The s-Block Elements

INTRODUCTION

(a) Elements of IA and IIA group of the periodic table are called s-block elements

(b) For these elements outer s-orbital is in the process of filling.

(c) IA [ns^1] group elements are called **alkali metals** and IIA [ns^2] group elements are called **alkaline earth metals**.

GENERAL CHARACTERISTIC

(a) They are good conductors of heat and electricity.

(b) They are malleable and ductile.

(c) Exhibit group valency of 1 and 2 for IA and IIA groups respectively.

(d) They are prepared by the electrolysis of their fused salts.

(e) They are very reactive as their last shell contains 1 or 2 electrons which can be give off easily (low ionization potential).

(f) They form colourless compounds except chromates, dichromates etc.

(g) Their cations are diamagnetic.

(h) They form ionic compounds (except Li and Be).

(i) Their solutions in liquid ammonia are good conductors of electricity and are good reductants

(j) Oxides are basic in nature.

PROPERTIES OF ALKALI METALS (IA)

Elements	Electronic	IP(eV)	At.Vol.	At. Radii 'A'	Ionic radii 'A'	m.pt. °C	b.pt. °C	Standard electrode potential (volt)	Electronegativity
Li (3)	[He] $2s^1$	5.4	13.1	1.23	0.60	181	1336	–3.04	1.0
Na (11)	[Ne] $3s^1$	5.1	23.7	1.54	0.95	98	883	–2.71	0.9
K (19)	[Ar] $4s^1$	4.3	45.3	2.03	1.33	64	760	–2.92	0.8
Rb (37)	[Kr] $5s^1$	4.2	55.9	2.16	1.48	39	688	–2.92	0.8
Cs (55)	[Xe] $6s^1$	3.9	70.0	2.35	1.69	29	690	–2.92	0.7

PROPERTIES OF ALKALINE EARTH METALS (IIA)

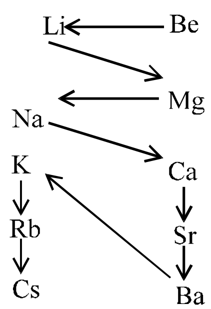
Elements (IIA)	Electronic Configuration	IP (eV)	At. Vol.	At. Radii 'A'	Ionic radii 'A'	m.pt. °C	b.pt.°C	Standard electrode Potential (volt)	Electronegativity
Be (4)	[He] $2s^2$	9.3	5.0	0.9	0.31	1277	2970	–1.80	1.5
Mg (12)	[Ne] $3s^2$	7.6	14.0	1.36	0.65	650	1100	–2.37	1.2
Ca (20)	[Ar] $4s^2$	6.1	29.9	1.74	0.99	8.38	1440	–2.87	1.0
Sr (38)	[Kr] $5s^2$	5.7	33.7	1.91	1.13	768	1380	–2.89	1.0
Ba (56)	[Xe] $6s^2$	5.2	39.0	1.98	1.35	714	1640	–2.90	0.9

PHYSICAL PROPERTIES OF S-BLOCK ELEMENTS :

Element of IA Group (Alkali Metals)

(i) Atomic Size :

These elements are largest in size in the period and the atomic size increase in going downwards in the group.



Order of size

Be < Li < Mg < Na < Ca < Sr < Ba < K < Rb < Cs

(ii) Oxidation state :

These metals exhibit +1 oxidation state, difference of their first and second ionisation potentials is more than 16 ev. Therefore their +1 oxidation state is more stable.

(iii) Density :

$$\text{Density} = \frac{\text{Atomic weight}}{\text{Volume}} = \frac{M}{V}$$

Atomic weight increase from Li to Cs in the group and volume also increase, but increase in atomic weight is more when compared to volume. Therefore, density increases from Li to Cs.

Exception :

Density of Na is more than that of K.

Density :

Li < K < Na < Rb < Cs

Element of IIA Group (Alkaline earth Metals)

(i) Atomic Size :

Size of these elements are small as compared to alkali metals and it increases on going downwards in the group.

Order of size :

Be < Mg < Ca < Sr < B

(ii) Oxidation State :

These metals exhibit + 2 oxidation state, difference of their second and first ionisation potentials is 11 eV. Therefore, the +2 oxidation state of these metals is more stable.

(iii) Density

Atomic weight increase from Be to Ba in a group and volume also increases, but increase in atomic weight is more as compared to volume. Therefore, density increases from Be to Ba.

Exception

Density of Mg is more as compared to Ca (Ca < Mg).

Density :

Ca < Mg < Be < Sr < Ba

(iv) Tendency of forming ionic Bond : One electron is present in the outermost shell of these metals. They form cation by the loss this electron, i.e., they form ionic bond in their compounds.	**(iv) Tendence of forming ionic Bond :** There are two electrons in the outermost shell of these metal, whicha re donated to form ionic compounds for example, $BaCl_2$, $CaCl_2$, etc. Due to small size of cations of Be and Mg, their compounds have covalent character.
(v) Standard Electrode potential or Standard Oxidation Potential : The measure of the tendency of doanting electrons of a metal in water is called its electrode potential. If concentration of metal ions is unity, then it is called standard electrode potential. Lithium has highest electrode potential which is due to its highest hydration energy.	**(v) Standard Electrode potential or Standard Oxidation potential :** Size of these metals is less than that of alkali metals. Therefore, their ionisation potential will be higher than those of alkali metals, i.e. they have low tendency of donating electron as compared to alkali metals. Their standard electrode potentials (oxidation potentials) are lower than those of alkali metals and increases in the group with increases in atomic size from Be to Ba. Be < Mg < Ca < Sr < Ba
(vi) Colourless and Diamagnetic ions : The property of an ion as being colourless or coloured, depends on the number of unpaired electrons present in the ion. If unpaired electrons are present in an ion, then these electrons get excited by the energy from light and show colour on coming back to the ground state. The ion which have unpaired electrons, show magnetic properties. Whereas, the ions having paired electrons nullify the magnetic fields of each other. Such ions are called diamagnetic ions.	**(vi) Colourless and Diamagnetic ions :** These metals form dipositive ions (M^{+2}). These dipositive ions have noble gas configuration and their compounds are colourless, because all the electrons are paired. Their ions are diamagnetic due to presence of paired electrons. For example, $BeCl_2$, $CaCl_2$, $CaCO_3$, $BaSO_4$ etc. are colourless compounds.
(vii) Flame Test : Alkali metals have large size. When they are heated in the flame of Bunsen burner, the electrons present in the valence shell move from lower energy level to higher energy level by absorption of heat from the flame ($ns^1 n^0p$). When they come back to the ground state, they emit the extra energy in the form of visible light to provide colour to the flame. Elements and their respective colours imported to the flame are give below.	**(vii) Flame Test :** Size of Be and Mg is very small and their electrons are strongly bonded to the nucleus. These electrons cannot be excited to higher energy level by the flame of the burner. Thus, Be and Mg do not impart any colour to the flame. Elements and their respective colour imparted to the flame are given below :
(viii) Photoelectric effect : Size of Cs is large and one electron is present in its outermost shell. due to this, electron of outermost shell is emitted by absorption of visible light. Therefore, Cs shows photoelectric effect. This is the reason that it is used in the cells.	**(viii) Photoelectric effect :** Due to small size of these metals as compared to alkali metals, their ionisation potential is high. Thus, electrons can be released only by high energy radiations.

Alkali metals	Alkaline earth metals
(ix) Solubility in Liquefied Ammonia : Ionisation potential is low due to large size of these metals, i.e., they readily dissolve in liquefied ammonia to form blue coloured solution, which is a good conductor of electricity and strong reducing agent. $M + nNH_3 \rightarrow M^{+1}$ + Ammoniated electron Ammoniated metal ion	**(ix) Solubility in Liquefied Ammonia :** Due to small size of Be and Mg. Their ionisation potential is high. Therefore, they do not dissolve in liquified ammonia. Ca, Sr and Ba give ammoniated electron by getting dissolved in liquiefied ammonia due to large size due to which the solution turns blue. $Ca + nH_3 \rightarrow Ca^{+2} + 2e^- (NH_3)_n$ The solution is a good conductor of electricity and a strong reducing agent.
(x) Hydration Energy : Hydration energy decreases on going downwards in the group, due to increase in the size of metal ion Li > Na > K > Rb > Cs Lithium gets more hydrated due to high hydration energy of Li^+ and the charge present on its gets protected. Thus, with the increase of hydration, size of ion increases and electricl conductance decreases.	**(x) Hydration Energy :** Hydration energy of the metal ions (M^{+2}) is higher than that of the elements of IA group, because the size of these cations is small and charge is high. Hydration energy decreases on going downards in the group, due to increase in the size of cations. Be > Mg > Ca > Sr > Ba
(xi) Reactivity : Due to large size of these metals, the electron of the outermost shell is weakly attracted towards the nucleus.	**(xi) Reactivity** Due to small size of these metals as compared to alkali metals, the alkaline earth metals are less reactive than the alkali metals. Their reactivity increases from Be to Ba with increase in the size of the metal.
(1) Na is very reactive and is kept in kerosene, so that air does not come directly in contact with sodium.	(1) Berylium does not react with hot water, Mg reacts with hot water, whereas Ca, Sr and Ba react even with cold water.
(2) Li hardly reacts with steam, whereas, Cs reacts even with cold water.	(2) All these metals react with oxygen to form MO type oxides (M = Be, Mg, Ca, Sr and Ba), but due to low ionisation potential and high reactivity, Ca, Sr and Ba form peroxides also at low temperature.
(3) Li forms only one of oxide (Li_2O), because ionisation potential of Li is high. Superoxide are paramagnetic and coloured due to the presence of unpaired electron. Order of their stability is as follows : Normal oxide > Peroxide > Superoxide.	(3) Be and Mg are less reactive due to their high ionisation potential and they form normal oxides because of breaking of O=O bond.
(xii) Lustrous Surface : Lustre is due to mobile electons in the metallic lattice. Valence electrons generate vibration in the electrical field of the light waves. The vibrating electrons emit electromagnetic energy in the form of light, and thus the surface of these metals starts shining.	**(xii) Lustrous Surface :** Luster is due to mobile electron in the metallic lattice. Valence electrons generate vibration in the electrical field of the light waves. The vibrating electrons emit electromagnetic energy in the form of light, and thus the surface of these metals starts shining.

(xiii) Tendency of Forming Complex compounds : These metals have weak tendency of forming complex compound due to large size, low charge density.	**(xiii) Tendency of Forming Complex compounds:** These metals have weak tendency of forming complex compounds due to large size, low charge density. But these metals have higher tendency of forming complex compounds as compared to alkali metals, due to their relatively smaller size. This tendency decreases from Be to Ba.
(xiv) Strength of metallic Bonds (Softness) Metallic bond is weak due to presence of one electron in the valence shell and the BCC structure. The packing efficiency is 68%. Thus, packing of atoms is loose and these elements are soft. These metals are soft because one electrons is present in their valence shell, which participates in bond formation. Thus, metallic bond is weak. Atomic size increases in the group from Li to Cs, due to which strength of metallic bond decreases. This is the reason why Li is hard, but Na and K are soft, whereas Cs is liquid due to weak metallic bonds. Sheets and wires can be prepared from Li because of its hardness.	**(xiv) Strength of Metallic Bonds (Softness)** There are two electrons in the outermost shell of these metals, which participate in bond formation. Therefore metallic bond is weak, but a little bit stronger than the elements of IA group. Their atomic size is smaller as compared to elements of IA group. Therefore, these metals from strong metallic bonds as compared to metals of IA group. Thus, these metals are harder than the metals of IA group. Order of their hardness is Be > Mg < Ca > Sr > Ba. They have BCC, HCP and FCC structures, i.e. packing efficiency is more than that of the elements of IA group.
(xv) Melting Point and Boiling Point : Their melting and boiling points are low due to weak metallic bonds. Strength of metallic bond decreases in the group from Li to Cs, due to which hardness from Li to Cs. Li > Na > K > Rb > Cs Thus, melting and boiling points decrease down the group.	**(xv) Melting Point and Boiling Point :** Melting and boiling points of these metals are low, but these metals are harder as compared to metals of IA group. Thus, their melting and boiling points are higher as compared to metals of IA group. Hardness decreases from Be to Ba, due to which melting and boiling points decrease. Be > Ca > Sr > Ba > Mg

CHEMICAL PROPERTIES

Element of IA Group (Alkali Metals)	Elements of IIA Group (Alkaline Earth Metals)
(i) (a) Reacton with Air : Li is stable in air, surface of Na become nonlustrous, Rb and Cs spontaneously burn in air. **(b)** These metals form alkaline carbonates in moist air, because these metals react with air to form metal oxides, which further reacts with moisture and CO_2 to form metal carbonates. $4Na + O_2 \rightarrow 2Na_2O$ $Na_2O + H_2O$ (moisture) $\rightarrow 2NaOH$ $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$	**(i) Reaction with Air :** Beryllium is stable due to its low reactivity. The surface of Mg becomes gloomy in air, Sr and Ba burn spontaneously in air.

(ii) Reaction with oxygen : Li forms one type of oxide (M_2O) and Na forms two type of oxide (M_2O, M_2O_2 and MO_2)

Basic nature, ionic character and reactivity of these oxides increases from Li to Cs.

(1) Basic nature of these oxides increases from Li to Cs, due to increase in the size of caton, because the species that gives electron is a base. Therefore, the tendency of donating electrons increases from Li to Cs.

(2) Size of cation increases from Li to cs. Therefore, according of Fajans Rule, ionic character of these oxides increases from Li to Cs, due to which melting and boiling points increase.

(3) Solubility in water increases from Li to Cs oxides, due to increase in ionic character of these metal oxides,

(4) Due to increase in atomic size from Li to Cs, reactivity of these metal oxides increases.

(iii) Hydroxides :

Basic nature of these hydroxides increases from Li to Cs.

LiOH < NaOH < KOH < RbOH < CsOH

Ionic character, melting point, boiling point, reactivity thermal stability and solubility in water increase from Li to Cs.

(iv) Halides / Chlorides :

(1) Alkali metals directly combine with halogen to form halides (MX), which are ionic compounds.

(2) **Hydrolysis of Halides :** The ionic compounds get dissolved in water, while the covalent compounds get Hydrolysed. Ionic character increases from LiCl to CsCl. Therefore, the amount of hydrolysis of decreases from LiCl to CsCl.

(3) LiCl gets hydrolysed due to its covalent nature. Decreasing order of these halides in undergoing hydrolysis is as follows "

LiCl > NaCl > KCl > RbCl > CsCl

(ii) Reaction with oxygen : Be and Mg form normal MO type oxides, whereas, Ca, Sr and Ba form normal oxides (MO) as well as peroxides MO_2. Their peroxides are coloured due to crystal defect.

Basic nature (BeO < MgO < CaO < SrO < BaO), ionic character, melting point, boiling point, thermal sta bility reactivity and solubility in water of these oxides increases from Be to Ba, BeO shows amphoteric nature and therefore, react with acids as well as bases. MgO is a weak base, while CaO, SrO and BaO are strongly basic.

(iii) Hydroxides :

Ionic character, melting point, boiling point, reactivity, thermal stability and solubility in water increases from Be to Ba. Increasing order of basic character of these hydroxides is as follows :

$Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$

$Be(OH)_2$ reacts with acids as well as base, due to their amphoteric nature. Other hydroxides react with acids only.

(iv) Halides / Chlorides :

(1) All these metals react with halogens to form MX_2 type halides ($BeCl_2$, $MgCl_2$, $CaCl_2$, $SrCl_2$, $BaCl_2$)

(2) Ba turns on coming on contact with chlorine.

(3) Covalent character of these halides decreases from $BeCl_2$ to $BaCl_2$. Therefore, the amount of hydrolysis also decreases from $BeCl_2$ to $BaCl_2$. Only $BeCl_2$ and $MgCl_2$ get hydrolysed due to their covalent nature .Other halides do not get hydrolysed.

Hydrolysis is as follows :

$BeCl_2 > MgCl_2 > CaCl_2 > SrCl_2 > BaCl_2$

(v) Metal carbonates

(1) All these metals from M_2CO_3 type carbonates. (Li_2CO_3, Na_2CO_3, K_2CO_3, Rb_2CO_3, Cs_2CO_3)

(2) Li_2CO_3 is least stable out of all these carbonates, because it is covalent and decomposes to Li_2O and CO_2 at low temperature. Order of their stability is as follows :

$Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$

(3) Stability of carbonates of IA group metals > stability of carbonates of IIA group metals.

(vi) Nitrides :

Among all alkali metals, only lithium directly combines with nitrogen to form nitride. Other alkali meta ls combine indirectly with nitrogen, because Li_3N is covalent and as the metallic character increases, the tendency of donating electron and forming ionic bond increases. Due to which strength of metal nitrogen bond decreases

(vii) Sulphates :

Li_2SO_4 , $Na_2SO_4 < K_2SO_4 < RbSO_3 < Cs_2SO_4$

(viii) Nitrates :

$LiNO_3$ decomposes to Li_2O at low temperature, whereas $NaNO_3$ gets decomposed to $NaNO_2$

(ix) Hydrides :

(1) Lithium reacts with hydrogen.

(2) Thermal stability of LiH is high.

$LiH > NaH > KH > RbH > CsH$

They are ionic hydrides and their stabilty depends on lattice energy.

(x) Reaction with dilute acids :

Due to alkaline nature, these metals react rapidly with dilute acids and the rate of reaction increases from Li to Cs, because of inrease in basic character.

(xi) Bicarbonates :

These metals from $MHCO_3$ type bicarbonates thermal stability of these bicarbonates increase from Li to Cs.

(xii) Formation of Amalgams :

Alkali metals form amalgams with mercury and alloys with other metals.

(v) Metal carbonates :

(1) All these metals form MCO_3 type carbonates ($BeCO_3$, $MgCO_3$, $CaCO_3$, $SrCO_3$, $BaCO_3$)

(2) $BeCO_3$ is least stable out of all these carbonates because it is covalent and decomposes to BeO and CO_2 at low temperature. Order of their stability is as follows.

$BeCO_3 < MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

(3) Stability of Carbonates of IIA group metals < stability of carbonates of IA group metals.

(vi) Nitrides :

Only Be and Mg (and to some extent Ca) burn in N_2 to form nitrides (M_3N_2), which decomposes to give NH_3.

$3Mg + N_2 \rightarrow Mg_3N_2$

$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$

(vii) Sulphates :

Solubility of Sulphates : Their hydration energy is high due to small size of Be^{+2} and Mg^{+2} and it overcomes the lattice energy. This is the reason why

$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

Increasing order of thermal stability

$BeSO_4 < MgSO_4 < CaSO_4 < SrSO_4 < BaSO_4$

(viii) Nitrates :

These metals also form $M(NO_3)_2$ and allnitrates give oxides on decomposition.

(ix) Hydrides :

(1) These metals (except Be) combine with hydrogen to form MH_2 type hydrides. Thermal stability of these hydrides is as follows.

$BeH_2 < MgH_2 > CaH_2 > SrH_2 > BaH_2$

BeH_2 and MgH_2 get polymerized.

Thermal stability of BeH_2 is high due to low electropositive character of Be, which decreases from BeH_2 to BaH_2.

(x) Reaction with dilute acids :

Beryllium is amphoteric, so it reacts slowly with dilute acids. Other metals are alkaline and therefore react rapidly with dilute acids.

(xi) Bicarbonates :

These metals form $M(HCO_3)_2$ type bicarbonates.The thermal stability of bicarbonates increases from Be to Ba.

(xii) Formation of Amalgams :

These metals form alloys with other metals and amlagams with mercury.

BEHAVIOUR OF LITHIUM DIFFERENT FROM OTHER ALKALI METALS

Due to small size of Li, it has high tendency of polarization and due to high density of electrical charge. It shows difference with other alkali metals.

(1) Li is hard, due to which its melting and boiling points are higher as compared to other metals.

(2) LiOH is weak base compared to other hydroxides.

(3) Li forms single type of oxide (Li_2O), whereas, Na(M_2O and M_2O_2), K, Rb and Cs (M_2O, M_2O_2 and MO_2) form more type of oxides.

(4) LiCl is insoluble in water, whereas, other chlorides are soluble, LiCl gets dissolved in benzene, petrol and ether.

(5) Due to small size of Li^{+1} , its hydration energy is high.

(6) Li does not get affected easily by moist air. Therefore, it can be kept open in the air, whereas, other metals form oxides.

(7) Due to high hydration energy of Li, its conductivity is low.

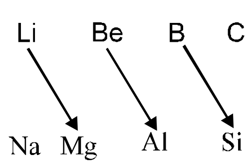
(8) Li directly combines with N_2 to form Li_3N whereas, other metals do not form nitrides.

(9) Phosphate, oxalate, chloride, fluoride, sulphate and carbonate of Li are insoluble in water, whereas the above compounds of other alkali metals are soluble.

(10) Due to small size of Li, its ionisation potential electronegativity and electron affinity are higher than those of the other alkali metals.

(11) Due to covalent nature of LiCl, their melting and boiling points are lower than those of other alkali metal halides.

DIAGONAL RELATIONSHIP BETWEEN LITHIUM AND MAGNESIUM :



Due to this relationship, there will be similarities in the following properties.

(1) Li and Mg both are hard matals due to the presence of strong metallic bonds in them.

(2) Li and Mg both are hard, therefore, their melting and boiling points are high.

(3) LiOH and $Mg(OH)_2$ both are weak bases.

(4) LiCl and $MgCl_2$ are insoluble in water due to their covalent nature, but soluble in organic solvents.

(5) LiCl and $MgCl_2$ get hydrolysed due to their covalent nature.

(6) Li and Mg directly combine with O_2 to form normal oxides (Li_2O and MgO)

(7) Li_2SO_4 and $MgSO_4$ show isomorphism.

(8) Li and Mg directly combine with N_2 to form Li_3N and Mg_3N_2

(9) Carbonates and nitrates of Li and Mg are unstable and readily decompose to form oxides.

(10) Hydration energies of Li^{+1} and Mg^{+2} ions are higher due to small size.

(11) Chlorides of Li and Mg remain in the form of LiCl. $2H_2O$ and $MgCl_2.6H_2O$.

(13) Li and Mg form complex compounds due to their small size.

BEHAVIOUR OF BERYLLIUM DIFFERENT FROM OTHER ALKALINE EARTH METALS :

Beryllium exhibits different behaviour due to small size as compared to other elements of its group.

(1) Ionisation potential and electronegativity of Be are higher than those of other metals.

(2) $BeCl_2$ is insoluble in water, due to its covalent nature, but soluble in organic solvents. Other chlorides ($CaCl_2$, $SrCl_2$ and $BaCl_2$) get dissolved in water.

(3) $BeCl_2$ gets hydrolysed due to its covalent nature. Chlorides of Ca, Sr and Ba get dissociated.

(4) BeO and $Be(OH)_2$ are amphoteric in nature. Therefore they react with acids as well as bases. Other oxides react only with acids due to their alkaline nature.

$BeO + 2NaOH \rightarrow Na_2BeO_2 + H_2O$
Sodium berylate

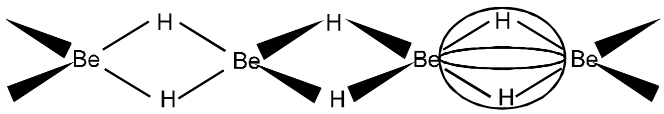
$BeO + 2HCl \rightarrow BeCl_2 + H_2O$

(5) Beryllium forms single type of oxide (MO), Ca Sr and Ba form peroxides also.

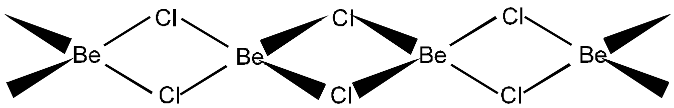
(7) Beryllium does not give flame test, Ca, Sr and Ba impart characteriestic colours to the flame.

(8) Due to small size, Be forms complex compounds.

(9) Hydrides and halides of Be get polymerized.



Plymerized BeH_2 in which tricentric forces are present.



Polymerized $BeCl_2$

(10) Berylium does not react with water even at high temperatures. Others (Ca, Sr and Ba) react even with cold water.

DIAGONAL RELATIONSHIP BETWEEN BE AND AL -

Berylium shows difference from IIA group elements, but it shows similarity with Al.

(1) Be and Al both are hard due to strong metallic bonds. Therefore, their melting and boiling points are high.

(2) $BeCl_2$ and $AlCl_3$ both are covalent compounds. Therefore, they are insoluble in water and soluble in organic solvents.

(3) Both get hydrolysed due to their covalent tendency.

(4) Melting points of $BeCl_2$ and $AlCl_3$ are low due to their covalent tendency.

(5) Be and Al both have tendency of forming complex compounds due to small size.

(6) Be and Aluminium form similar type of normal oxides (BeO and Al_2O_3)

(7) $Be(OH)_2$.$Al(OH)_3$,, BeO and Al_2O_3 are amphoteric in nature.

$BeO + 2HCl \rightarrow BeCl_2 + H_2O$

$Al_2O_3 + 2HCl \rightarrow 2AlCl_3 + 3H_2O$

$Al_2O_3 + NaOH \rightarrow 2NaAlO_2 + H_2O$
Sodium metaaluminate

$BeO + 2NaOH \rightarrow Na_2BeO_2 + H_2O$
Sodium berylate

(8) $BeCl_2$ and $AlCl_3$ from dimers, because both are electron deficient compounds.

(9) Be and Al both become inert in conc. HNO_3, because both form a protective layer of oxides.

(10) Be and Al both react directly with C to form Be_2C and Al_4C_3, respectively, which give methane on reaction with water.

$Be_2C + 2H_2O \rightarrow CH_4 + 2BeO$

$Al_4C_3 + 12H_2O \rightarrow 3CH_4 + 4Al(OH)_3$