

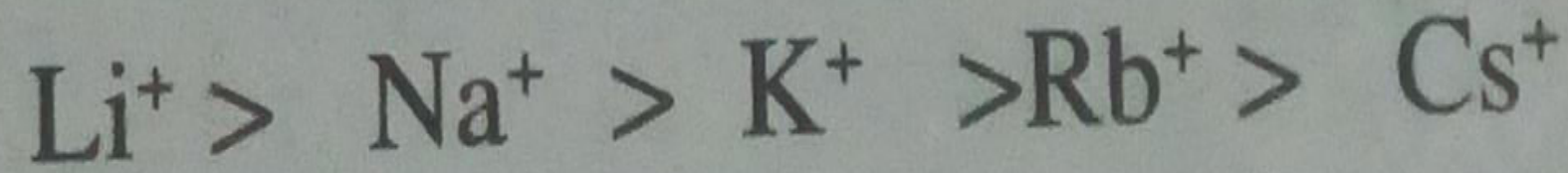
INORGANIC CHEMISTRY -III

- Representative Elements-I
- Jessy Anto Therattil
- 2015-2016

Table 2.8: The hydration enthalpies of alkali metal ions

Ion	Li^+	Na^+	K^+
Enthalpy of hydration (kJ mol^{-1})	-506	-406	-330

The hydration enthalpies of alkali metal ions become less negative as the size of the ion increases. The energy liberated per mole being in the order



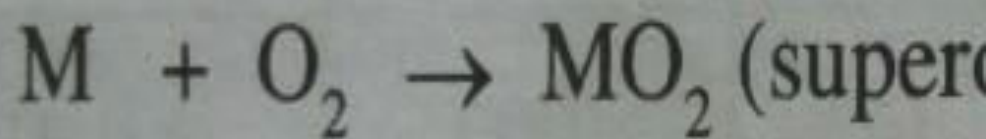
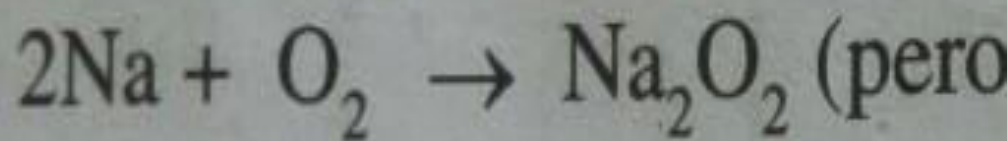
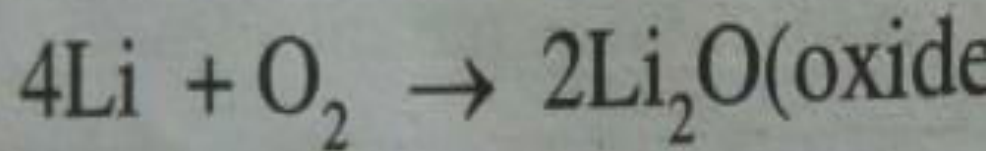
maximum degree of hydration and thereby the

$O(l) \rightarrow M^+(aq)$

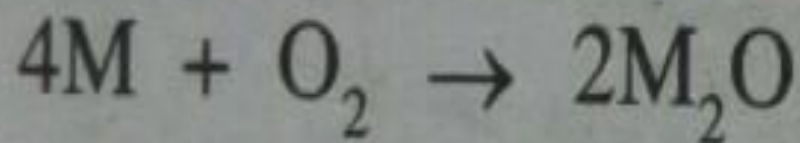
ce between the two terms *ionization enthalpy* and *ionization energy* are regarded synonymous here for the sake of comparison between the values of $\Delta_i H^\circ$ and ionization energy.

values therefore not only depend upon the ionization enthalpy but also upon the hydration enthalpy of the ions in aqueous solution. It is seen that, despite having the highest ionization enthalpy, sodium is the easiest to ionize and has the highest difficulty among the alkali metals in

- (i) **Reactivity towards air/O₂:** Alkali metals forming oxides. Lithium forms *monoxide* metals form *superoxides*.



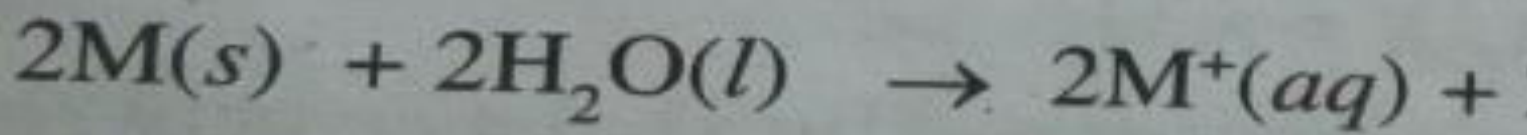
All these metals form their *monoxides* too
O₂.



Lithium shows exceptional behaviour in

$E_{M^+/M}^\circ / V$	-3.04	-2.7
-----------------------	-------	------

(iii) **Reactivity towards water:** The alkali metals react with water to form hydroxides and hydrogen.



Although the reaction of Li with water is not as violent as that of the other alkali metals, it still reacts explosively with water. The explosion is due to its small size and very high hydration enthalpy.

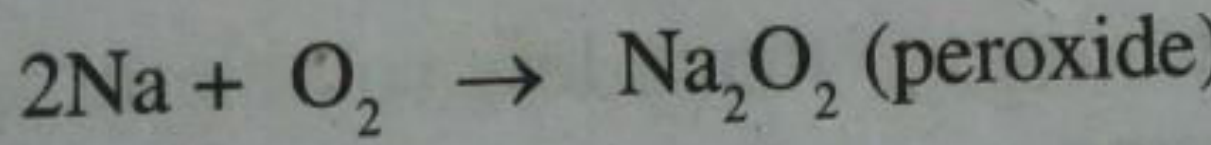
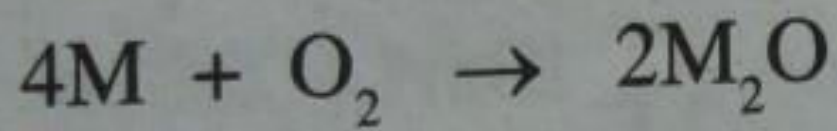
(iv) **Reactivity towards hydrogen:** All alkali metals react with hydrogen at high temperature to form ionic hydrides.



(v) **Reactivity towards halogens:** The alkali metals react with halogens to form halides.

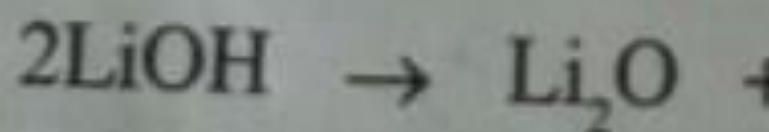
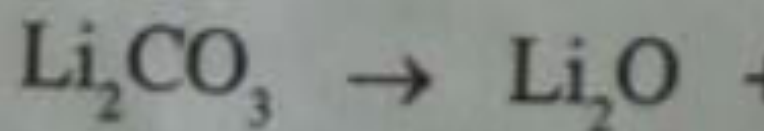
(-)
charge/radius ratio) of its ion. Some points in this

1. The melting point and boiling point of Li are metals.
2. Li is much harder than other alkali metals.
3. Lithium is the least reactive but the strongest alkali metals.
4. Li reacts with oxygen least readily among monoxide Li_2O whereas other alkali metals (M_2O_2) or superoxide (MO_2)] too.

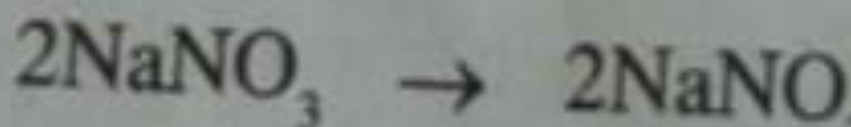
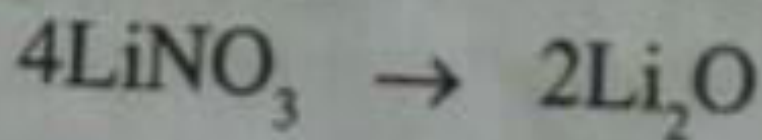


9. Li_2CO_3 , LiF and Li_3PO_4 are the corresponding salts of other alkali metals.

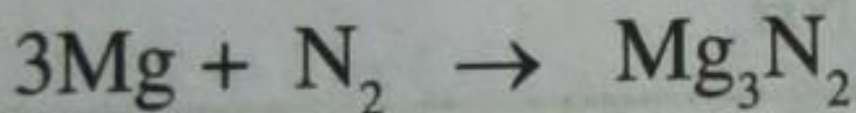
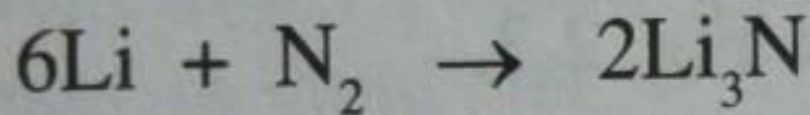
10. While the carbonates and hydroxides of other alkali metals are stable, Li_2CO_3 and LiOH undergo thermal decomposition.



11. Lithium nitrate when heated gives lithium oxide and nitrogen dioxide. Other metal nitrates undergo thermal decomposition to give metal nitrites and oxygen.

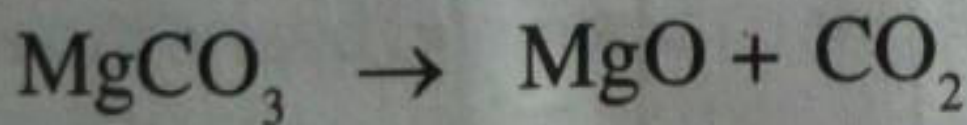
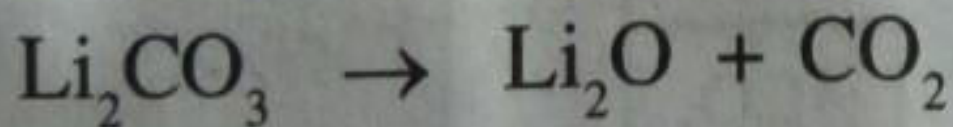


(iv) Both form a nitride each by direct combination



(v) Their monoxides, Li_2O and MgO , do not combine with oxygen to form peroxides or superoxides.

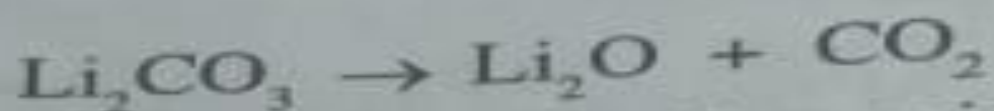
(vi) The carbonates of Li and Mg decompose easily to form oxides and CO_2 .



(vii) Both LiCl and MgCl_2 , on account of their small size, are highly soluble in ethanol.

lattice enthalpies. In fact, except Li_2CO_3 , other alkali metal carb
before they eventually decompose into oxides at temperatures a

um carbonate is not so stable to heat and decomposes
ry small in size, polarizes a large CO_3^{2-} ion leading
 Li_2O and CO_2 .



solubilities of the salts of Group 1 are determined by
enthalpies, the hydration enthalpies of the cations
in going from solid to solution. Whereas Li_2CO_3
the remaining carbonates of the Group 1 metals
of the alkali metal carbonates increase as we
tion can be explained as follows.

alkali metal carbonates, the lattice enthalpies of
the hydration enthalpies of the alkali metal cations
Group with increase in the size of the cation [R_{hyd}].
factors have opposing influences on solubility. The
solubility on moving down the Group whereas
However, the decrease in the lattice enthalpy
therefore more than compensates for the decrease
enthalpy. As a result, the solubilities of the alkali

Hydroxides — Basicity

Except LiOH, the alkali metal hydroxides are the strongest and dissolve freely in water with evolution of much heat on hydration of the ions. This is due to their low ionization enthalpies and electropositive characters.

The basic character of the alkali metal hydroxides (MOH) increases down the Group. This can be explained as follows.

On moving down Group 1 from Li to Cs, the first ionization enthalpy decreases and electropositive character increases. As a result, in aqueous solution, the cleavage of the M—OH bond becomes easier on moving down the Group, and the basic character of the metal hydroxide increases.

