The s-Block Elements & The p-Block Elements

1. Find A, B and C in the following reactions $NH_3 + A + CO_2 \rightarrow (NH_4)CO_3$
$(NH_4)_2CO_3 + B \rightarrow CaCO_3 \downarrow + 2NH_4Cl$
$NH_4HCO_3 + NaCl \rightarrow NH_4Cl + C$

   A. $A - H_2O\ ; B - CaCl_2\ ;\ C - NaHCO_3$

   B. $A - H_2O\ ; B - O_2\ ;\ C - Na_2CO_3$

   C. $A - H_2O\ ; B - O_2\ ;\ C - NaHCO_3$

   D. $A - O_2\ ; B - CO_2\ ;\ C - Na_2CO_3$

   The raw materials used in solvay's process are:
   $NaCl, NH_3$, and $CaCO_3$
   The following reaction is solvay's process took place:
   $2NH_3 + CO_2 + H_2O \rightarrow (NH_4)_2CO_3$

   $(NH_4)_2CO_3 + CaCl_2 \rightarrow CaCO_3 \downarrow + 2NH_4Cl$

   $NH_3 + CO_2 + H_2O \rightarrow NH_4HCO_3$

   $NH_4HCO_3 + NaCl \xrightarrow{30^oC} NaHCO_3 + NH_4Cl$
   Calcination to get sodium carbonate
   $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

   A = H_2O
   B = CO_2
   C = $NaHCO_3$

The s-Block Elements & The p-Block Elements

2. Given below are two statements:
Statement I ; Both $CaCl_2 \cdot 6H_2O$ and $MgCl_2 \cdot 8H_2O$ undergo dehydration on heating.

Statement II : BeO is amphoteric whereas the oxides of other elements in the same group are acidic.

In the light of the above statements, choose the correct answer fromm the options given below.

A. Statement I is false but statement II is true

B. Both statement I annd statement II are true

C. Both statement I and statement II are false

D. Statement I is true but statement II is false

$CaCl_2 \cdot 6H_2O$ undergoes dehydration on heating but $MgCl_2 \cdot 8H_2O$ undergoes hydrolysis on heating.

BeO is amphoteric and other metal oxides of II A group are basic in nature.
Thus, both Both statement I and statement II are false

3. The correct order of conductivity of ions in water is

A. $Na^+ > K^+ > Rb^+ > Cs^+$

B. $Rb^+ > Na^+ > K^+ > Li^+$

C. $Cs^+ > Rb^+ > K^+ > Na^+$

D. $K^+ > Na^+ > Cs^+ > Rb^+$

The alkali metal ions in aqueous solution get hydrated. The extent of hydration of an ion is directly proportional to its charge density. The size of hydrated metal is decreases down the group and hence their mobility increases or their conductivity increases. Thus The correct order of conductivity of ions in water is $Cs^+ > Rb^+ > K^+ > Na^+$

The s-Block Elements & The p-Block Elements

4. One of the by-products formed during the recovery of NH_3 from solvay process is

- **A.** $CaCl_2$
- **B.** $Ca(OH)_2$
- **C.** $NaHCO_3$
- **D.** NH_4Cl

Solvay (ammonia soda) process is used for the manufacture of washing soda (Na_2CO_3).

Recovery of NH_3:$2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + CaCl_2 + H_2O$
By product : $CaCl_2$

The s-Block Elements & The p-Block Elements

5. Match List -I with List-II.

List I	List II
$(a)\ Ca(OCl)_2$	(i) Antacid
$(b)\ CaSO_4 \cdot \frac{1}{2}H_2O$	(ii) Cement
$(c)\ CaO$	(iii) Bleaching powder
$(d)\ CaCO_3$	(iv) Plaster of paris

Choose the most appropriate answer from the option given below.

A. (a) - (iii), (b) - (ii), (c)c - (i), (d) - (iv)

B. (a) - (iii), (b) - (ii), (c) - (iv), (d) - (i)

C. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

D. (a) - (i), (b) - (iv), (c) - (iiii), (d) - (ii)

$CaSO_4 \cdot \frac{1}{2}H_2O$ - Plaster of Paris

$Ca(OCl)_2$ - Bleaching agent

CaO is used in cement.

$CaCO_3$ is used as an Antacid.

The s-Block Elements & The p-Block Elements

6. A s-block element (M) reacts with oxygen to form an oxide of the formula MO_2. The oxide is pale yellow in colour and paramagnetic. The element (M) is

- **A.** K
- **B.** Na
- **C.** Mg
- **D.** Ca

Reactivity towards air:
Alkali metals tarnish in dry air due to the formation of their oxides which in turn react with moisture
to form hydroxides.
They burn vigorously in oxygen forming oxides:
Lithium monoxide
$4Li + O_2 \longrightarrow 2Li_2O$
Sodium peroxide
$2Na + O_2 \longrightarrow Na_2O_2$
Other superoxide:
$M + O_2 \longrightarrow MO_2$
Where M = K, Rb, Cs
The superoxide O_2^- ion is stable only in the presence of larger cations such as K, Rb, Cs.

Be and Mg are inert to oxygen due to the formation of an oxide film on their surface.
Calcium, strontium and barium are readily attacked by air to form oxides and nitrides.

The s-Block Elements & The p-Block Elements

7. Match List-I with List-II :

List-I	List-II
Elements	Properties
(a) Li	(i) Poor water solubility of I^-
(b) Na	(ii) Most abundant element in cell fluid
(c) K	(iii) Bicarbonate salt used in fire extinguisher
(d) Cs	(iv) Carbonate salt decomoses easily on heating

Choose the correct answer from the options given below :

A. (a) - (i), (b) - (iii), (c) - (ii), (d) - (iv)

B. (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

C. (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

D. (a) - (iv), (b) - (ii), (c) - (iii), (d) - (i)

Among alkali and their componds Li_2CO_3 is thermally least stable and decomposes easily on heating.

$NaHCO_3$ is used as fire extinguisher.

K is most abundant element in cell fluid,

CsI is a covalent compond and has poor water solubility.

$\therefore$ correct answer is (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

8. Given below are two statements : One is labelled as $Assertion\ A$ and the other is labelled as $Reason\ R$.

$Assertion\ A$: Lithium halides are some what covalent in nature.

$Reason\ R$: Lithium possess high polarisation capability.

In the light of the above statements, choose the most appropriate answer from the options given below

A. A is false but R is true

B. Both A and R true but R is NOT the correct explanation of A

C. A is true but R is false

D. Both A and R are true and R is the correct explanation of A

In alkali series going down the group, the size of the ion increases and the electropositive character increases which makes it more ionic in nature.
According to Fajan's rule, due to smaller size of lithium, it has high polarising power which makes LiCl more covalent in nature.
All alkali metals are soft and they can be easily cut through a knife except Li. Li is hard due to its anomalous behaviour. This is due to its exceptional smaller size and higher polarising power.

The s-Block Elements & The p-Block Elements

9. The set of elements that differ in diagonal relationship from those of the other sets is

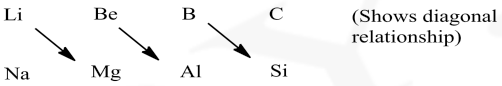
A. B - Si

B. Li - Na

C. Be - Al

D. Li - Mg

Due to similar size of Li and Mg they show similar properties.
The ionic radius of Be^{2+} is estimated to be 31 pm; the charge/radius ratio is nearly the same as that of the Al^{3+} ion. Hence beryllium resembles aluminium in some ways.
Due to its small size and similar charge/mass ratio, boron varies from other group 13 members, but it resembles to the silicon, the second element of the group 14 to exhibit diagonal relationship.



Li - Na belong to same group

The s-Block Elements & The p-Block Elements

10. Match List-I with List -II :

List-I	List-II
(a)Li	(i) Photoelectric cell
(b) Na	(ii) Absorbent of CO_2
(c)K	(iii) Coolant in fast breeder nuclear reactor
(d)Cs	(iv) Treatment of cancer
	(v) Bearings for motor engines

Choose the correct answer from the options given below :

A. (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

B. (a)-(v), (b)-(iii), (c)-(ii), (d)-(i)

C. (a)-(v), (b)-(i), (c)-(ii), (d)-(iv)

D. (a)-(v), (b)-(ii), (c)-(iv), (d)-(i)

Li - bearing for motor engines; (a)-(v)
Na - coolant in fast breeder reactor; (b)-(iii)
K - absorbent of CO_2; (a)-(ii)
Cs - Photoelectric cell; (d)-(i)

The s-Block Elements & The p-Block Elements

11. Given below are two statements :

Statement I : None of the alkaline earth metal hydroxides dissolve in alkali.

Statement II : Solubility of alkaline earth metal hydroxides in water increases down the group.

In the light of the above statements, choose the most appropriate answer from the options given below.

A. Statement I and Statement II both are correct

B. Statement I and Statement II both are incorrect

C. Statement I is incorrect but Statement II is correct

D. Statement I is correct but Statement II is incorrect

- $Be(OH)_2$ is amphoteric in nature hence it dissolves in both acid and alkali.
- Solubility of alkaline earth metal hydroxide in water increases down the group due to rapid decreases in lattice energy as compared to hydration energy.

Hence, option (c) is correct

The s-Block Elements & The p-Block Elements

12. Match List -I with List -II:

	List -I		List -II
(a)	Be	(i)	treatment of cancer
(b)	Mg	(ii)	extraction of metals
(c)	Ca	(iii)	incendiary bombs and signals
(d)	Ra	(iv)	windows of X-ray tubes
		(v)	bearing for motor engines

Choose the most approapriate answer from the option given below.

A. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (v)

B. (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

C. (a) - (iii), (b) - (iv), (c) - (v), (d) - (ii)

D. (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

Be - used in making windows of X-rays tube
Mg- incendiary bombs and signals
Ca- extraction of metals
Ra- treatment of cancer

The s-Block Elements & The p-Block Elements

13. Match List -I and List -II

	List - I (Elements)		List - II (Properites)
(a)	Ba	(i)	Organic solvent soluble compounds
(b)	Ca	(ii)	Outer electronic configuration$6s^2$
(c)	Li	(iii)	Oxalate insoluble in water
(d)	Na	(iv)	Formation of very strong monoacidic base

Choose the correct answer from the options given below:

A. (a) - (iii), (b) - (ii), (c) -(iv)and(d) -(i)

B. (a) - (ii), (b) - (iii), (c) -(i)and(d) -(iv)

C. (a) - (i), (b) - (iv), (c) -(ii)and(d) -(iii)

D. (a) - (iv), (b) - (i), (c) -(ii)and(d) -(iii)

Ba - $[Xe]6s^2$
Ca - Calcium oxalate is insoluble (sparingly soluble) in water.
Li - $LiCl$ is soluble in organic solvents like pyridine.
Na- $NaOH$ is a very strong monoacidic base.

The s-Block Elements & The p-Block Elements

14. Water does not produce CO on reacting with:

- ✗ **A.** C
- ✗ **B.** CH_4
- ✓ **C.** CO_2
- ✗ **D.** C_3H_8

$H_2O + CO_2 \longrightarrow H_2CO_3$

all other will produce CO on reaction with water.

$C_nH_{2n+2} + nH_2O \xrightarrow[Ni]{1270\ K} nCO + (2n+1)H_2$

$CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270\ K} CO(g) + 3H_2(g)$

$C(s) + H_2O(g) \overset{1270\ K}{\longrightarrow} CO(g) + H_2(g)$

15. The correct order of bond dissociation enthalpy of halogens is:

- ✓ **A.** $Cl_2 > Br_2 > F_2 > I_2$
- ✗ **B.** $F_2 > Cl_2 > Br_2 > I_2$
- ✗ **C.** $Cl_2 > F_2 > Br_2 > I_2$
- ✗ **D.** $I_2 > Br_2 > Cl_2 > F_2$

$Cl_2 > Br_2 > F_2 > I_2$

Bond dissociation enthalpy of F_2 is lower than Cl_2 and Br_2. F_2 has $F-F$, F_2 involves repulsion of non-bonding electrons & moreover its size is small and hence due to high repulsion its bond dissociation energy is very low.

The s-Block Elements & The p-Block Elements

16. The incorrect statement regarding the structure of C_{60} is

- ✔ **A.** It contains 12 six-membered rings and 24 five-membered rings
- ✘ **B.** The six-membered rings are fused to both six and five-membered rings
- ✘ **C.** Each carbon atom forms three sigma bonds
- ✘ **D.** The five-membered rings are fused only to six-membered rings

C_{60} contains twenty six-membered rings and twelve five-membered rings.

C_{60} (fullerene) looks like a soccer ball and contains 20 six membered rings and 12 five membered rings of carbon atoms.

Six membered rings are fused with both six membered as well as five membered rings while five membered rings are attached only with six membered rings.

17. Given below are the statements about diborane.

(a) Diborane is prepared by the oxidation of $NaBH_4$ with I_2.

(b) Each boron atom is in sp^2 hybridized state.

(c) Diborane has one bridged 3 centre-2-electron bond.

(d) Diborane is a planar molecule.

The option with correct statement(s) is :

- ✘ **A.** (c) only
- ✘ **B.** (a) and (b) only
- ✘ **C.** (c) and (d) only
- ✔ **D.** (a) only

$2NaBH_4 + I_2 \longrightarrow B_2H_6 + 2NaI + H_2$

In B_2H_6, B atoms are sp^3 hybridised
B_2H_6 has two bridged $3c - 2e$ bonds
B_2H_6 is non planar

The s-Block Elements & The p-Block Elements

18. Which one of the following compounds of Groups-14 elements is not known?

A. $[GeCl_6]^{2-}$

B. $[SiF_6]^{2-}$

C. $[Sn(OH)_6]^{2-}$

D. $[SiCl_6]^{2-}$

$[SiCl_6]^{2-}$ is not known. The main reasons are :
(i) six large chloride ions cannot be accommodated around Si^{4+} due to limitation of its size
(ii) Interaction between lone lone pair of chloride ion and Si^{4+} is not very strong.

19. Match List-I with List-II

List-I	List-II
(a) $NaOH$	(i) Acidic
(b) $Be(OH)_2$	(ii)Basic
(c)$Ca(OH)_2$	(iii) Amphoteric
(d) $B(OH)_3$	
(e) $Al(OH)_3$	

Choose the most appropriate answer from the options given below :

A. (a)-(ii), (b)-(ii), (c)-(iii), (d)-(i), (e)-(iii)

B. (a)-(ii), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(iii)

C. (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(iii)

D. (a)-(ii), (b)-(iii), (c)-(ii), (d)-(i), (e)-(iii)

$NaOH$- Basic
$Ca(OH)_2$- Basic
$Be(OH)_2$ - Amphoteric
$Al(OH)_3$- Amphoteric
$B(OH)_3$- Acidic
Option (d) is correct

20. In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected?

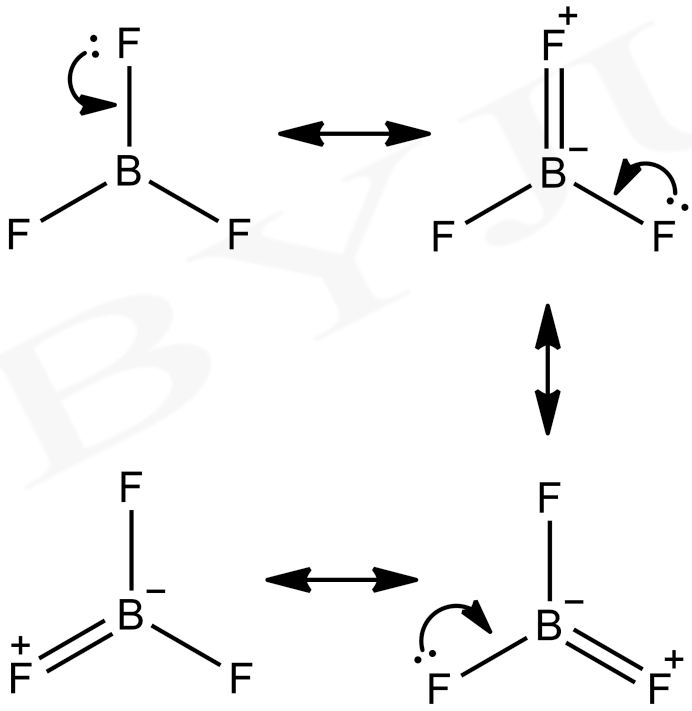
A. BBr_3

B. BCl_3

C. BI_3

D. BF_3

Among the given boron trihalides, the extent of back donation is maximum in BF_3 due to smaller size of $F-$atom.



The s-Block Elements & The p-Block Elements

21. Arrange the following bonds according to their average bond energies in descending order:
$C-Cl, C-Br, C-F, C-I$

✗ **A.** $C-Cl > C-Br > C-I > C-F$

✗ **B.** $C-Br > C-I > C-Cl > C-F$

✗ **C.** $C-I > -Br > C-Cl > C-F$

✓ **D.** $C-F > C-Cl > C-Br > C-I$

In $C-F$ there is $2p-2p$ overlapping involved, in $C-Cl$ the overlapping involved is $2p-3p$ whereas for $C-Br$ and $C-I$ the overlapping involved are $2p-4p$ and $2p-5p$ respectively. The bond length for the various type of overlapping can be given as;
$2p-2p < 2p-3p < 2p-4p < 2p-5p$

As we know that $\text{Bond energy} \propto \frac{1}{\text{Bond Length}}$

The order of bond energy is:
$C-F > C-Cl > C-Br > C-I$

22. The reaction of $H_3N_3B_3Cl_3(A)$ with $LiBH_4$ in tetrahydrofurah gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $H_3N_3B_3(Me)_3$. Compounds (B) and (C) respectively, are:

✗ **A.** Boron nitride and $MeBr$

✓ **B.** Borazine and $MeMgBr$

✗ **C.** Borazine and $MeBr$

✗ **D.** Diborane and $MeMgBr$

$$\underset{(A)}{B_3N_3H_3Cl3} + LiBH_4 \rightarrow \underset{B}{B_3N_3H_6} + LCI + BCI_3$$

$$\underset{A}{B_3N_3H_3Cl_3} + 3\underset{C}{MeMgBr} \rightarrow B_3N_3H_3\,(CH_3)_3 + 3MgBrCl$$

So, B is borazine and C is CH_3MgBr

The s-Block Elements & The p-Block Elements

23. The correct statements among I to III regarding group 13 elements oxide are:
(I) Boron trioxide is acidic
(II) Oxides of aluminium and gallium are amphoteric
(III) Oxides of indium and thallium are basic.

- ✔ **A.** (I), (II) and (III)
- ✘ **B.** (II) and (III) only
- ✘ **C.** (I) and (III) only
- ✘ **D.** (I) and (II) only

All statements are correct.

$B_2O_3 \rightarrow acidic$

Al_2O_3 and Ga_2O_3 are amphoteric oxides.

In and Tl oxides are basic in nature.

As we go down the group non-metallic character decreases and metallic character increases.

24. Diborane(B_2H_6) reacts independently withO_2 and H_2O to produce:

- ✘ **A.** $HBO_2 \; and \; H_3BO_3$
- ✘ **B.** $H_3BO_3 \; and \; B_2O_3$
- ✔ **C.** $B_2O_3 \; and \; H_3BO_3$
- ✘ **D.** $B_2O_3 \; and \; [BH_4]^-$

The reactions are:

$B_2H_6 + H_2O \rightarrow 2H_3BO_3 + 3H_2$

$B_2H_6 + 3O_2 \rightarrow B_2O_3 + 3H_2O$

Correct option is (c)

The s-Block Elements & The p-Block Elements

25. The hydride that is not electron deficent is:

- **A.** B_2H_6
- **B.** AlH_3
- **C.** SiH_4
- **D.** GaH_3

(1) B_2H_6 : Electron deficient

(2)AlH_3 : Electron deficient

(3)SiH_4 : Electron precise as it has octet configuration in Si

(4)GaH_3 : Electron deficient

Correct option is (c)

26. The relative stability of +1 oxidation state of group 13 element follows the order :

- **A.** $Al < Ga < Tl < In$
- **B.** $Tl < In < Ga < Al$
- **C.** $Al < Ga < In < Tl$
- **D.** $Ga < Al < In < Tl$

Due to the inert pair effect as we move down the group in 13^{th} group lower oxidation state become more stable.

So, the correct order is:
$Al < Ga < In < Tl$

The s-Block Elements & The p-Block Elements

27. The electronegativity of aluminium is similar to :

A. Boron

B. Carbon

C. Lithium

D. Beryllium

In the second and third period of the periodic table, there are certain pairs of diagonally adjacent elements that show diagonal relationship. These pairs of diagonally adjacent elements, shows some similarity in the properties. The extent of these similarities in the properties is much lower than the similarities within a group. These similarities in the properties of diagonally adjacent elements are due to the similar polarizing power, similar ionic charge to size ratio of diagonally adjacent elements.
Second period metals that are present in groups 1, 2 and 13, show diagonal relationship. Lithium shows diagonal relationship with magnesium. Beryllium shows diagonal relationship with aluminium. Boron shows a diagonal relationship with silicon.
Aluminium is the diagonally opposite element of beryllium. Beryllium and aluminium have similar atomic sizes. They have a similar charge to size ratio. Hence, Beryllium and aluminium have similar properties as they show diagonal relationship.
The electronegativity of aluminium is 1.5. The electronegativity of beryllium is 1.5.
The electronegativity of aluminium is similar to the electronegativity of beryllium.
Hence, the correct option is the option (d) Beryllium.

The s-Block Elements & The p-Block Elements

28. The set in which componds have different nature is :

A. $B(OH)_3$ and H_3PO_3

B. $B(OH)_3$ and $Al(OH)_3$

C. $Be(OH)_2$ and $Al(OH)_3$

D. $NaOH$ and $Ca(OH)_2$

$B(OH)_3$ - Acidic
H_3PO_3 - Acidic
$Be(OH)_2$ - Amphoteric
$Al(OH)_3$ - Amphoteric
$NaOH$- Basic
$Ca(OH)_2$- Basic

Option (b) contains acidic and amphoteric species

29. Number of amphoteric compounds among the following is _____.

BeO
BaO
$Be(OH)_2$
$Sr(OH)_2$

Accepted Answers

2 2.0 2.00

Solution:

BeO - Amphoteric oxide
BaO - Basic oxide
$Be(OH)_2$ - Amphoteric hydroxide
$Sr(OH)_2$ - Basic hydroxide

The s-Block Elements & The p-Block Elements

30. Among the following, number of metal/s which can be used as electrodes in the photoelectric cell is _____ (Integer answer)

Li
Na
Rb
Cs

Accepted Answers

1 1.0 1.00

Solution:

Among the given alkali metals, only cesium (Cs) is used as electrode in the photoelectric cell due to its lowest ionisation energy.