

Group-13 Elements: Boron Family

SINGLE CORRECT CHOICE TYPE QUESTIONS

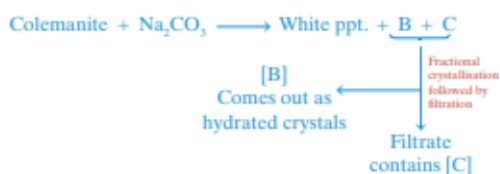
- The highest and the lowest melting point of elements in Group 13, are of respectively
(A) B, Al (B) Tl, B (C) B, Ga (D) B, Tl
- The electropositive character is the maximum for which of the following elements in Group 13?
(A) Al (B) Tl (C) B (D) In
- Boric acid cannot be titrated with NaOH satisfactorily because it is a weak acid. But on addition of diols it behaves as a strong acid. However, on addition of which of the following diols, the titration with NaOH is still not satisfactory on using phenolphthalein as indicator?
(A) Glycerol (B) Mannitol
(C) Sorbitol (D) Ethylene glycol
- The sum of first three ionization energies is the highest for which of the following elements?
(A) Tl (B) Al (C) Ga (D) B
- The first ionization energy for which of the following elements is the highest?
(A) Tl (B) Ga (C) Al (D) In
- Which of the following processes helps to react Al with cold water readily to evolve H_2 ?
(A) Amalgamating with Hg
(B) Galvanizing with Zn
(C) Anodizing with dil. H_2SO_4
(D) None of these.
- Among the Group 13 elements, which of the following burns in N_2 at high temperature forming compound MN?
(A) In (B) Al (C) Ga (D) Tl
- For the construction of a bridge over the connecting channels of the sea, which kind of cement is recommended?
(A) Portland cement
(B) Slag cement
(C) High alumina cement
(D) All of these

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

- Which of the following substances expand when they form a solid from liquid state?
(A) H_2O (B) Ga (C) Ge (D) Bi
- Diborane can be prepared by which of the following methods?
(A) $Mg_3B_2 + H_3PO_4 \xrightarrow{\text{heating}}$
(B) $BX_3 + LiAlH_4 \xrightarrow[\text{X = F, Cl, Br}]{\text{ether}}$
(C) $BF_3(g) + NaH \xrightarrow{180^\circ}$
(D) $NaBH_4 + I_2 \xrightarrow[\text{solution}]{\text{in diglyme}}$
- Limited $LiH + AlCl_3 \longrightarrow P$ Which of the following statements is/are correct regarding P?
(A) It is an electron deficient molecule.
(B) It is a non-volatile solid
(C) It acts as a strong reducing agent.
(D) There are 3c-2e bonds in P.
- The most common trivalent cations forming alum is/are
(A) Fe^{3+} (B) Cr^{3+} (C) Al^{3+} (D) Ce^{3+}
- In which of the following reactions, B_2O_3 acts as a basic oxide?
(A) $CaO + B_2O_3 \rightarrow Ca(BO_2)_2$
(B) $P_2O_5 + B_2O_3 \rightarrow 2BPO_4$
(C) $As_2O_5 + B_2O_3 \rightarrow 2BAsO_4$
(D) $CuO + B_2O_3 \rightarrow Cu(BO_2)_2$
- CO_2 is passed through sodium metaborate solution. The state(s) of hybridization of B in the product is/are
(A) sp^2 (B) sp^3d (C) sp^3 (D) dsp^2
- Which of the following compounds can make boric acid solution strongly acidic when added to the solution of boric acid?
(A) Ethylene glycol
(B) Glycerol
(C) Salicylic acid
(D) Mannitol

COMPREHENSION TYPE QUESTIONS

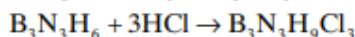
Passage 1: For Questions 1 – 2



- The white precipitate is of
(A) $\text{Ca}(\text{HCO}_3)_2$
(B) CaCO_3
(C) Borax
(D) NaBO_2
- On passing _____ gas, compound C converts into B again. The gas is
(A) H_2 (B) CO_2 (C) CO (D) N_2

Passage 2: For Questions 3 – 4

Borazine is more reactive than benzene and addition reactions occur quite readily but hydrolysis occurs slowly.



- Which of the following statements is incorrect?
(A) Maximum number of atoms present in one plane for borazine is 12.
(B) The protonation occurs on B-atom in the above reaction with HCl.
(C) The product may exist either in the chair or boat form.
(D) None of these.
- Which of the product(s) is/are formed during the hydrolysis of $\text{B}_3\text{N}_3\text{H}_6$?
(A) $\text{B}(\text{OH})_3$
(B) NH_3
(C) H_2
(D) All of these

Passage 3: For Questions 5 – 7

Cement is made by heating the mixture of limestone, sand and clay at a temperature of $1450\text{--}1600^\circ\text{C}$ in a rotary kiln. The gypsum is also added between 2–5%.

- The purpose of addition of gypsum into the cement is
(A) to slow down the setting process.
(B) to fasten the setting process.
(C) to increase its strength.
(D) Both (A) and (C).
- The highest percentage of which compound is present in Portland cement?
(A) CaO (B) Al_2O_3
(C) SiO_2 (D) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- Which of the following is/are the properties of high alumina cement?
(A) It has good sea-water resistance
(B) It can withstand very high temperature
(C) It has good resistance towards dilute mineral acid
(D) All of these.

ASSERTION-REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:

- If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
- If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.
- If Statement I is true but Statement II is false.
- If Statement I is false and Statement II is true.

- Statement I:** In alum, M^+ cannot be Li^+ .

Statement II: Li^+ has the smallest size among alkali metal ions.

- Statement I:** Borax solution is acidic in nature.

Statement II: Borax solution acts as a buffer solution also.

- Statement I:** Borazon (cubic boron nitride) is hard while inorganic graphite is slippery in nature.

Statement II: Both have two dimensional-layer structure.

- Statement I:** Aluminium is amphoteric in nature.

Statement II: Aluminium dissolves in dil. HCl as well as in aqueous solution of NaOH evolving H_2 .

- Statement I:** Alum may be used as an antiseptic.

Statement II: Coagulation of colloidal particles in blood is caused by ions present in alum.

INTEGER ANSWER TYPE QUESTIONS

The answer to each of the following questions is a non-negative integer.

1. How many compounds given below are correctly matched with their uses?

- (i) Borax solution : Buffer
 (ii) AlCl_3 : Friedel-Crafts reaction
 (iii) Al_2O_3 : Abrasive powder
 (iv) $\text{Al}(\text{OH})_3$: High alumina cement
 (v) $\text{B}(\text{OH})_3$: Manufacture of optical glasses
 (vi) NaBH_4 : Reducing agent

2. Find the number of H_2 molecules formed from the hydrolysis of one molecule of diborane.

8. When one mole of ammonium alum is heated, the number of moles of gaseous product is _____.

9. The number of bridge (3c-2e) bonds present in $\text{Al}(\text{BH}_4)_3$ is _____.

3. Find the number of compounds from the following with which diborane cleaves unsymmetrically forming $[\text{L}_2\text{H}_2\text{B}]^+ [\text{BH}_4]^-$ type of complex.

NH_3 , Et_3N , Et_2NH , EtNH_2 , CO , tetrahydrofuran

4. The maximum number of boron atoms that lie in one plane for the anionic part of borax is _____.

5. The number of sp^3 hybridized atoms in sodium peroxoborate is _____.

6. The number of H_2O molecules required for complete hydrolysis of one molecule of borazine is _____.

7. The number of sp^3 hybridized orbitals in one molecule of borax is _____.

10. The tricalcium aluminate is better written as $\text{Ca}_3[\text{Al}_6\text{O}_{18}]$. The anionic part has very similar structure of beryl's anion. The number of Al-O-Al linkage in this structure is _____.

MATRIX-MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labelled as (A), (B), (C) and (D), while those in Column II are labelled as (P), (Q), (R), (S) and (T). Any given statement in Column I can have correct matching with one or more statements in Column II.

1. Match the compounds with similar skeleton structure.

Column I	Column II
(A) Borazole	(P) Al_2Br_6
(B) Boron nitride	(Q) Cyclohexane
(C) $\text{B}_3\text{N}_3\text{H}_9\text{Cl}_3$	(R) Benzene
(D) Diborane	(S) Graphite

2. Match the boron halides with their properties.

Column I	Column II
(A) BF_3	(P) Molecule has highest boiling point.
(B) BCl_3	(Q) Compound is liquid.

Column I	Column II
(C) BBr_3	(R) Molecule has most effective back bonding.
(D) BI_3	(S) Molecule is solid.
	(T) Compound is gaseous.

3. Match the reactions with the type of products formed.

Column I	Column II
(A) $\text{B}_2\text{H}_6 + \text{MeOH}$	(P) Addition reaction.
(B) $\text{B}_2\text{H}_6 + \text{Et}_2\text{S}$	(Q) Produces ionic compound.
(C) $\text{B}_2\text{H}_6 + \text{MeNH}_2$	(R) Adduct formation.
(D) $\text{B}_2\text{H}_6 + \text{CH}_2 = \text{CHR}$	(S) Evolves hydrogen.

ANSWERS

Single Correct Choice Type Questions

1. (C) 3. (D) 5. (A) 7. (B)
2. (A) 4. (D) 6. (A) 8. (C)

Multiple Correct Choice Type Questions

1. (A), (B), (C), (D) 3. (A), (B), (C), (D) 5. (B), (C) 7. (B), (C), (D)
2. (A), (B), (C), (D) 4. (A), (B), (C), (D) 6. (A), (C)

Comprehension Type Questions

1. (B) 3. (B) 5. (D) 7. (D)
2. (B) 4. (D) 6. (A)

Assertion–Reasoning Type Questions

1. (A) 2. (D) 3. (C) 4. (A) 5. (A)

Integer Answer Type Questions

1. 5 3. 3 5. 16 7. 19 9. 6
2. 6 4. 3 6. 9 8. 31 10. 6

Matrix–Match Type Questions

1. (A) \rightarrow (R)
(B) \rightarrow (S)
(C) \rightarrow (Q)
(D) \rightarrow (P)
2. (A) \rightarrow (R), (T)
(B) \rightarrow (Q)
(C) \rightarrow (Q)
(D) \rightarrow (P), (S)
3. (A) \rightarrow (S)
(B) \rightarrow (R)
(C) \rightarrow (Q)
(D) \rightarrow (P)