightarrow{H_2O} Mg(OH)_2$.

MgO: magnesia, weak base.

$Mg(OH)_2$: milk of magnesia, weak base, – used to remove acidity.

$$\boxed{\text{Basic strength} \propto \frac{1}{I.E}}$$

KOH > NaOH > LiOH → Basicity

→ $Mg(OH)_2$ + $NaHCO_3$ (Baking soda) → used to remove acidity.

→ CaO (quick lime, lime) $\xrightarrow{\text{hydrolysis}}$ $Ca(OH)_2$ (Slaked lime, lime water)

→ Li_2O, Na_2O, K_2O, Rb_2O, Cs_2O ↓ I.E ↓es, Basic strength ↑es. $\xrightarrow{H_2O}$ LiOH, NaOH, KOH, RbOH, CsOH ↓ I.E ↓es, Basic ↑

→ $$\boxed{\text{Basic strength of oxide / hydroxide} \propto \frac{1}{I.E}}$$

IIA → BeO, MgO, CaO, SrO, BaO ↓ I.E ↓es, B.S ↑es $\xrightarrow{HOH}$ hydrolysis → $Be(OH)_2$, $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$ ↓ I.E ↓es, B.S. ↑es

• Basic strength → M_2O (alkali) > MO (alkaline). due to more I.E of IIA than IIA.

→ CsOH → strongest base in chemistry.

Q. Arrange B. strength ↓es order:— K_2O, TiO, CaO, Cs_2O, CO_2 (acidic non-metal oxide), NiO (less basic)

→ $Cs_2O > K_2O > CaO > TiO > NiO > CO_2$.

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→ unit of oxide → O^{-2}
peroxide → O_2^{-2}
superoxide → O_2^{-}

- $M \xrightarrow{O_2} \underset{\text{oxide}}{M_2O} \xrightarrow[\text{excess}]{O_2} \underset{\text{peroxide}}{M_2O_2} \xrightarrow[\text{excess}]{O_2} \underset{\text{superoxide}}{MO_2}$

Li $\xrightarrow{O_2}$ always form oxide.
Na $\xrightarrow{O_2}$ oxide & peroxide
K, Rb, Cs, Fr $\xrightarrow{O_2}$ form all oxide, peroxide & superoxide.

IIA
Be, Mg $\xrightarrow{O_2}$ oxide
Ca, Sr, Ba $\xrightarrow{O_2}$ peroxide

Q. $K \xrightarrow[\Delta]{O_2}$ oxide, peroxide, superoxide] if O_2 in excess.

Q. $Mg \xrightarrow[\Delta]{O_2\ (excess)}$ Oxide only.

Q. $Ba \xrightarrow[excess]{O_2}$ peroxide.

Note:- peroxide & superoxide formed by s-block due to large size.

Q. Which ~~IIA~~ form superoxide (no form.) with excess of O_2?
(a) Be (b) Ca (c) Ba ~~(d) None~~

	Oxide	Peroxide	Superoxide
unit	O^{2-}	O_2^{-2}	O_2^{-}
	$1s^2 2s^2 2p^6$		
	0-unpaired.	0-unpaired	1-unpaired.
	Diamagnetic	Diamagnetic	Paramagnetic, orange colored.
	Base	Base + H_2O_2	Base + H_2O_2 + O_2

→ Peroxide & superoxide form H_2O_2 with H_2O. So, they act as bleaching agent & oxidising agent. (also with dil. HCl)

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$CaO + HOH \longrightarrow Ca(OH)_2$

$CaO_2 + HOH \longrightarrow Ca(OH)_2 + H_2O_2$

$+ dil\ HCl \longrightarrow CaCl_2 + H_2O_2$.

→ Peroxide and superoxide (mainly) used in space and submarines because it absorb CO_2 and evolve O_2.

$2KO_2$ → superoxide. $\xrightarrow{CO_2} K_2CO_3 + 3O_2$

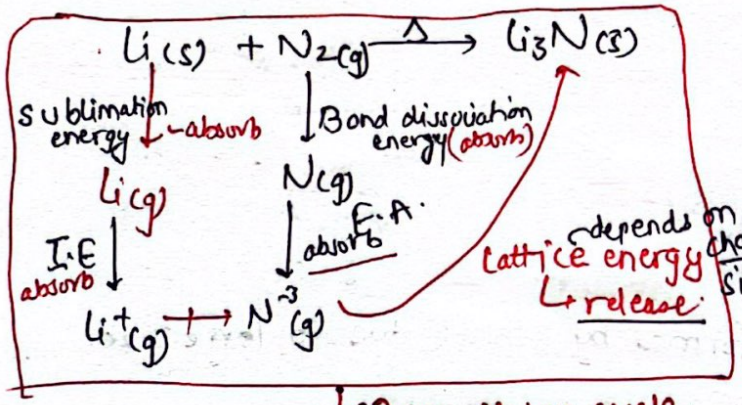
Q. Which metal form superoxide with excess of O_2?

(a) Li (oxide) (b) Na (peroxide.) ~~(b)~~ K (c) All

Rxn with N_2

$M + N_2 \xrightarrow{\Delta} M_3N$ (IA)

$M + N_2 \xrightarrow{\Delta} M_3N_2$ (IIA)



↳ Born Haber cycle.

Release E > absorb E

L.E ∝ charge / size

Note:- Compound को formation हुन लाई release E धेरै हुन पर्यो absorb energy भन्दा ।.

$Na(s) + N_2(g) \xrightarrow{\Delta}$ No rxn.

↳ due to absorb E > release E.

→ Only Li form nitride when heated with N_2 because of small size of U result is high lattice energy.

→ All IIA metal form nitride when heated with N_2 because of small size & high charge result in high L.E.

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$\rightarrow Be + N_2 \xrightarrow{\Delta} Be_3N_2$

IIA block → all
IA " → Li only

2. Which metal form nitride when heated with N_2?

(a) Li (b) Mg (c) Ba (d) Al ~~(e) All~~

$\downarrow$
AlN

Note:- Nitride on rxn with water form Base & ammonia.

e.g. $Li_3N + 3HOH \longrightarrow 3LiOH + NH_3$

$Mg_3N_2 + 6HOH \longrightarrow 3Mg(OH)_2 + 2NH_3$

$Ca_3N_2 + HOH \longrightarrow Ca(OH)_2 + NH_3$

$Ca_3P_2 + HOH \longrightarrow Ca(OH)_2 + PH_3$.

Q. $Ca \xrightarrow[\Delta]{air\ (CO_2, N_2)} CaO + Ca_3N_2$

$CaO \xrightarrow{H_2O} Ca(OH)_2$

$Ca_3N_2 \xrightarrow{H_2O} Ca(OH)_2 + NH_3 \xrightarrow{HCl}$ white fumes of NH_4Cl.

$Ca(OH)_2 \xrightarrow{CO_2} CaCO_3$

Q. $M \xrightarrow[\Delta]{air\ (CO_2, N_2)} \text{---} \xrightarrow{HOH} \text{--} \xrightarrow{HCl} NH_4Cl$.

M = ?

(a) Li, Na, K (b) Li, Na, Mg

(c) Li, Mg, K ~~(d)~~ Li, Mg, Ba

Q. Which pair exist?

(a) Li_3N, Na_3N (b) Li_3N, K_3N ~~(c)~~ Li_3N, Ba_3N_2 (d) None

Reaction with NH_3

→ Solubility in liq. NH_3

- All alkali metal are soluble in liq. NH_3 and blue color appe

$$M \longrightarrow \underset{\text{liq } NH_3}{M^+} + \underset{\text{liq } NH_3}{e^-}$$

$$M + (x+y)NH_3 \longrightarrow M^+ + e^-$$

M^+ → $[M(NH_3)_x]^+$ — ammoniated cation

e^- → $[e(NH_3)_y]^-$ — ammoniated e^- or solvated e^-

→ When alkali metal is dissolved in liq. NH_3, बनेको solution f four properties

- conducting → due to ammoniated cation & e^-.
- Paramagentic
- Reducing agent
- Blue color

→ only due to ammoniated e^-.

→ IIA (alkaline Earth metals)

Be, Mg in liq. NH_3 - doesnot gives blue color due to high ionisation energy

but other alkaline earth metals give

Be, Mg → difficult → $M^{+2} + 2e^-$ → so, no blue color

Ca, Sr, Ba → give blue color.

$$M + (x+y)NH_3 \longrightarrow M^{+2} + 2e^-$$

M^{+2} → $[M(NH_3)_x]^{+2}$

$2e^-$ → $2[e(NH_3)_y]^-$

→ Dilute solution is unstable & blue color disappear after sometimes due to formation of metal amide & H_2 gas.

$$[M(am)^+] + [e(am)]^- + liq.\ NH_3 \longrightarrow MNH_2 + \frac{1}{2}H_2$$

ammoniated metal; am. electron; $NH_2^- + H^+$; metal amide

→ Dilute solution is blue color & paramagnetic but concentrated solution is bronze color & diamagnetic
by metal cluster formation

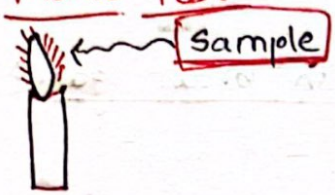
• Dry NH_3

$Na + dry.\ NH_3 \longrightarrow NaNH_2 + \frac{1}{2}H_2$

but $Li + dry.\ NH_3 \longrightarrow \underset{\text{Amide}}{Li_2NH} + H_2$

$K, Na, Rb + dry.\ NH_3 \longrightarrow Amide + \frac{1}{2}H_2$

Flame Test



→ flame energy absorb by valence e^- and goes to higher energy level
Very unstable → color impart.

→ Alkali metal & their salt give specific color in a flame because valence e^- exited to high energy level after absorption of flame energy.

Li → Crimson red
Na → Golden Yellow
K → voilet
Rb → Red voilet
Cs → Blue

→ IA & IIA
(I.E)

→ Be, Mg doesnot provide color in flame. because of small size & have valence e^- strongly hold by nuclei (high I.E) so, exitation by flame energy not possible.

Be, Mg } X.
Ca - Brick red
Sr → Crimson red
Ba → Apple red

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Q. Alkali metal give color in flame due to:-

(a) valance e^- one (b) low I.E (c) Both (d) None

$Cu - 1ve^-$ no color

max

Q. Flame test useful testing of :-

(a) s-block metal (b) d-block metals (c) Both (d) None

(a) IA (b) IIA (c) IIIB (d) IIIA (e) a & b.

Boron f.

→ d-block compounds are colored in solid state or H_2O but doesnot provide color in flame.

Q. Compound (X) on heating evolved reddish brown gas & give apple green color in flame:- X is:-

(a) $BaCO_3$ (b) $Mg(NO_3)_2$ (c) $Ca(NO_3)_2$ (d) $Ba(NO_3)_2$

$BaO + CO_2$

$MO + NO_2 + \frac{1}{2}O_2$

reddish brown

apple green

~~Action of air~~ Reactivity :-

$$\text{Reactivity} \propto \frac{1}{I.E}$$

→ Alkali metal are highly reactive due to low I.E & therefore kept in Kerosene or petrol or diesel.

but Lithium store in paraffin wax.

lighter metal

Q. Na store in:-

(a) H_2O (b) D_2O (c) ROH (d) Kerosene

Note:- a, b, c contain acidic hydrogen.

$$Na + ROH \rightarrow RONa + \frac{1}{2}H_2$$

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→ Reactivity of 's' block metal increases down the group because I.E decreases.

Li → gently
Na → vigrous
K } reactivity ↑es. IE ↓es.
Rb } Explosive
Cs

– All IA can even react with cold water.

→ Be – with steam
Mg – Hot water
Ca
Sr } cold water
Ba

I.E ↓es, reactivity ↑es.

Q. In which group all metal react with cold H_2O?

(a) IA (b) IIA (c) IIIA (d) IIIB

IIA → except Be & Mg.
IIIA → p block
IIIB → d-block.
IIIA, IIIB → Never react with cold H_2O.

→ Reactivity order of Na Fe Mg.

→ Na > Mg > Fe (steam react).
IA IIA d-block

– 's' block metal more reactive than 'd' block.

Q. vigrous rxn of Na with cold water controlled by addition of

(a) ice (b) D_2O (c) ROH (d) CH_3COOH (e) Amalgum formation

ice, D_2O, ROH, CH_3COOH → contains acidic 'H'.

Amalgum formation → CHAPA metals → can't gives H_2 gas.

→ mpt order of LiCl NaCl KCl RbCl CsCl

Action of Halogen:-

$M + X_2 \longrightarrow MX$
(IA)

MX → ionic but LiX is covalent
but LiF → ionic

$M + X_2 \longrightarrow MX_2$
ionic but BeX_2 & MgX_2 are covalent

[Be_2C → नष्ट ionic
↳ अपवाद H_2O compound]

→ m.pt of ionic compound ∝ lattice energy × charge / size

→ mpt of ionic > covalent.

ionic { NaCl, KCl, RbCl, CsCl } > LiCl (covalent)

more lattice en
NaCl > KCl
↳ mpt.

→ NaCl > KCl > RbCl > CsCl > LiCl → m.pt

mpt → NaF > NaCl > NaBr > NaI

CaF_2 > $CaCl_2$ > $CaBr_2$ > CaI_2

Action of H_2

$M \xrightarrow[H_2]{\Delta} MH$ (IA)

MH: metal hydride → Ionic Hydride / Saline hydride / Salt like hydride

Li → Cs → ionic

LiH, NaH, ⋮, CsH → Ionic.

MH → unit of H is H^-

$M \xrightarrow[H_2]{\Delta} MH_2$ (IIA) → ionic hydride.

Ca to Ba → Ionic

but Be, Mg → covalent

BeH_2, MgH_2 → not ionic, covalent

* polymeric

$(BeH_2)_n$, $(MgH_2)_n$ → Bicentric bonding or Banana bond

↓ e⁻ deficient

CaH_2, ⋮, BaH_2 → ionic.

Unit of H in MH_2 (IIA) is H^- Except in BeH_2 & MgH_2 ↳ not ionic

Thermal stability of ionic hydride ∝ lattice energy

L.E ∝ charge / size

T.S.

↳ LiH > NaH > KH > RbH > CsH

← Size ↓es, L.E ↑es.
T.S ↑es.

- HF > HCl > HBr > HI → T.S.
  - covalent; not ionic.
  - on the basic of bond length.
  - ∴ T.S ↓

→ $H_2O > H_2S > H_2Se > H_2Te$

$NH_3 > PH_3 > AsH_3 > SbH_3$] covalent

→ Size ↑es, bond length ↑es,
Bond dissociation E ↓es, Thermal stability ↓es.

Q. Correct statement regarding ionic hydride?
(a) contain H^- unit (b) non conducting in solid state
(c) non-volatile (d) High mpt. ~~(e)~~ All

Note:- Ionic hydrides are drying agent as well as reducing agent
- Ionic hydride remove moisture from organic substance but not useful for drying alcohol & phenol.

$Na^+H^- + H^+-OH^- \longrightarrow NaOH + H_2$

$CH_3OH \rightarrow CH_3ONa + H_2$

Q. Ionic hydride are useful for drying of :-
(a) Alcohol (b) C_6H_5OH (c) C_6H_6 (Benzene.) (d) General drying agent (↳ Specific ✗)

- Ionic hydride ~~are~~ fused salt electrolysis, H_2 gas evolve at cathode.

NaH (molten) → $Na^+ + H^-$

cathode: $+e^-$ → Na

anode: $-e^-$ → $\frac{1}{2}H_2$

$CaH_2 \longrightarrow Ca^{++} + 2H_2^-$

$\downarrow 2e^-$ $\downarrow -2e^-$

Ca cathode. $H_2 + 2e^-$ anode

Note:- CaH_2 (Hydrolith) $+ 2H-OH \longrightarrow Ca(OH)_2 + 2H_2$ ↳ highly inflammable gas.

Q. Which compound on reaction with H_2O form alkaline sol n & evolve 1 mole H_2 gas?

(a) Na_2O $\downarrow HOH$ $NaOH$

(b) CaO $\downarrow HOH$ $Ca(OH)_2$

(c) CaH_2 $\downarrow 2HOH$ $Ca(OH)_2 + 2H_2$

(d) NaH $\downarrow HOH$ $NaOH + H_2$

Q. Compound on reaction with water form alkaline solution & give milkness when CO_2 pass?

(a) Na_2O $\downarrow H_2O$ $NaOH \xrightarrow{CO_2} Na_2CO_3 + H_2O$. ↳ soluble.

(b) CaO $\downarrow H_2O$ $Ca(OH)_2 \xrightarrow{CO_2} CaCO_3 + H_2O$ ↳ milkyness insoluble

(c) NaH $\downarrow H_2O$ $NaOH + H_2$ $\downarrow CO_2$ Na_2CO_3 ↳ soluble

(d) CaH_2 (hydrolith) $\downarrow H_2O$ $Ca(OH)_2 + H_2$ $\downarrow CO_2$ $CaCO_3$ ↳ milkyness insoluble

b & d

Q. Which pair form same gas product with H_2O?

(a) Na, Na_2O

(b) Ca, CaO

(c) Ca, CaH_2

Ca $\downarrow H_2O$ $Ca(OH)_2 + H_2$

CaH_2 $\downarrow H_2O$ $Ca(OH)_2 + H_2$

same

Q. Which of the following electronic configuration in the outermost two shells is characteristics of the alkaline earth metals?

(a) $(n-1)s^2p^6ns^2$

(b) $(n-1)s^2p^6d^{10}ns^2$

(c) $(n-1)s^2p^6ns^2p^1$

(d) None

Q. Which of the following configuration represents s-block element:-

(a) [Ar] $3d^{10}4s^1$ ✗

(b) [Ne] $3s^2 3p^1$

(c) [He] $2s^2 2p^6 3s^1$

(d) None

Q. The similarity in the properties of alkali metals is due to:-
(a) their same atomicity (b) similar outer shell electron configuration
(c) Same energy of valance shell (d) Same principal quantum no. of val. shell

Q. Which one of the following metal is largest in periodic table?
(a) K (b) Cs (c) Zn (d) Ba
smallest in it. smallest →

Q. The set representing the correct order of ionic radius is:-
(a) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$ (b) $Na^+ > Li^+ > Mg^{+2} > Be^{+2}$
(c) $Li^+ > Na^+ > Mg^{2+} > Be^{2+}$ (d) $Mg^{+2} > Be^{+2} > Li^+ > Na^+$

Q. The hydration enthalpies of alkali metal ions:-
(a) decrease with increasing ionic size down the group
(b) increase with increasing ionic size down the group
(c) remain same with increase ionic size down the group
(d) First decrease from Li to K & then increases from Rb to Cs.

Q. In aq. solution, the largest ion is:-
(a) $Na^+_{(aq)}$ (b) $Cs^+_{(aq)}$ (c) $Rb^+_{(aq)}$ (d) $Li^+_{(aq)}$ सानो लाई more water molecule ले घेर्ई।

Q. The ionic mobility of alkali metal ion in aq. solution is max. for:-
(a) Li^+ (b) Na^+ (c) K^+ (d) Rb^+

Q. Aq. solution of lithium salts are not good conductors of electricity because of:-
(a) High hydration energy of Li^+ ion (mobility कम हुन्छ).
(b) High ionisation energy of Li^+ ion.
(c) Small size of Li^+ ion
(d) non Metallic character of Li^+ ion

Q. Atomic radii of alkali metals (M) follow the order: $Li < Na < K < Rb$ but ionic radi in aq. solution follows the order $Li^+ > Na^+ > K^+ > Rb^+$. The reason for reverse order is:-
(a) ↑es in I.E (b) ↓es in metallic bond character
(c) ↑es in electro +ve character (d) ↓es in amt of hydration

Q. The most electropositive among the alkaline earth metal is:-
(a) Be (b) Mg (c) Ca (d) Ba

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Q. The ionization enthalpy of alkaline earth metals is :-

(a) greater than the elements of 1 & 13 groups.
(b) less than alkali metals
(c) greater than alkali metals
(d) equal to alkali metals

Q. Which of the following statement is incorrect?

(a) The atomic radius of Na is greater than Mg.
(b) Metallic bond ($\propto$ V.E) of Mg is greater than Na.
(c) Melting & Boiling point of Mg are less than Ca.
(d) Mg & Ca both impart characteristics color to flame.
not impart due to high I.E.

Q. Which one of the following increases on moving down the group from Li to Cs?

(a) Melting point (decrease)
(b) Hardness of metals
(c) Tendency to loose e^- (el. +ve ch. due to low I.E)
(d) Metallic bond strength.

Q. Which of the having ~~highest m.pt~~.

(a) Be
(b) Mg (lowest)
(c) Ca
(d) Sr

Q. With increase in atomic wt. melting point of alkali met.

(a) ↑es
(b) ↓es
(c) Remain constant
(d) donot show trend

Q. Select the correct statement.

(a) Density of alkali metals regulary ↑es in moving down the group from Li to Cs.
(b) Group I elements are the largest in horizontal periods in periodic table (exclude noble gases) (due to vanderwaals radius. max size)
(c) The mpt & bpt of group IA elements ↑es on moving down Li to Cs.
(d) Alkali metals are more harder than alkaline earth metals.

Q. Correct order of density? $\propto$ mass.

(a) Mg > Ca > Sr
(b) Ca > Mg > Sr
(c) Ca < Mg < Sr (exp)
(d) Mg < Ca < Sr

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Q. The density of:-

(a) Na > K (exception) (b) Na = K (c) K > Na (d) Li > K

Q. The strong reducing agent of alkali metals (aq. माने) is :-

(a) Li (b) Na (c) K (d) Cs

Q. In K, Rb & Cs, the decreasing order of reducing power in gaseous state?

(a) K > Cs > Rb (b) Cs > Rb > K

(c) K < Cs < Rb (d) Rb > Cs > K

Reducing agent

$$M_{(g)} \xrightarrow{(I.E)} M^{+}_{(g)} + e^{-}$$

low for fast process.

good reducing agent

→ Alkali metal are strong reducing agent due to low ionization energy.

→ In every period, alkali metal has low I.E.

period → size ↓es, I.E ↑es

→ $\boxed{\text{Reducing power} \propto \frac{1}{\text{ionisation energy}}}$ – gas med.

→ Cesium is strongest reducing agent in gaseous medium.

→ R.A → Li < Na < K < Rb < Cs. – gaseous med.

size ↑es, I.E ↓es, R.A ↑es.

$\boxed{\text{Reducing power} \propto \frac{1}{SRP}}$ – aqueous medium.

SRP: standard redn pot.

→ ECS

Li → −3.05
K → −2.92
Ba → −2.9
Sr
Ca
Na → −2.71
Mg

SRP ↑es, R.P ↓es. (in aq. med.)

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→

	Strongest	Weakest
IA)	Gaseous → Cs	Li
	aq → Li	Na.
IIA →	Gaseous → Ba	Be
	aq. → Ba	Be

→ Ba is good reducing agent in IIA group in both mediums.

'If medium is not mentioned then aq. medium मानो

→ Lithium is strongest R.A in aq. medium in whole periodic table due to min. SRP & max. Hydration energy due to small size.

ECS

Li
Cs Rb K
Ba
Sr
Ca
Na
Mg
Be

@ लेकर देलन sir के नाक पे मारे BeBe

Q. Strong R.A. reductant in IIA & IA aq group is:—

(a) Ba, Li (b) Li, Be (c) Cs, Ba (d) Ba, Cs

Q. Weak reductant in aq. alkali metal?

(a) Li (b) Na (c) K (d) Cs

Q. Which of the following alkaline earth metal is strongest reducing agent?

(a) Ca (b) Sr (c) Ba (d) Mg

Q. In view of their low I.E the alkali metals are;-

(a) weaking O.A. (b) Strong R.A
(c) strong O.A (d) Weak R.A

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Q. Consider the following points which are correct?

(a) Cs is strongest reducing agent in IA group element.

(b) Be does not form peroxide in IIA group elements. } Correct.

(c) The density of potassium is less than sodium

(d) In alkali metals Li, Na, K & Rb, Lithium has minimum value of M.P.

Q. Select the correct statement with respect to alkali metals.

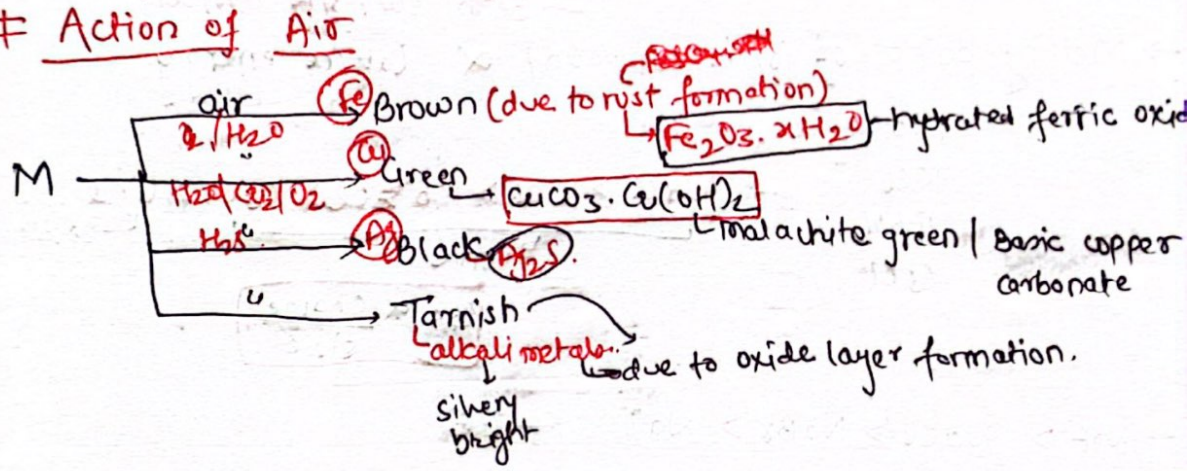
(a) Melting point decrease with increasing atomic no.

(b) Density of K is less than Na.

(c) Salt of Li to Cs impart characteristic flame color.

(d) All of above

Action of Air



Q. Alkali metal tarnish in air due to formation of :-

(a) Hydride layer (b) Nitride layer

(c) Halide layer (d) Oxide layer

- But in moist air, carbonate form

$$Na + O_2 \longrightarrow Na_2O \xrightarrow{HOH} NaOH \xrightarrow{CO_2} Na_2CO_3.$$

- Only Li form oxide & nitride when heated in dry air (small size & l & other alkali metal form only oxide when burn in air.

$$Li \xrightarrow[O_2 / N_2]{air} Li_2O + Li_3N$$

$$Na \longrightarrow Na_2O$$

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Q. M $\xrightarrow[\Delta]{air}$ Oxide / Nitride $\xrightarrow{HOH}$ NH_3 $\xrightarrow{HCl}$ white fumes. M = ?

(a) Na (b) K (c) Ba (d) None

Action of Halogen

$M + X_2 \longrightarrow MX$ (IA)

Ionic but LiX is covalent
↳ LiF is ionic

$M + X_2 \longrightarrow MX_2$ (IIA)

Ionic but BeX_2 & MgX_2 → covalent
but MgF_2 → ionic

Be_2C → ionic
↳ Be का एक ही compound

→ Melting point of ionic compound ∝ Lattice energy.

NaCl
KCl
RbCl
CsCl

– NaCl > KCl > RbCl > CsCl > LiCl
ionic — covalent

$L.E \propto \frac{Charge}{size}$

– NaF > NaCl > NaBr > NaI → L.E

→ Note:- LiCl exist in hydrated form and other chloride anhydrous form and tendency to form halide hydrate ↓es down the group because size ↑es.

$LiCl \cdot 2H_2O$ → Hydrated

NaCl
KCl
:
:
– Anhydrous

$MgCl_2 \cdot 6H_2O$
$CaCl_2 \cdot 6H_2O$
:
$BaCl_2 \cdot 2H_2O$
– Hydrated.

Q. Metal chloride exist in the form of hydrate ($MCl \cdot 2H_2O$) : M = ?

(a) Li (b) Na (c) Rb (d) Cs

• $MgCl_2 \cdot 6H_2O \xrightarrow{\Delta} MgCl_2 + 2HOH \longrightarrow MgO + 2HCl$
(covalent)

• $CaCl_2 \cdot 6H_2O \xrightarrow{\Delta} CaCl_2 + 6H_2O$

→ Ionic chloride hydrate on heating becomes anhydrous but covalent chloride hydrate on heating form metal oxide because hydrolysed by water of crystallization.

Q. $MgCl_2 \cdot 6H_2O \xrightarrow{\Delta} MgCl_2 + HOH$

$\hookrightarrow MgO$.

$MgCl_2 \cdot 6H_2O \xrightarrow[\text{dry HCl}]{\Delta} MgCl_2$

absorb water of crystallization

Q. $AlCl_3 \cdot 6H_2O$ on heating form :- $\boxed{AlF_3 - \text{only ionic}}$

covalent

(a) $AlCl_3 \cdot 3H_2O$ (b) $AlCl_3$ (c) $Al(OH)_3$ ~~(d)~~ Al_2O_3 (e) Al

→ $\overset{+3}{Fe}Cl_3 \cdot 6H_2O \xrightarrow{\Delta} \cancel{FeO} \cdot Fe_2O_3$.

covalent

Metal oxide

Q. Which compound on heating form anhydrous ~~con~~ chloride?

(a) $MgCl_2 \cdot 6H_2O$ (b) $AlCl_3 \cdot 6H_2O$

(c) $FeCl_3 \cdot 6H_2O$ ~~(d)~~ $CaCl_2 \cdot 6H_2O$ ~~(e)~~ $BaCl_2 \cdot 2H_2O$.

covalent

Δ → MO.

ionic Δ → ~~clo~~ MCl_2.

Q. In which reaction anhy. $AlCl_3$ form:-

(a) $AlCl_3 \cdot 6H_2O \xrightarrow{\Delta} Al_2O_3$.

(b) $Al + \text{dil. } HCl \longrightarrow AlCl_3 + H_2$.

पानी

(c) $Al(OH)_3 + HCl \longrightarrow AlCl_3 + H_2O$

~~(d)~~ $Al_2O_3 + 3C + Cl_2 \xrightarrow{\Delta} AlCl_3 + 3CO$.

good L.A.

→ $BeO + C + Cl_2 \xrightarrow{\Delta} BeCl_2 + CO$.

$\boxed{MO + C \rightarrow MO}$ Cl_2 $MCl_2 + CO$.

– $\overset{+3}{Fe_2}O_3 + C + Cl_2 \xrightarrow{\Delta} FeCl_3 + CO$.

~~Q. In whic~~

Q. In which rxn anhy. $AlCl_3$ form:—

(a) $Al + \underline{dry.\ Cl_2} \longrightarrow AlCl_3$

(b) $Al_2O_3 + 3C + Cl_2 \xrightarrow{\Delta} AlCl_3 + 3CO$

(c) $Al + \underline{dry\ HCl} \xrightarrow{\Delta} AlCl_3 + H_2$

~~(d)~~ ~~AU~~

Abnormal behaviour of Li & Be

Reason:- small size of Li result in high polarizing power or high ionic potential.

(1) $\underline{LiCl.2H_2O}$ — covalent & hydrated.

$MCl \rightarrow$ ionic & anhydrous
(other IA)

Q. MCl exist as $MCl.2H_2O$. M' is:-

~~(a)~~ Li (b) Na (c) Rb (c) K

Hydration $\propto \frac{1}{size}$

Q. Incorrect statement:

~~(a)~~ LiCl exist in form of $\underline{LiCl.H_2O}$ → $LiCl.2H_2O$.

(2) Li burn in air

$Li \xrightarrow[\Delta]{air} Li_2O + Li_3N$. (due to small size of Li result in high lattice energy.)

other IA $\xrightarrow{air}$ M_2O. only.

(3) $Li \xrightarrow[excess]{O_2}$ only oxide.

Na $\xrightarrow[excess]{O_2}$ oxide + peroxide

K, Rb, Cl $\xrightarrow[excess]{O_2}$ " " + superoxide.

(4) $Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$

but other ~~Li~~ IA carbonate $\xrightarrow{\Delta}$ No rxn.
(Thermally stable)

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$Li_2CO_3 + Na_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$ ✗

$Li_2CO_3 + Na_2CO_3 \cdot 10H_2O \xrightarrow{\Delta} Li_2O + CO_2 + Na_2CO_3 + 10H_2O$

→ $Li_2SO_4 \xrightarrow{\Delta}$ decompose ~~soo~~

but Na_2SO_4 … Cs_2SO_4 $\xrightarrow{\Delta}$ decompose soo

(5) $LiNO_3 \xrightarrow{\Delta} Li_2O + NO_2 + \frac{1}{2}O_2$

but $NaNO_3$ … $CsNO_3$ $\xrightarrow{\Delta} MNO_2 + \frac{1}{2}O_2$

(6) $LiHCO_3$ (liq.), $NaHCO_3$, $KHCO_3$ (solid) … $\xrightarrow{\Delta} M_2CO_3 + H_2O + CO_2$

(9) Q. Which exist in solid state?

(a) $LiHCO_3$ (b) $KHCO_3$ (c) $AgHCO_3$ (d) $Zn(HCO_3)_2$

(7) LiH, NaH, KH → All MH ionic

- Li_2SO_4 do esnot form alum due to small size.

$M_2SO_4 \cdot M_2(SO_4)_3 \cdot 24H_2O$

M^+ → alkali (Li^+, Na^+ ...)

M^{+3} → Fe^{+3}, Cr^{+3}, Al^{+3}.

→ $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ ↳ Potash alum.

$\xrightarrow{\Delta} K_2SO_4 + Al_2O_3 + SO_3 + 24H_2O$

$SO_3 \rightarrow SO_2 + O_2$

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Note:- Potash alum लाई Heat गऱ्यो भने Gas trivalent alumin sulphate बाट आउँछ।

Abnormal Be

① $Be(OH)_2$ | BeO → amphoteric

$Mg(OH)_2$ / MgO
$Ca(OH)_2$ / CaO, SrO, BaO — Basic.
" "

→ $Be(OH)_2 \xrightarrow{HCl} BeCl_2 + H_2O$

→ $Be(OH)_2 \xrightarrow{NaOH} Na_2BeO_2$ Soluble complex
Sod. Berylate.

Q. Which oxide doesnot react with NaOH. (basic)

(a) CaO (basic) (b) B_2O_3 (c) SiO_2 (acidic) (d) BeO (amphoteric)

② Be liberate H_2 gas with acid & base
but other IIA metals liberate H_2 gas with acid only.

$Be \xrightarrow{HCl} BeCl_2 + H_2\uparrow$

$Be \xrightarrow{NaOH} Na_2BeO_2 + H_2\uparrow$

but

$Mg \xrightarrow{NaOH}$ No rxn.

BeO, $Be(OH)_2$, Be — Amphoteric → $\xrightarrow{HCl}$ ✓, $\xrightarrow{NaOH}$ ✓

Q. Na_2BeO_2 form in:-

(a) $Be \xrightarrow{NaOH}$ " $+ H_2$.

(b) $BeO \xrightarrow{NaOH}$ " ÷

(c) $Be(OH)_2 \xrightarrow{NaOH}$

(d) Al

③ Be solube in alkali due to Berylate formation but other IIA metals insoluble in alkali

④ $Be_2C \xrightarrow{HOH} CH_4$. methane

but CaC_2, BaC_2 $\xrightarrow{HOH}$ C_2H_2 ethyne

Q. In nepal at the ocassion of marriage, the fire works used give green flame. Which of the following radicals may be present?
(a) Na^+ (b) K^+ (c) Ba^{2+} (d) Ca^{2+}

Q. Alkali metals give colour in Bunsen flame due to:-
(a) low I.E (b) low m.pt (c) softness (d) one e^- in V.Shell

Q. Which of the following doesnot give flame coloration?
(a) $MgCl_2$ (b) $BaCl_2$ (c) $CaCO_3$ (d) $SrCO_3$

Q. Which of the following imparts voilet coloration to the Bunsen burner non-luminous flame?
(a) NaCl (b) BaI_2 (c) $CaCl_2$ (d) KCl

Q. A fire work give out crimson colored light. It contains a salt of
(a) Ca (b) Na (c) Sr (d) Ba

Q. The yellow color flame is of:-
(a) Na (b) K (c) Ca (d) Ba

Q. On allowing ammonia solution of s-block metals to stand for a long time, blue color becomes fade. The reason is:-
(a) formation of NH_3 gas (b) formation of metal amide
(c) cluster formation of metal ions (d) formation of metal nitrate

Q. On heating sodium metal in the current of dry ammonia leads to the formation of which gas?
(a) $NaNH_2$ (solid) (b) NaN_3 (c) NH_3 (d) H_2

Q.

Q. An element having E.C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$ will form

(a) acidic oxide (b) Basic oxide

(c) Amphoteric oxide (d) Neutral oxide

Q. Which of the following is amphoteric oxide?

(a) CaO (b) SrO (c) BeO (d) MgO

Q. In the presence of O_2, on heating Li forms:-

(a) LiO (b) LiO_2 (c) Li_2O (d) Li_2O_2

Calso in excess

Q. The basic strength of which hydroxide is max.?

(a) LiOH (b) NaOH (c) CsOH (d) KOH

Q. Cesium oxide will be:-

(a) very strongly basic (b) Acidic

(c) weakly basic (d) Amphoteric

Q. A compound used in space vehicles to absorb CO_2 & liberate O_2 is:-

peroxide + superoxide prior.

(a) NaOH (b) Na_2O (c) Na_2O_2 (d) CaO + NaOH

Q. Which metal will not form superoxide?

(a) Li oxide (b) Be oxide (c) Na peroxi. (d) Al

Q. Which of the following element form superoxide as major product when heated in excess of air?

(a) Mg (b) Na (c) Cs (d) Li

Q. Sodium burns in dry air to give:-

(a) Na_2O oxide (b) Na_2O_2 (c) NaO_2 (d) Na_3N

Q. The oxide that gives Hydrogen peroxide on treatment with a dilute cold acid is:-

(a) PbO_2 (b) Na_2O_2 (c) MnO_2 (d) SnO_2

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Q. Which of the following are amphoteric.

A. $Be(OH)_2$ (A) B. $Sr(OH)_2$ (B) C. $Cd(OH)_2$ (B) D. $Fe(OH)_3$ (A)

(a) A & C (b) B & C (c) A & D (d) B & D

Q. Which one of the following is most basic?

(a) BeO (amphoteric) (b) MgO (c) SiO_2 (acidic) (d) P_2O_5 (acid)

Q. Quick lime & slaked lime respectively are:-

(a) $CaCO_3$ & $Ca(OH)_2$ (b) CaO & $Ca(OH)_2$

Q. Oxygen ions in its peroxide (O_2^{2-}), superoxide (O_2^-), oxide (O^{2-}) =

(a) O_2^-, O_2^{2+}, O_2^{-2}

(b) O_2^{2-}, O_2^-, O_2^{-2}

(c) O_2^{-2}, O^{-2}, O^-

(d) O_2^-, O_2^{-2}, O^{-2}

Alum

$M_2SO_4 \cdot M'_2(SO_4)_3 \cdot 24H_2O$ (M: monovalent, M': trivalent)

or, $MM'(SO_4)_2 \cdot 12H_2O$

monovalent: Na^+, NH_4^+, K^+, Rb^+, Cs^+

trivalent: Fe^{+3}, Al^{+3}, Cr^{+3}, Sc^{+3}, Ti^{+3}

Note:- Monovalent cation (Li^+) can't be used because it has 4 coordination number.

For alum, it has 6 coordination no.

→ Naming of Alum

(1) $K_2SO_4 \cdot Al_2SO_4 \cdot 24H_2O$ → potash Alum

(2) $Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ → soda Alum

(3) $(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ → Ammonium Alum

(4) $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$ → Chrome Alum

(5) $(NH_4)_2SO_4 \cdot Fe_2(SO_4)_3 \cdot 24H_2O$ → Ferric alum

Note:- If trivalent cation is Al then name is given from monovalent but if trivalent cation is not Al then name is given from trivalent.

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Heating effect of Alum

$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O \xrightarrow[-24H_2O]{\Delta} K_2SO_4 \cdot Al_2(SO_4)_3 \xrightarrow{\Delta} K_2SO_4 + Al_2O_3 + SO_3\uparrow$

(amorphous powder)

X (alum) $\xrightarrow{\Delta}$ amorphous powder

Prep:

$Al_2O_3 + H_2SO_4 \longrightarrow Al_2(SO_4)_3 + H_2O$

$Al_2(SO_4)_3 + K_2SO_4 + aq.sol \xrightarrow{cool}$ crystalline $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ (Alum)

Uses:- Act as coagulant (Blood clotting).
- purification of H_2O
- Antiseptic
- Tanning of leather.

Q. Which of the metal cation doesnot used for alum?

(a) Na^+ (b) K^+ (c) Cs^+ ~~(d)~~ Li^+

Q. Find the coordination of each metal cation in alum?

(a) 4 ~~(b)~~ 6 (c) 8 (d) 10

Q. Which is pseudo alum?

(a) ~~(b)~~ $(NH_4)_2SO_4 \cdot Cr_2(SO_4)_2 \cdot 24H_2O$

(b) ~~(b)~~ $Na_2SO_4 \cdot MnSO_4 \cdot 24H_2O$ (mono, divalent)

(c) None

Q. X $\xrightarrow{\Delta}$ swells up ~~High Temp~~ Amorphous powder.

X is:-

(a) Carbide ~~(b)~~ Alum (c) Both (d) None

Alum $\xrightarrow{\text{Flame test}}$ Lilac color (pale violet)

Q. Monovalent cation in X compound is:-

(a) Na^+ ~~(b)~~ K^+ (pale violet or lilac) (c) Rb^+ (d) Cs^+

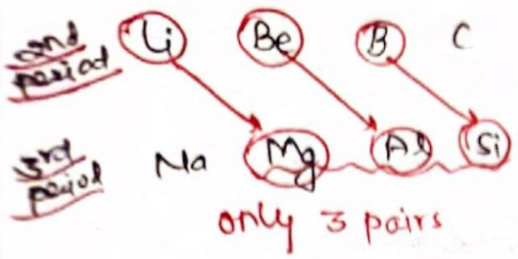
Q. $X \xrightarrow{\Delta}$ Trivalent cation has 3 unpaired e^-.

(a) Al^{+3} ~~(b)~~ Cr^{+3} (c) Fe^{+3} (d) Au
└pentovalent.

Diagonal relationship

2nd period: Li Be B C ..... F Ne

3rd period: Na Mg Al Si ..... Cl Ar



only 3 pairs

→ LiCl, $MgCl_2$ } covalent

→ BeO, Al_2O_3 } Amphoteric

→ Be_2C, Al_4C_3 } carbide $\xrightarrow{HOH}$ CH_4 Methane

– Diagonal relationship arises due to
or
Property of Li & Mg are similar
or
property of Be & Al are similar

Reason:- Almost same size.
Almost same ionic potential
or polarising power.

Similarity between Li & Mg

① LiCl and $MgCl_2$ are covalent & deliquescent. (ह्यानी ताले)
└absorb large H_2O & exist as Hydrate.

– $LiCl \cdot 2H_2O$
– $MgCl_2 \cdot 6H_2O$

② $Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$
└only 1A metal.
$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$

③ $LiNO_3 \xrightarrow{\Delta} Li_2O + NO_2 + O_2$

$Mg(NO_3)_2 \xrightarrow{\Delta} MgO + NO_2 + O_2$

Reddish brown color.

④ $Li \xrightarrow[\text{excess}]{O_2}$ oxide

$Mg \xrightarrow[\text{excess}]{O_2}$ oxide

⑤ $\left.\begin{matrix} Li \\ Mg \end{matrix}\right] \xrightarrow[\Delta]{air} \begin{matrix} Li_2O + Li_3N \\ MgO + Mg_3N_2 \end{matrix}$

⑥ $\left.\begin{matrix} LiHCO_3 \\ Mg(HCO_3)_2 \end{matrix}\right] \rightarrow$ exist in liquid state

Note: $LiH \rightarrow$ ionic but $MgH_2 \rightarrow$ covalent.

$Li \rightarrow$ flame test দিচ্ছে but $Mg \rightarrow$ Flame test দিচ্ছে

$Li \rightarrow$ soluble in liq. NH_3

$Mg \rightarrow$ not soluble in liq. NH_3

Similarity between Be & Al

① Both oxide & hydroxide are amphoteric

$BeCl_2 + H_2O \xleftarrow{HCl} BeO / Be(OH)_2 \xrightarrow{NaOH} Na_2BeO_3$ (sod. Berylate) $\leftarrow Na_2[Be(OH)_4]^{-2}$

$AlCl_3 + H_2O \xleftarrow{HCl} Al_2O_3 / Al(OH)_3 \xrightarrow{NaOH} NaAlO_2$ (sod. meta aluminate) $\leftarrow Na[Al(OH)_4]^-$

$\rightarrow$ Soluble complex

② Both metal liberate H_2 gas with acid & base.

$BeCl_2 + H_2 \xleftarrow{dil.HCl} Be \xrightarrow{NaOH} Na_2BeO_2 + H_2$

$AlCl_3 + H_2 \xleftarrow{dil.HCl} Al \xrightarrow{NaOH} NaAlO_2 + H_2$

③ Both metal soluble in alkali due to complex formation.

④ Caustic soda (NaOH) store in a container of:-

ⓐ Al ⓑ Be ⓒ Zn ⓓ Pb ⓔ Sn ~~ⓕ~~ Cu.

soluble complex পাওয়া ← amphoteric

④ $\left.\begin{matrix} (BeH_2)_n \\ (AlH_3)_n \end{matrix}\right] \rightarrow$ covalent, polymeric & Tricentric.

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⑤ $BeCl_2$, $AlCl_3$ → covalent & exist as dimer by co-ordinate or Halogen bridge bond.

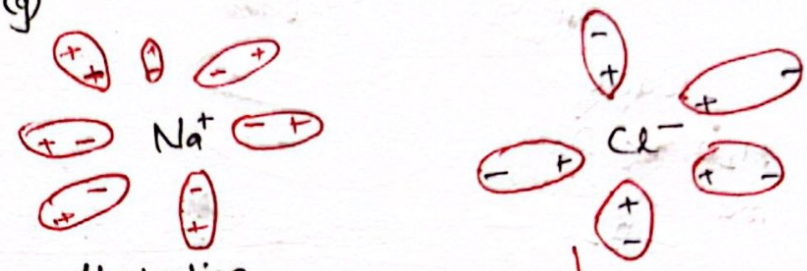
Solubility of S-block

$\overset{\oplus}{Na}\ \overset{\ominus}{Cl} \xrightarrow{H_2O} Na^+ + Cl^-$

L.E

1 mole of ionic compound लाई Break गर्न लागेको or ions लाई compound ~~बनाउन लागेको~~ energy is Lattice energy.

$Na^+_{(g)} + Cl^-_{(g)} \longrightarrow NaCl$



Hydration
└ Hydrated ion
└ Hydration energy → release energy during Hydration.

→ Hydration E must be greater than lattice energy to form hydrated ion / soluble compound.

→ Hydration process is ion-dipole interaction.

→ Ionic compound soluble in H_2O due to hydration process, HE release > L.E.
but covalent compound insoluble in H_2O.

→ $\underset{L.E.}{Na^+Cl^-} \xrightarrow{H_2O} [Na(H_2O)_n]^+ + [Cl(H_2O)_n]^- + H.E.$

Q. Ionic compound soluble in H_2O due to:-

ⓐ HE > L.E ⓑ ion-dipole attraction (└ Hydration)

ⓒ H-bond ✓ ⓓ both a & b.

→ covalent compound like LiCl, $BeCl_2$, $MgCl_2$ ... are insoluble in water but they are soluble in organic solvent like C_6H_6, $CHCl_3$, CCl_4, ether, due to covalent nature.

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Q. LiCl soluble in :-

(a) H_2O (b) D_2O ~~(c)~~ pyridine (O. solvent) (d) None

Q. $MgBr_2$ & MgI_2 are soluble in acetone due to :-

(a) electrovalent nature ~~(b)~~ covalent nature

(c) Both (d) None

Q. NaCl (Ionic) more soluble in :-

~~(a)~~ H_2O (b) D_2O (Heavy water) (c) R_2O (Org. solvent) (d) Same in all.

NaCl

$H_2O > D_2O$

more diel. constant.

↳ 81.

Trick

No. of polyatomic anion ≥ no. of cation, then solubity decreases from top to bottom.

→ $Be(NO_3)_2$

1C 2A.

Monoatomic anion	Polyatomic
O^{--} / OH^-	CO_3^{--}, SO_4^{--},
S^{--} / F^-	ClO_4^-, $X = Cl^-$ / Br^-
	NO_3^-.

[In halide F^- → monoatomic
Cl^- / Br^- / I^- → polyatomic]

→ $Be(NO_3)_2$ (polyatomic)

(1) (2)

$\boxed{\text{polyatomic anion} > \text{cation}}$

→ $Be(NO_3)_2 > Mg(NO_3)_2 > Ca(NO_3)_2 > > Ba(NO_3)_2$

solubility.

→ $LiNO_3 > > > CsNO_3$. no. of polyatomic anion = cation

1C 1A

← Solubility

→ $LiOH \leq \leq \leq CsOH$

monoatom.

→ $Be(OH)_2 < < < < < Ba(OH)_2$

mono

⑤ $BeCO_3$ (poly) > > -> -> $BaCO_3$ polyat. anion = cation
1C 1A

⑥ Li_2CO_3 (poly) < < < < < Cs_2CO_3 polyat. anion < cation
2C 1A
so Sol. ↑es. down the group

⑦ LiF (mono) < < < < CsF

⑧ BeO (mono) < < < < BaO

⑨ BeS (mono) < < < < BaS

⑩ $BeSO_4$ (poly) > > > > > $BaSO_4$
1C 1A

⑪ BeX_2 (poly) ~~>~~ ~~>~~ ~~>~~ ~~>~~ BaX_2 polyat. X = Cl, Br, I
1C 2A

⑫ $LiClO_4$ (poly) > > > > $CsClO_4$
1C 1A

⑬ $BeCrO_4$ (poly) > > > > $BaCrO_4$
1C 1A

but in Bicarbonate

$LiHCO_3$

IA → top to bottom increases

IIA →

→ Solubility ∝ Dielectric constant

$\boxed{HOH > CH_3OH > CH_3COCH_3 > CH_3OCH_3}$ → Diel. const.

→ H_2O_2 & H_2SO_4 has high dielectric constant but not used as a solvent because of its oxidising nature.

→ $FeSO_4$ (+2) $\xrightarrow{H_2SO_4}$ Fe^{+3}
highly explosive.

— Higher lattic energy favors lower solubility.
But higher H.E favors more solubility.

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→ $BaSO_4$ is insoluble in H_2O → LE > H.E

• $BeCO_3$ (poly, IC, IA) > $MgCO_3$ > $CaCO_3$ > $SrCO_3$ > $BaCO_3$ — solubil

max. soluble

less insoluble, more insoluble, insoluble, es↓ LE

HE↓es

Q. $BeCO_3$ का
(a) LE > HE
(b) HE > LE

Q. $BaCO_3$ का
(a) LE > HE
(b) HE > LE

Top → HE↓es → bottom

Top → L.E↓es → bottom

LE ∝ charge / size

but LE कम decrease but HE more decrease.

→ $Be(OH)_2$ (monoat.) < $Mg(OH)_2$ < _ < _ < $Ba(OH)_2$

solubility

HE↓es, L.E↓

→ $BeSO_4$ (poly, IC, IA) > $MgSO_4$ > $CaSO_4$ > $SrSO_4$ > $BaSO_4$ solubility

soluble, insoluble

size↑es, solubility↓es, L.E↓es, HE↓es

कम घटता, छोटे घटते

Q. Which property increases with ↑es in atomic no. in IIA.
(a) I.E↓es (b) EN↓es (c) solubility of SO_4 in H_2O↓es.
(d) solubility of Hydroxide in H_2O↑es.

Q. In which sulphate, HE > LE?
(a) $CaSO_4$ (b) $SrSO_4$ (c) $BeSO_4$ (d) $BaSO_4$

→ BeF_2 (mono.) < MgF_2 < CaF_2 < SrF_2 < BaF_2

exception but max. soluble.

↳ MgF_2 < CaF_2 < SrF_2 < BaF_2 < BeF_2

soluble complex

$[Be(H_2O)_4]F_2$

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Q. Solubility का decreasing order :-

(a) $CaCO_3$ (insoluble) $NaHCO_3$ $KHCO_3$
(limestone)

→ $KHCO_3 > NaHCO_3 > CaCO_3$

Note:

(1) All nitrate of chemistry are soluble in H_2O. So, nitrate mines not found in earth crust.

(2) All nitrate on heating evolve oxygen gas.

$LiNO_3 \xrightarrow{\Delta} Li_2O + NO_2 + \frac{1}{2}O_2$

$NaNO_3 \xrightarrow{\Delta} NaNO_3 + \frac{1}{2}O_2$ (reddish brown color)

$AgNO_3 \xrightarrow{\Delta} Ag + NO_2 + \frac{1}{2}O_2$

(3) 'd' block halide & sulphide ~~and~~ ~~sol~~ are insoluble.

$Cu^{+2}, Zn^{+2}, Ni^{+2} \xrightarrow{H_2S}$ CuS, ZnS, NiS ↓ ppt.

→ ~~Ag~~ Aq. NaCl $\xrightarrow{AgNO_3}$ AgCl + $NaNO_3$
white ppt.

→ AgF (soluble in H_2O) | AgCl (white) | AgBr (light yellow) | AgI (yellow)
(insoluble)

Q. Which sulphide soluble :-

(a) CuS (b) ZnS (c) FeS ~~(d) NaS~~.

Q. Which compound is insoluble ?

~~(a)~~ Mercuric chloride (b) Mercuric nitrate

(c) Mercurous nitrate (d) None

(4) s-block metal fluoride insoluble due to high lattice energy.

$NaF < NaCl < NaBr < NaI$

size ↑, LE ↑ es. solubility ↑ es.

Q. Which compound is soluble in H_2O?

(a) HgI_2 (b) Ag_2S (c) $AgCl$ (d) $BaCO_3$ (e) $BaSO_4$

(f) BaO / $Ba(OH)_2$.
↳ sol.

Q. $M \longrightarrow MSO_4$
soluble

MO
insoluble
↓ NaOH
soluble complex.

$M = ?$

(a) Be (b) Mg (c) Ca (d) Ba

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