



## CHEMISTRY

### JEE (MAIN AND ADVANCED) CHEMISTRY

#### ELEMENTS OF BORON FAMILY

##### PROBLEMS

1. Why boron cannot form  $B^{3+}$  ion ?



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2. Gallium is used as a pyrometric liquid. Why?



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3. Which is more stable among  $Tl^{+3}$  and  $Tl^{+1}$ . Why?



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4. Why the maximum covalency of boron is only four where as that of aluminium is six ?



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5.  $Tl(OH)_3$  is less basic than  $TlOH$ . Why ?



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6. Write the correct order of reducing character of 13th group elements in +3 states.



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7. How ionic nature of trihalides of IIIA elements is related to their acidic character?



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8. When boron trifluoride forms an adduct with ammonia, what are the changes in the hybridisation and geometry?



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9. Why is boric acid considered as a weak acid?



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10. Diborane molecule has six hydrogen atoms, but all atoms cannot be substituted in methylation. Why?



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11. The  $p\pi - p\pi$  back bonding occurs in the halides of boron and not in those of aluminium. Explain.



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12. White fumes appear around the bottle of anhydrous aluminium chloride. What is the reason ?



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13. Use of Al for domestic purpose is reduced now. Why ?



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19. White fumes appear around the bottle of anhydrous aluminium chloride. What is the reason ?



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20. Use of Al for domestic purpose is reduced now. Why ?



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### SUBJECTIVE EXERCISE-1 (Long answer questions)

1. What properties in the group IIIA elements do not show gradation ?  
Explain the irregularity .



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2. Write an essay on the anomalous behaviour of Boron ?



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3. Write any two forms of borax that occur in nature. Give their formula.

Explain the principle of borax bead test with atleast one example.



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4. Name all boric acids and give their formulae. Discuss the preparation of orthoboric acid from Colemanite.



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5. Write an essay on the preparation and chemical activity of diborane.



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6. What do you mean by electron deficient molecules ? Give two examples.

Explain the structure of diborane.



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7. Explain any two methods of preparation of diborane. Write the reactions of  $B_2H_6$  with a)  $H_2O$  b)  $CO$ . Give equations.



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### SUBJECTIVE EXERCISE-1 (Short answer questions)

1. Write the Boron family elements in the order. Write the electronic configurations of  $2^{nd}$ ,  $3^{rd}$  and  $4^{th}$  elements of the group.



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2. Explain the following sequence of IE's in group IIIA. B(801), Al(577), Ga(579), In(558), Tl(589)  $\text{kJ mol}^{-1}$ .



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3. Explain why the EN's of Ga, In and *Tl* do not vary much though they are expected to decrease in the group.



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4. Define oxidation state. How does it vary in the groups ?



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5. Draw the structure of a metaborate ion.



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6. Explain with a suitable example borax bead test.



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7. Mention any 3 uses of borax.



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8. Write the formulas of all the boric acids.



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9. What are boranes ? How are they classified ?



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10. A mixture of a hydride of Boron and ammonia are passed through a hot tube. What is the result?



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11. What is the orbital structure of  $B_2H_6$  ? Explain the structure.



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12. How can you prove chemically the bridge structure of  $B_2H_6$  ?

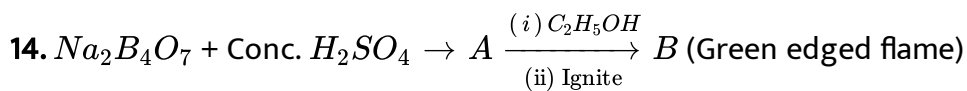


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13. Name an amphoteric oxide of 13 group elements, explain with suitable reactions.



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Identify A and B .



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### SUBJECTIVE EXERCISE-1 (Very Short answer questions)

1. The general electronic configuration of group III elements



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2. What is the common oxidation state of group IIIA elements ? How does it change down the group ?



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3. What is inert pair effect ?





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4. Identify the inert pair in indium.



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5. Give the formula and structure of borazine.



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6. Boron does not occur in the free state. Why?



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7. What happens when  $\text{LiAlH}_4$  and  $\text{BCl}_3$  mixture in dry ether is warmed



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8. Write the conditions required for diborane to react with CO ?



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9. What is the orbital structure of diborane ?



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10. Write the names of alloying metals with aluminium.



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11. Write the structure of  $AlCl_3$  as a dimer.



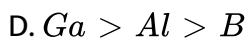
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12. How is boron-10 isotope used in nuclear chemistry ?

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### OBJECTIVE EXERCISE -1 (General introduction and properties)

1. The order of abundance of IIIA group elements is



**Answer: A**

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2. IIIA group element which forms only covalent compounds either in anhydrous state or in aqueous state is

A. Al

B. Ga

C. In

D. B

**Answer: D**



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**3. Which of the following is most abundant in the earth crust ?**

A. Boron

B. Aluminium

C. Gallium

D. Thallium

**Answer: B**



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4. (A): The atomic size of gallium is less than expected

(R): In gallium the  $3^{10}$  delectrons do not shield effectively

- A. A and R are true, R explains A
- B. A and R are true, R does not explain A
- C. A is true, but R is false
- D. A is false, but R is true

**Answer: A**



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5. + 1 oxidation state is stable for the element

- A. B
- B. Al
- C. Ga

D. Tl

**Answer: D**



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**6.** The element that exhibits negative oxidation state in IIIA group is

A. B

B. Al

C. Ga

D. Tl

**Answer: A**



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7. Among the III A group elements, the difference in the atomic radius is large in between

- A. Aluminium and Boron
- B. Gallium and Aluminium
- C. Thallium and Indium
- D. Gallium and Indium

**Answer: A**



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8. Aluminium exhibits diagonal relationship with

- A. Beryllium
- B. Silicon
- C. Carbon
- D. Germanium

**Answer: A**



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**9. Which element cannot form a cation ?**

A. Al

B. B

C. Cs

D. Bi

**Answer: B**



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**10. Electronic structure acquired by compounds of IIIA group elements in bonding is**



- A. Sextet
- B. Doublet
- C. Octet
- D. Super octet

**Answer: A**



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**11.** The nature of  $B_2O_3$  is

- A. Neutral
- B. Amphoteric
- C. Acidic
- D. Basic

**Answer: C**



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12. Thallous chloride is more stable than thallic chloride because of

- A. More ionic character
- B. Larger size of  $Tl^+$  ion
- C. High hydration energy of  $Tl^+$  ion
- D. Inert pair effect

**Answer: D**



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13. Which of the following pair of elements have same atomic radius

- A. B, Al
- B. Al, Ga
- C. Ga, In

D. B,Tl

**Answer: B**



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**14.** Thallium shows different oxidation states because

- A. It is transition element
- B. Of inert pair effect
- C. Of its amphoteric character
- D. Of its higher reactivity

**Answer: B**



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**15.** Which of the following is used in high temperature thermometry?

A. Na

B. Ga

C. Tl

D. Hg

**Answer: B**



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**16. (A) :** Among IIIA group elements, Boron has highest melting point

**(R) :** Boron has giant polymeric structure

A. A and R are true, R explains A

B. A and R are true, R does not explain A

C. A is true, but R is false

D. A is false, but R is true

**Answer: A**



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17. Which one is a non-metal in group 13 ?

A. B

B. Al

C. Ga

D. In

**Answer: A**



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18. The electropositive character increases from B to Al and then decreases from Al to Tl because of

A. Increase in the size of the elements

B. Decrease in the ionization energy of the elements

C. Decrease in the electronegativity of the elements

D. Ineffective shielding of the nuclear charge by d-electrons in the case of Ga, In and Tl

**Answer: D**



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**19.** When boron atom undergoes  $sp^3$  hybridization

A. all the four  $sp^3$  orbitals contain one electron in each of them

B. three orbitals contain one electron in each of them and the fourth one is vacant

C. two orbitals contain one electron in each of them and two others are vacant

D. one  $sp^3$  orbital contains one electron pair while others have lone electrons

**Answer: B**



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**20.** Boron exhibits diagonal relationship with

A. Si

B. C

C. Al

D. Be

**Answer: A**



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**21. (A):**  $TiCl_3$  acts as a good oxidant

**(R):**  $Ti^{+3}$  is less stable than  $Ti^{+2}$

- A. A and R are true, R explains A
- B. A and R are true, R does not explain A
- C. A is true, but R is false
- D. A is false, but R is true

**Answer: A**



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**22.** Which one of the following elements does not form triiodide on reacting with iodine?

- A. B
- B. Tl
- C. Al
- D. Ga

**Answer: B**





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**23.** Osmotic pressure of the solution can be increased by

- A. Increasing the temperature of the solution
- B. decreasing the temperature of the solution
- C. increasing the volume of the vessel
- D. diluting the solution

**Answer: D**



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**24.** Which one of the following forms a basic oxide?

- A. B
- B. Tl
- C. Al

D. Ga

**Answer: B**



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### OBJECTIVE EXERCISE -1 (Borax, Boric acids and Boron hydrides)

1. (A): Borax bead test is not suitable for  $\text{Al(III)}$

(R) :  $\text{Al}_2\text{O}_3$  is insoluble in water

A. A and R are true, R explains A

B. A and R are true, R does not explain A

C. A is true, but R is false

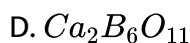
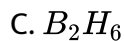
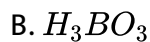
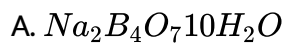
D. A is false, but R is true

**Answer: B**



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2. Glassy bead is obtained by heating



**Answer: A**



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3. Borax bead test is not given by

A. Aluminium salt

B. Cobalt salt

C. Copper

D. Nickel salt

**Answer: A**



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**4.** Boric acid is prepared from borax by the action of

A.  $\text{HCl}$

B.  $\text{NaOH}$

C.  $\text{CO}_2$

D.  $\text{Na}_2\text{CO}_3$

**Answer: A**



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**5.** The hybridisation of boron in ortho boric acid is

A.  $\text{sp}$

B.  $sp^2$

C.  $sp^3$

D.  $sp^3d$

**Answer: B**



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6. Boric acid ( $H_3BO_3$ ) has

A. Trigonal structure

B. Tetrahedral structure

C. Layer structure, in which  $BO_3$  units are linked by oxygen

D. Layer structure, in which planar  $BO_3$  units are linked by hydrogen bonding

**Answer: D**



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7. Boric acid is polymer due to

- A. its acidic nature
- B. the presence of hydrogen bonds
- C. its mono basic nature
- D. its geometry

**Answer: B**



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8. The number of atoms involved in bridged bonds in one diborane molecule is

- A. 4
- B. 2
- C. 6

D. 5

**Answer: A**



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**9.** The bonds not present in diborane are

A. B-H

B. B-H-B

C. B-B

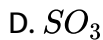
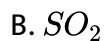
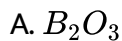
D. H-B-H

**Answer: C**



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**10.** When B is reacted with conc.  $H_2SO_4$ , the gaseous product is

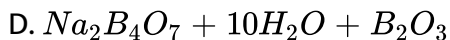
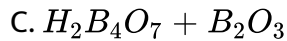
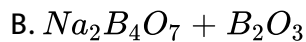
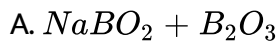


**Answer: B**



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**11. Borax bead is a mixture of**



**Answer: A**



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12. The number of bridge hydrogen atoms in diborane is

A. 1

B. 2

C. 3

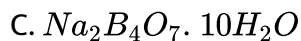
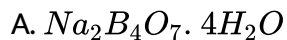
D. 4

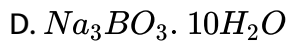
**Answer: B**



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13. The formula of kernite or razorite is



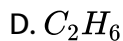
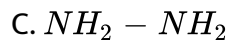
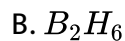
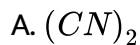


**Answer: A**



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**14.** Which of the following is used as a rocket fuel?



**Answer: B**



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**15.** In diborane, the hybridisation of Boron is

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $sp^3d$

**Answer: C**



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**16.** The number of three centred, two electron bonds in diborane is

A. 2

B. 4

C. 3

D. 6

**Answer: A**



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17. Reduction of  $BCl_3$  with lithium aluminium hydride gives

- A. Borazole
- B. Borazine
- C. Diborane
- D. All

**Answer: C**



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18. Basicity of  $H_3BO_3$  is

- A. 1
- B. 2
- C. 3

D. 0

**Answer: A**



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**19.** The gas liberated when aluminium reacts with conc.  $H_2SO_4$  is

A.  $H_2S$

B.  $O_2$

C.  $SO_2$

D.  $H_2$

**Answer: C**



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**20.** Which metal forms a protective oxide layer to prevent corrosion ?

A. Au

B. Cu

C. Al

D. Ag

**Answer: C**



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**21.** In metallurgy, the substance which can act as de-oxidizer is

A. B

B.  $Al_2O_3$

C.  $AlN$

D.  $Al$

**Answer: D**



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22. Dihydrate of alumina is called

A. Diaspore

B. Cryolite

C. Bauxite

D. Gypsum

**Answer: C**



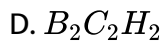
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23. Diborane reacts with carbon monoxide to form

A.  $BH_3CO$

B.  $B_3N_3H_6$

C.  $H_3BO_3$

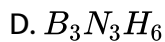
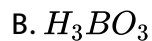


**Answer: A**



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**24.** Diborane on hydrolysis gives



**Answer: B**



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**25.** Regarding 'Al' the wrong statement is



- A. It reacts with both acids and bases
- B. Its maximum covalency is '6'
- C. It is a strong reducing agent
- D. It becomes passive with conc HCl

**Answer: C**



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**26. Which of the following has no reaction with HCl ?**

- A. B
- B. Al
- C. Ga
- D. Tl

**Answer: A**



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27. The H-B-H bridged angle in diborane is

A.  $121.5^\circ$

B.  $97^\circ$

C.  $119^\circ$

D.  $133^\circ$

**Answer: B**



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28. Borax when dissolved in water exhibits

A. alkaline nature

B. acidic nature

C. neutral nature

D. amphoteric nature

**Answer: A**



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**29.** On strong heating, Boric acid gives

A. B

B.  $B_2H_6$

C.  $B_2O_3$

D.  $BO_2$

**Answer: C**



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**OBJECTIVE EXERCISE -1 (Aluminium Chloride)**

1.  $AlCl_3$  is

- A. Anhydrous and covalent
- B. Anhydrous and ionic
- C. Covalent and basic
- D. Coordinate and acidic

**Answer: A**



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2. Which of the following statement about  $AlCl_3$  is not correct ?

- A. It exists as a dimer
- B. It is a covalent compound
- C. It involves back bonding between Cl and Al
- D. Its aqueous solution conducts electricity

**Answer: C**



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**3. Which of the following is not correct ?**

- A. Anhydrous  $AlCl_3$ , exists as  $Al_2Cl_6$
- B. Anhydrous  $AlCl_3$  sublimes on heating
- C. Anhydrous  $AlCl_3$  fumes in air
- D. Anhydrous  $AlCl_3$  is ionic

**Answer: D**



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**4. In  $Al_2Cl_6$  the covalency of aluminium is**

- A. 6

B. 4

C. 3

D. 2

**Answer: B**



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**5.**

$AlCl_3$  fumes in moist air due to its hydrolysis

b) Al metal is stable in dry air because of protective oxide layer.

c)  $p\pi - p\pi$  back bonding does not occur in halides of aluminium because of larger size.

d) Anhydrous  $AlCl_3$  cannot be prepared by heating  $AlCl_3 \cdot 6H_2O$ .

Correct statements are

A. a , b only

B. b,c only

C. a,c,d only

D. All of these

**Answer: D**



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6.  $AlCl_3$  exists as a dimer through halogen bridged bonds.

(R):  $AlCl_3$  gets stability by accepting electrons from the bridged halogen.

A. Both A and R are true, R explains A

B. Both A and R are true, R does not explain A

C. A is true, but R is false

D. A is false, but R is true

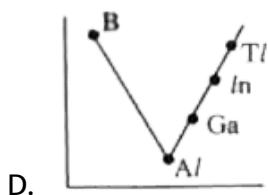
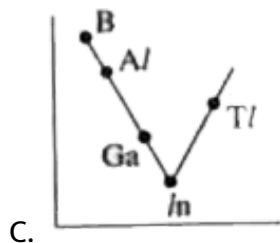
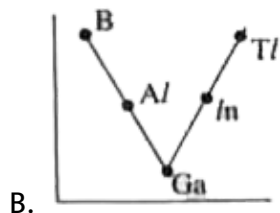
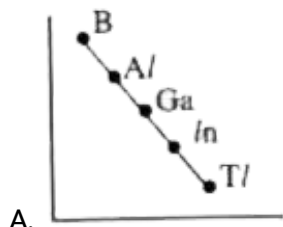
**Answer: A**



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## OBJECTIVE EXERCISE - 2 (General introduction and properties)

1. Which one of the following correctly represents the variation of electronegativity (EN) with atomic number (Z) of group 13 elements?





**Answer: D**



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**2. IIIA group element with highest density is**

A. B

B. Al

C. In

D. Tl

**Answer: D**



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**3. The ionisation energies from Ga to Tl do not decrease due to**

A. Shielding effect

- B. Improper shielding effect
- C. Increase in atomic size
- D. Decrease in nuclear charge

**Answer: B**



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**4. Electronegativity is least for**

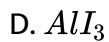
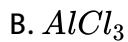
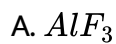
- A. Tl
- B. Al
- C. Ga
- D. B

**Answer: B**



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5. Which of the following is ionic



**Answer: A**



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6. Among the following most metallic element is

A. Al

B. Ga

C. In

D. Tl

**Answer: A**



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7. The tendency of forming  $M_{\text{aq}}^{3+}$  is highest for which IIIA group elements ?

A. B

B. Al

C. Ga

D. Tl

**Answer: B**



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8. Least basic among the following is

A.  $\text{InOH}$

B.  $\text{TlOH}$

C.  $\text{B}(\text{OH})_3$

D.  $\text{Al}(\text{OH})_3$

**Answer: C**



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**9.** Al and Ga have nearly the same covalent radii, because of

A. Greater shielding effect of 's' electrons of 'Ga' atoms

B. Poor shielding effect of 's' electrons of 'Ga' atoms

C. Poor shielding effect of 'd' electrons of 'Ga' atoms

D. Greater shielding effect of 'd' electrons of 'Ga' atoms

**Answer: C**



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10. The maximum covalency of aluminium is 6 where as that of boron is '4' because

- A. Aluminium is more electropositive than boron
- B. Al' can form a cation where as boron can not
- C. Al' contains vacant 'd' orbitals in its valence shell where as boron does not
- D. 'Al' is a metal where as boron is a non metal

**Answer: C**



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11. Which one of the following has the lowest melting point

- A. B
- B. Al

C. Ga

D. Tl

**Answer: C**



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12.  $E^0_{Al^{3+}/Al} = -1.66V$  and  $E^0_{Tl^{3+}/Tl} = 1.26 V$ . Then which of the following statements is correct ?

A. Aluminium has high tendency to form  $Al^{3+}$  ions in aqueous solution.

B.  $Tl^{3+}$  is unstable in aqueous solution

C.  $Tl^{3+}$  is a powerful oxidising agent

D. Al is a powerful reducing agent

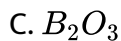
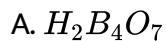
**Answer: D**



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## OBJECTIVE EXERCISE - 2 (Borax, Boric acids and Boron hydrides)

1.  $H_3BO_3 \xrightarrow{\text{Red heat}} X$ . 'X' in the reaction is

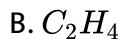
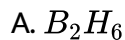


**Answer: C**

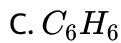


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2. The non planar molecule among the following is





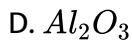
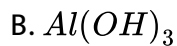


**Answer: A**



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3. White fumes appear around the bottle of anhyd.  $AlCl_3$  due to the formation of

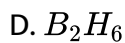
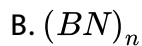
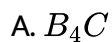


**Answer: A**



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4. Borazole on strong heating gives



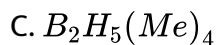
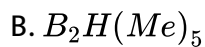
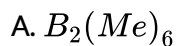
Answer: B



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5. Methylation of diborane gives

[Me = methyl group]



D. All these above

**Answer: C**



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**6.** The number of  $\sigma$  and  $\pi$  bonds present in inorganic benzene

- A.  $9\sigma, 6\pi$
- B.  $6\sigma, 3\pi$
- C.  $9\sigma, 3\pi$
- D.  $12\sigma, 3\pi$

**Answer: D**



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**7.** The number of electrons shared between the two Boron atoms directly in the formation of bonds in diborane molecule

A. 4

B. 2

C. 0

D. 8

**Answer: C**



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**8. When strongly heated, orthoboric acid leaves a residue of**

A. Metaboric acid

B. Tetraboric acid

C. Boric anhydride

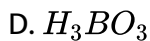
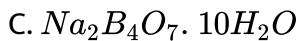
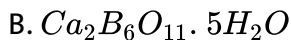
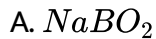
D. Boron

**Answer: C**



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9. Borax is

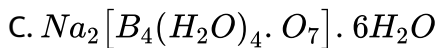
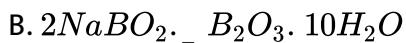
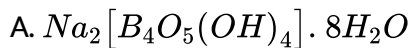


Answer: C



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10.  $Na_2B_4O_{7.10}H_2O$  can also be represented as



D. All the above

**Answer: A**



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11.  $BCl_3$  does not exist as dimer but  $BH_3$  exist as dimer because

A. Cl is more electropositive than H

B. There is  $P\pi - P\pi$  back bonding in  $BCl_3$  but  $BH_3$  does not contain such multiple bonding

C. Large chlorine atoms do not fit between small sized boron atoms whereas small hydrogen atoms get fitted between boron atoms

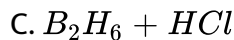
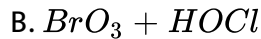
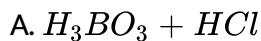
D. None of these

**Answer: B**



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12. The product formed in the reaction  $BCl_3 + H_2O \rightarrow$



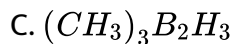
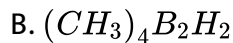
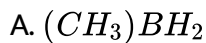
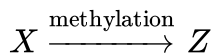
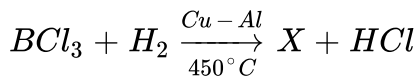
D. No reaction

**Answer: A**



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13. What is Z in the following reactions ?



D.  $(CH_3)_6B_2$

Answer: B



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### OBJECTIVE EXERCISE - 2 (Aluminum Chloride)

1. Which of the following statements is correct?

- A.  $BCl_3$  and  $AlCl_3$  are both Lewis acids and  $BCl_3$  is stronger than  $AlCl_3$
- B.  $BCl_3$  and  $AlCl_3$  are both Lewis acids and  $AlCl_3$  is stronger than  $BCl_3$
- C.  $BCl_3$  and  $AlCl_3$  are both equally strong Lewis acids
- D.  $BCl_3$  and  $AlCl_3$  are both not Lewis acids.

Answer: A





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2. The number of bonds present in dimeric  $AlCl_3$  are

A. 8

B. 3

C. 6

D. 4

Answer: A



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3. Correct statement regarding  $B_2H_6$  and  $Al_2Cl_6$

A. Both have three centred two electron bonds

B. Hybridisation of 'B' in  $B_2H_6$  is  $sp^2$  where as Al in  $Al_2Cl_6$  is  $sp^3$   
hybridised

C.  $B_2H_6$ , has hydrogen bridge bonds and  $Al_2Cl_6$  has halogen bridging

D. Both have two centred three electron bonds

**Answer: B**



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4. In  $Al_2Cl_6$  the number of covalent and co-ordinate bonds are

A. 3,3

B. 2,4

C. 6,2

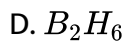
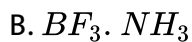
D. 6,0

**Answer: C**



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1. Which of the following does not exist ?



Answer: C



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2. The Nature of  $Al_2O_3$  is

A. Neutral

B. Amphoteric

C. Basic

D. Acidic

**Answer: B**



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3. The correct order of ionization potential  $[IP_1]$  among the IIIA group elements is:

A.  $B > Ga > Al > Tl > In$

B.  $B > Ti > Al > Ga > In$

C.  $B > Tl > Al > Ga = In$

D.  $B > Tl > Ga > Al > In$

**Answer: D**



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4. The incorrect statement among the following is

- A. Among IIIA group elements the density increases from B to Tl
- B.  $\text{TiCl}$  is more stable than  $\text{TiCl}_3$
- C. Boron has 2 penultimate electrons where as Aluminium has 18 penultimate electrons
- D. Boron exhibits allotropy

Answer: C



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5.  $\text{B}_2\text{H}_6 + \text{NH}_3 \xrightarrow{120^\circ\text{C}} \text{X}$ . Where 'X' is

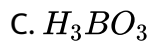
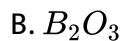
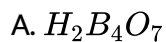
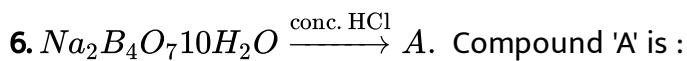
- A.  $[\text{BH}_2(\text{NH}_3)_2]^+ [\text{BH}_4]^-$
- B.  $[\text{BH}_2(\text{NH}_3)_2]^+ [\text{BH}_3]^-$
- C.  $(\text{BH}_4)^+ [\text{BH}_2(\text{NH}_3)_2]^-$



**Answer: A**



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**Answer: C**



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7. Indium and thallium of III group have nearly similar atomic radii due to poor screening effect shown by f-electrons in the

- A. Penultimate shell of thallium
- B. Anti penultimate shell of indium
- C. Anti penultimate shell of thallium
- D. Penultimate shell of indium

**Answer: C**



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8. The anhydride of boric acid is

- A. Metaboric acid
- B. Tetraboric acid
- C. Boron trioxide
- D. All

**Answer: C**



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**9.** The statements regarding Diborane are

- i)  $B_2H_6$  is stable in the absence of grease and moisture at low temperature
- ii) Diborane burns in oxygen to produce a very high temperature
- iii) Borazole contains ionic bonds

A. iii is only correct

B. i and ii are correct

C. i and iii are correct

D. ii and iii are correct

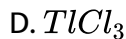
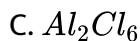
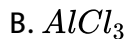
**Answer: B**



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10. Which of the following chloride is most unstable ?



Answer: D



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11. The reason for the formation of hydrogen bridge bond in  $B_2H_6$  is

A. that it has 14 electrons to form bonds

B. that it has shortage of electrons

C. to get structure similar to  $C_2H_6$

D. that the boron atoms have lone electron pairs

**Answer: B**



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**12.** The chloride of one of the following elements is a stable covalent compound in solid state but ionic in their solutions. It is

A. B

B. Al

C. In

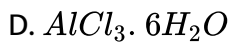
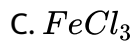
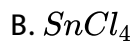
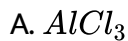
D. Tl

**Answer: B**



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**13.** Which of the following is not a Lewis acid?

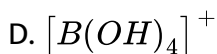
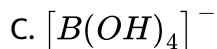
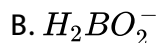
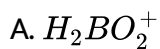


**Answer: D**



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**14.** Orthoboric acid behaves as weak monobasic acid giving  $H_3O^+$  and



**Answer: C**



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15. Select correct statement(s) about  $H_3BO_3$

- A. It has triangular  $BO_3^{3-}$  units
- B. In solid state, molecules are hydrogen bonded
- C. Both the above statements 1 and 2 are correct
- D. None of the statements are correct

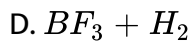
Answer: C



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16. The reactants in the industrial method of preparation of diborane are

- A.  $BCl_3 + LiAlH_4$
- B.  $BF_3 + LiAlH_4$
- C.  $BF_3 + LiH$



**Answer: C**



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17. The total number of vacant orbitals involved in bond formation in diborane is

A. 2

B. 3

C. 4

D. 6

**Answer: A**



**Watch Video Solution**

18. Standard electrode potential values for  $Al^{3+} / Al$  is -1.66V and that of  $Tl^{3+} / Tl$  is +1.26. then,

- A. Aluminium is more electropositive than thallium
- B. Aluminium is less electropositive than thallium
- C. Both aluminium and thallium are equally electropositive
- D. Cannot be predicted

**Answer: A**



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19. Which is not correct in case of boric acid ?

- A. It is a tribasic acid
- B. It has planar structure
- C. It acts as monobasic acid
- D. It is soluble in hot water

**Answer: A**



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**20.** When diborane undergoes complete methylation, the number of hydrogen atoms replaced is

A. 6

B. 2

C. 4

D. 3

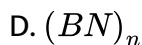
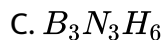
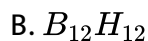
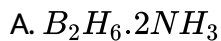
**Answer: C**



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**21.** Diborane reacts with ammonia under different conditions to give a variety of products. Which one among the following is not formed in

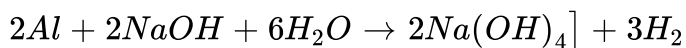
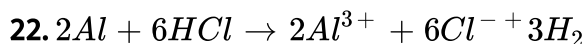
these reactions?



**Answer: B**



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These reactions suggest that aluminium is

A. acidic in nature

B. Basic in nature

C. Amphoteric in nature



D. Neutral in nature

**Answer: C**



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**23.** The oxides of group 13 elements are given as

A)  $B_2O_3$  B)  $Al_2O_3$  C)  $Ga_2O_3$  D)  $In_2O_3$

A. A and B are basic in nature

B. B and C are amphoteric in nature

C. C and D are acidic in nature

D. A and D are neutral

**Answer: B**



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24. Aluminium liberates dihydrogen gas with both dil.HCl and aqueous NaOH. The volume ratio of dihydrogen gas evolved from equal amounts of aluminium in these reactions is

A. 1 : 2

B. 2 : 3

C. 1 : 3

D. 1 : 1

**Answer: D**



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25. Boron is unable to form  $BF_6^{3-}$  ion because of

A. high electronegativity

B. non availability of d-orbitals

C. maximum covalency of boron is six

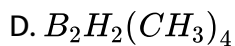
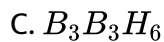
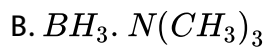
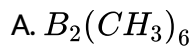
D. small size of boron

**Answer: B**



**Watch Video Solution**

**26.** The compound formed when diborane reacts with trimethyl amine is



**Answer: B**



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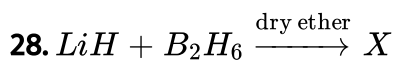
27. Which of the following is formed when diborane reacts with sodium hydride in diethyl ether?

- A. Sodium boride
- B. Sodium borate
- C. Sodium metaborate
- D. sodium tetra hydridoborate

**Answer: D**



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In this reaction 'X' is used as

- A. Oxidising agent
- B. Reducing agent
- C. Flux for soldering metals

D. Mild antiseptic

**Answer: B**



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**29.** The use of aluminium and its compounds for domestic purposes is now reduced considerably because of their

A. toxic nature

B. rare availability

C. acidic nature

D. radioactivity

**Answer: A**



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30. On a weight - to - weight basis, the electrical conductivity of aluminium is

- A. half that of copper
- B. equal to that of copper
- C. twice that of copper
- D. ten times that of copper

**Answer: C**



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31. Structure of  $-BH_2$  group is

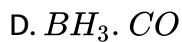
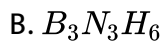
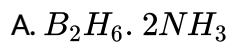
- A. linear
- B. planar
- C. tetrahedral
- D. octahedral

**Answer: B**



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**32.** Empirical formula of inorganic benzene is

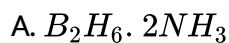


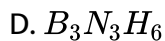
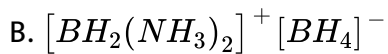
**Answer: C**



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**33.** Diborane on heating to  $200^\circ C$  with ammonia it gives



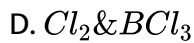


**Answer: D**



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**34.** Diborane reacts with HCl in the presence of  $AlCl_3$  and liberates



**Answer: D**



**Watch Video Solution**



35. What is the nature of aqueous borax solution ?

- A. Neutral
- B. Acidic
- C. Alkaline
- D. Amphoteric

**Answer: C**



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## LECTURE SHEET (EXERCISE - I) LEVEL - I (MAIN)

1. The order of abundance of IIIA group elements is

- A.  $Al > Ga > B > Tl > In$
- B.  $B > Ga > Al > In > Tl$
- C.  $B > Al > Ga > In > Tl$

D.  $Al > Ga > Tl > B > In$

**Answer: A**



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2. +1 oxidation state is stable for the element

A. B

B. Al

C. Ga

D. Tl

**Answer: D**



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3. Among the III A group elements, the difference in the atomic radius large in between

- A. Aluminium and Boron
- B. Gallium and Aluminium
- C. Thallium and Indium
- D. Gallium and Indium

**Answer: A**



**Watch Video Solution**

4. Which element can not form a cation ?

- A. Al
- B. B
- C. Cs
- D. Bi

**Answer: B**



**Watch Video Solution**

**5.** Which of the following pair of elements have same atomic radius

A. B, Al

B. Al, Ga

C. Ga, In

D. In, Tl

**Answer: B**



**Watch Video Solution**

**6.** The nature of  $B_2O_3$  is

A. Neutral

B. Amphoteric

C. Acidic

D. Basic

**Answer: C**



**Watch Video Solution**

7. When B is reacted with conc.  $H_2SO_4$ , the gaseous product is

A.  $B_2O_3$

B.  $SO_2$

C.  $O_2$

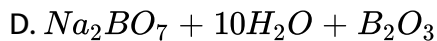
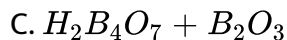
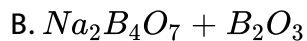
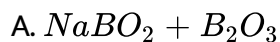
D.  $SO_3$

**Answer: B**



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8. Borax glass is a mixture of

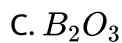
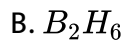


Answer: A



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9. On strong heating, Boric acid gives

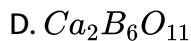
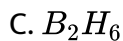
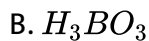
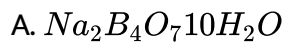


**Answer: C**



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**10.** Glassy bead is obtained by heating



**Answer: A**



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## LECTURE SHEET (EXERCISE - I) LEVEL - II (ADVANCED)

**1.** Thallium shows different oxidation states because

- A. It is transition element
- B. Of inert pair effect
- C. Of its amphoteric character
- D. Of its higher reactivity

**Answer: B**



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**2. Which of the following is used in high temperature thermometry ?**

- A. Na
- B. Ga
- C. Tl
- D. Hg

**Answer: B**



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3. The electropositive character increases from B to Al and then decreases from Al to Tl because of

- A. Increase in the size of the elements
- B. Decrease in the ionization energy of the elements
- C. Decrease in the electronegativity of the elements
- D. Ineffective shielding of the nuclear charge by d-electrons in the case of Ga, In and Tl

**Answer: D**



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4. III A group element with highest density is

- A. B
- B. Al

C. In

D. Tl

**Answer: D**



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5. Electronegativity is least for

A. Tl

B. Al

C. Ga

D. B

**Answer: A**



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6. The hybridisation of boron in ortho boric acid is

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $sp^3d$

Answer: B



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7. Boric acid ( $H_3BO_3$ ) has

A. Trigonal structure

B. Tetrahedral structure

C. Layer structure, in which  $BO_3$  units are linked by oxygen

D. Layer structure, in which planar  $BO_3$  units are linked by hydrogen bonding

**Answer: D**



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**8.** Boric acid is polymer due to

- A. its acidic nature
- B. the presence of hydrogen bonds
- C. its mono basic nature
- D. its geometry

**Answer: D**



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9. Least basic among the following is

A.  $\text{InOH}$

B.  $\text{TIOH}$

C.  $\text{B}(\text{OH})_3$

D.  $\text{Al}(\text{OH})_3$

Answer: C



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10.  $\text{H}_3\text{BO}_3 \xrightarrow{\text{Redhot}} \text{X}$ . 'X' in the reaction is

A.  $\text{H}_2\text{B}_4\text{O}_7$

B.  $\text{HNO}_2$

C.  $\text{B}_2\text{O}_3$

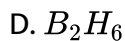
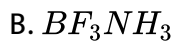
D. B

**Answer: C**



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**11.** Which of the following does not exist ?

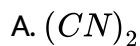


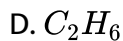
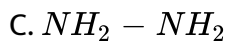
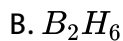
**Answer: C**



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**12.** The following has a potential to be used as a rocket fuel



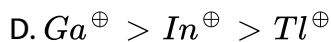
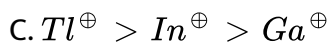
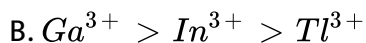
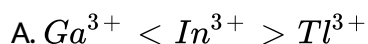


**Answer: B**



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**13.** Stability of monovalent and trivalent cations of Ga, In, Tl lie in the following sequence

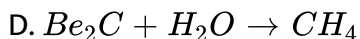
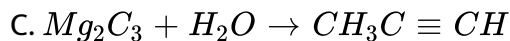
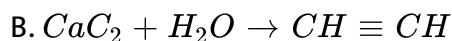
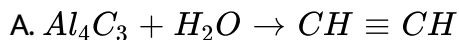


**Answer: B::C**



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14. When metal carbides react with  $H_2O$ , the correct equations are



Answer: B::C::D



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15. Which of the following statements are true for  $H_3BO_3$  ?

A. It is mainly monobasic acid and a Lewis acid

B. It does not act as a proton donor but acts as an acid by accepting hydroxyl ions



- C. It has a layer structure in which  $BO_3$  units are joined by hydrogen bonds
- D. It is obtained by treating borax with conc.  $H_2SO_4$

**Answer: A::B::C::D**



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**16.** Which of the following statements(s) is/are correct regarding the structure of borax ?

- A. Number of B - B bonds are zero
- B. Hybridization of each boron atom is  $sp^2$
- C. Number of B - O - B bonds are five
- D. Borax contain two different types of B - O bonds

**Answer: A::C::D**



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17. Al and Ga have nearly the same covalent radius, incorrect reason is

- A. Greater shielding effect of s-electrons of Ga atoms
- B. Poor shielding effect of s-electrons of Ga atoms
- C. Poor shielding effect of d-electrons of Ga atoms
- D. Greater shielding effect of d-electrons of Ga atoms

**Answer: A::B::D**



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18. Borazine is called 'inorganic benzene' in view of its ring structure with alternate BH and NH groups. Which of the following statements is correct about borazine ?

- A. Each B and N atom is  $sp^2$  hybridized
- B. Borazine satisfied the  $(4n + 2)$  Huckel's rule

C. Organic benzene, borazine both does not posses polar bonds

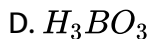
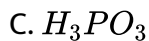
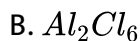
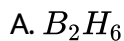
D. Borazine is isoelectronic with benzene

**Answer: A::B::D**



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**19.** In which of the following molecules, vacant orbitals cake part in hybridization?



**Answer: A::B**



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20. Orthoboric acid ( $H_3BO_3$ ) and metaboric acid ( $HBO_2$ ) differ in respect of

- A. Basicity
- B. Structure
- C. Melting point
- D. Oxidation

**Answer: A::B::C**



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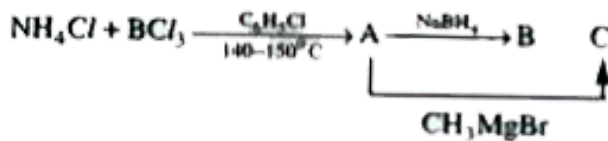
21.  $BF_3$  is

- A. Electron - deficient compound
- B. Lewis acid
- C. Used as rocket fuel
- D. Ionic compound

Answer: A::B



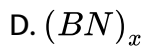
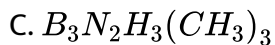
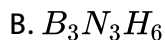
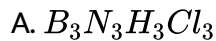
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22.

On the basis of reaction sequence given above, answer the following.

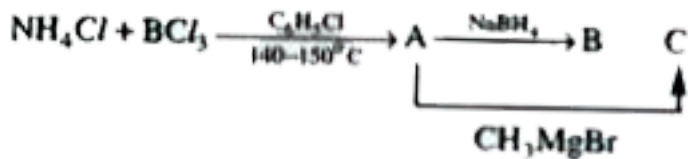
A is



Answer: A



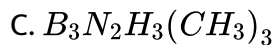
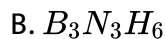
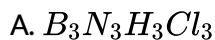
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23.

On the basis of reaction sequence given above, answer the following.

B is

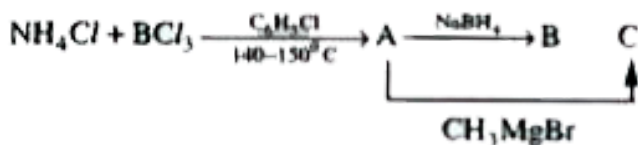


D. Inorganic graphite

**Answer: B**



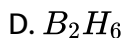
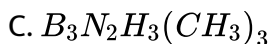
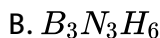
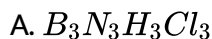
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24.

On the basis of reaction sequence given above, answer the following.

C is



**Answer: C**



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25. Boric acid  $\text{B}(\text{OH})_3$  is weak monobasic acid reacts with alkali to form borates. The most common borate of boric acid is borax represented as  $\text{Na}_2(\text{B}_4\text{O}_5(\text{OH})_4) \cdot 8\text{H}_2\text{O}$  which is made up of two tetrahedral and two

triangular units. On dissolution in water, these tetrahedral and triangular units are separated. Borax is useful primary standard for titration against acids.

The number of B - O - B linkage in borax is / are

The number of B - O - B linkages =

A. 2

B. 5

C. 4

D. 6

**Answer: B**



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**26.** Boric acid  $B(OH)_3$  is weak monobasic acid reacts with alkali to form borates. The most common borate of boric acid is borax represented as  $Na_2(B_4O_5(OH)_4) \cdot 8H_2O$  which is made up of two tetrahedral and two triangular units. On dissolution in water, these tetrahedral and triangular



units are repeated. Borax is useful primary standard for titration against acids.

Oxidation state of boron atom in borax is / are

- A. +3 only
- B. three atoms +3 and one atom +2
- C. +2 only
- D. two atoms +3 and two atoms +4

**Answer: A**



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27. How many of the following are non-metals B, Al, Ga, In, Tl, C, Si, Ge, Sn, Pb.



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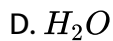
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1. Which of the following does not react with diborane

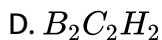
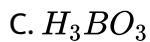
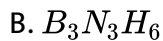
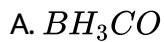


**Answer: C**



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2. Diborane reacts with carbon monoxide to form

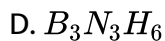
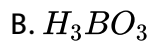


**Answer: A**



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**3. Diborane on hydrolysis gives**



**Answer: B**



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**4. The number of three centred, 2 electron bonds in diborane is**

A. 2

B. 4

C. 3

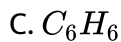
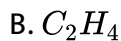
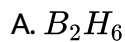
D. 6

**Answer: B**



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5. The non planar molecule among the following is

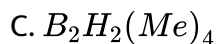
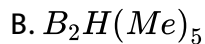
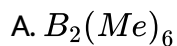


**Answer: A**



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6. Methylation of diborane gives [Me = methyl group]



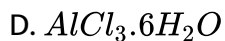
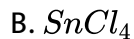
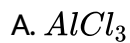
D. All the above

**Answer: C**



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7. Which of the following is not a Lewis acid ?

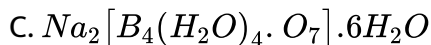
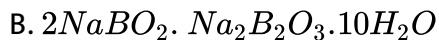
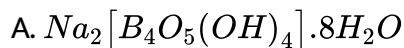


**Answer: D**



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8.  $Na_2B_4O_7 \cdot 10H_2O$  can also be represented as



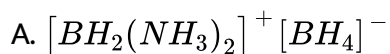
D. All the above

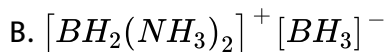
**Answer: A**



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9.  $B_2H_6 + NH_3 \xrightarrow{120^\circ C} X$ . Where X is



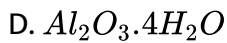
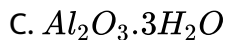
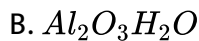
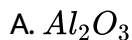


**Answer: A**



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**10. Diaspore is**



**Answer: B**



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11. Dihydrate of alumina is called

- A. Diaspore
- B. Cryolite
- C. Bauxite
- D. Gypsum

**Answer: C**



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12. Regarding 'Al' the wrong statement is

- A. It reacts with both acids and bases
- B. Its maximum covalency is '6'
- C. It is strong reducing agent
- D. It becomes passive with Conc. HCl

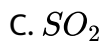
**Answer: D**



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## LECTURE SHEET (EXERCISE - II) LEVEL - II (ADVANCED)

1. The gas liberated when aluminium reacts with conc.  $H_2SO_4$  is



**Answer: C**



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2. In  $Al_2Cl_6$ , the covalency of aluminium is

A. 6

B. 4

C. 3

D. 2

**Answer: B**



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**3.** The number of electrons shared between the two Boron atoms directly in the formation of bonds in diborane molecule

A. 4

B. 3

C. 0

D. 8

**Answer: C**



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4. Which of the following is not, correct ?

- A. Anhydrous  $AlCl_3$  exists as  $Al_2Cl_6$
- B. Anhydrous  $AlCl_3$  sublimes on heating
- C. Anhydrous  $AlCl_3$  fumes in air
- D. Anhydrous  $AlCl_3$  is ionic

Answer: D



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5. An aqueous solution of alum is

- A. Acidic
- B. Basic
- C. Neutral

D. Amphoteric

**Answer: A**



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**6. All alums**

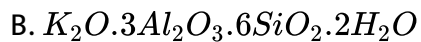
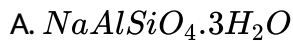
- A. Contain same ions
- B. Have similar crystal structure
- C. Contain same atoms
- D. Have the same molecular weight

**Answer: B**



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**7. The composition of mica is**

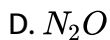
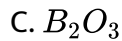
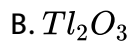
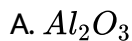


**Answer: B**



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**8. Which is pure basic oxide**



**Answer: B**



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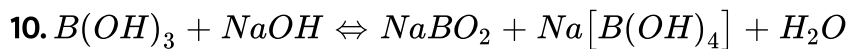
9. The number of  $\sigma$  and  $\pi$  bonds present in inorganic benzene

- A.  $9\sigma, 6\sigma$
- B.  $6\sigma, 3\pi$
- C.  $9\sigma, 3\pi$
- D.  $12\sigma, 3\pi$

Answer: D



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How can this reaction is made to proceed in forward direction ?

- A. addition of cis - 1, 2 diol
- B. addition of borax
- C. addition of trans - 1, 2 diol

D. addition of  $Na_2HPO_4$

**Answer: A**



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**11.** Boric acid is prepared from borax by the action of

- A. hydrochloric acid
- B. sodium hydroxide
- C. carbon dioxide
- D. sodium carbonate

**Answer: A**



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**12.** Select the correct statements about diborane



A.  $B_2H_6$  has three centre two electron bond

B. Each boron atom lies in  $sp^3$  hybrid state

C.  $H_t \dots B \dots H_t$  bond angle is  $122^\circ$

D. All hydrogens is  $B_2H_6$  lie in the same plane

Answer: A::B::C



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13.  $Al_2(SO_4)_3 + NH_4OH \rightarrow X$ ,  $X$  is

A. a white gelatinous precipitate

B. insoluble in excess of  $NH_4OH$

C. soluble in excess of NaOH

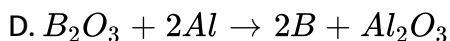
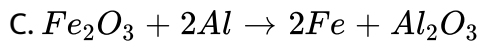
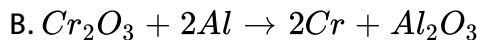
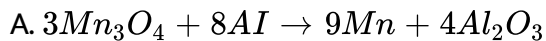
D. amphoteric in nature

Answer: A::B::C



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14. Which of the following reaction(s) is/are involved in thermit process ?

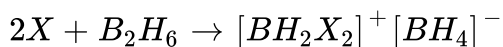


Answer: A::B::C

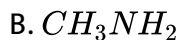


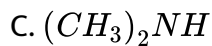
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15. In the reaction



the amines (s) X is/are



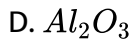
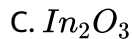
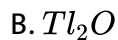
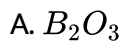


**Answer: A::B::C**



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**16. Which of the following oxides are basic ?**



**Answer: B::C**



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**17. Alumina is**

- A. A bad conductor of electricity
- B. Good conductor of electricity
- C. A dehydrating agent
- D. Insoluble in water

**Answer: A::D**



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**18. Potash alum is used as a**

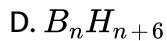
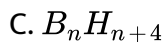
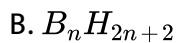
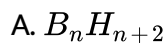
- A. Disinfectant
- B. Water softner
- C. Modarant in textile industry
- D. Fibre in polymer industry

Answer: B::C



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19. Boranes have general formula



Answer: C::D



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20. Hydrated  $AlCl_3$  is used as

A. Catalyst in cracking of petroleum

B. Catalyst in Friedel Crafts reaction

C. Modarant

D. All of the above

**Answer: C**



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21. Boron reacts with oxygen at  $700^{\circ}C$  to give (A). Compound (A) reacts with carbon and dry chlorine to give (B) an carbon monoxide. (B) on reduction with  $LiAlH_4$  gives (C ) along with LiCl and  $AlCl_3$ . (C ) on reaction with ammonia at  $200^{\circ}C$  gives (D).

In compound (B) :

A. Boron is  $sp^2$  hybridised

B. B is trigonal planar molecule

C. It is a Lewis base

D. Dimer

**Answer: A::B**



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22. Boron reacts with oxygen at  $700^{\circ}C$  to give (A). Compound (A) reacts with carbon and dry chlorine to give (B) an carbon monoxide. (B) on reduction with  $LiAlH_4$  gives (C ) along with  $LiCl$  and  $AlCl_3$ . (C ) on reaction with ammonia at  $200^{\circ}C$  gives (D).

Compound (C ) is

- A. an electron - deficient compound
- B. cation ( $3e$ ,  $2e$ ) bond
- C. has ethane like structure
- D. an ionic compound

**Answer: A::B**



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23. Boron reacts with oxygen at  $700^{\circ}C$  to give (A). Compound (A) reacts with carbon and dry chlorine to give (B) an carbon monoxide. (B) on reduction with  $LiAlH_4$  gives (C ) along with  $LiCl$  and  $AlCl_3$ . (C ) on reaction with ammonia at  $200^{\circ}C$  gives (D).

Compound (D) has B in \_\_\_\_\_ hybridised state

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $dsp^2$

**Answer: B**



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	Column - I	Column - II
	(A) $H_3BO_3$	(P) Hydrogen bonds
24.	(B) $Na_2B_4O_7$	(Q) Amphoteric
	(C) $Al_2O_3$	(R) Basic
	(D) $TiOH$	(S) Lewis acid



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25. In solid conundrum the number of oxygen atoms coordinate to aluminium ion is

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26. Total number of molecules having three centered two  $e^-$  bonds among the following is

$B_2H_6$ ,  $Al_2Cl_6$ ,  $BeCl_2(S)$ ,  $BeH_2(S)$ ,  $Al_2H_6$ ,  $[Be_2(CH_3)_2]_n$ ,  $C_2H_6$ ,  $Al_2(CF_3)_6$

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27. Tri alkyl aluminium molecules exists as dimer which contains 3 centered 2e bonds. The coordination number of bridged carbon atoms is

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1. The H-B-H bridged angle in diborane is

A.  $121.5^\circ$

B.  $97^\circ$

C.  $119^\circ$

D.  $133^\circ$

**Answer: B**



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2. The bonds not present in diborane is

A. B-H

B. B-H-B

C. B-B

D. H-B-H

**Answer: C**



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3. The main factor responsible for weak acidic nature of B - F bonds in  $BF_3$  is

- A. large electronegativity of F
- B. three centered two electron bonds in  $BF_3$
- C.  $p\pi - p\pi$  back bonding
- D. small size of B atom

**Answer: C**



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4. B - F bond order of  $BF_3$  is

- A. 1
- B. 2
- C. 3
- D.  $4/3$

**Answer: D**



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5. The two type of bonds present in  $B_2H_6$  are covalent and

- A. ionic
- B. co-ordinate
- C. hydrogen bridge bond
- D. metallic bond

**Answer: C**



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**6.** The green coloured borax bead obtained from copper salts is

- A. Cupric metaborate
- B. Copper orthoborate
- C. Copper boride
- D. Cuprous metaborate

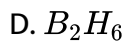
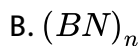
**Answer: A**



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**7.** Borazole on strong heating gives

- A.  $B_4C$



**Answer: B**



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8. Boron carbide,  $B_4C$  is widely used

A. in making acetylene

B. in making plaster of paris

C. as a hardest substance after diamond

D. in making boric acid

**Answer: C**



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9. Which one of the following is the correct statmenet

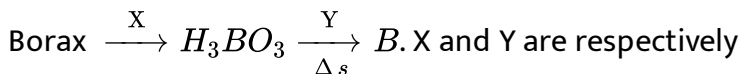
- A. Boric acid is a protonic acid
- B. Beryllium exhibits coordination number of six
- C. Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase
- D.  $B_2H_6 \cdot 2NH_3$  is known as 'inorganic benzene'

Answer: C



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10. Borax is coveredted into crystalline boron by the following steps



- A. HCl , Cu
- B. HCl, C
- C. C, Al

D. HCl, Al

**Answer: D**



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**11. Which is not true about borax ?**

- A. It is a useful primary standard for titrating against acids
- B. Borax forms basic buffer solution
- C. Aqueous solution of borax can be used as buffer
- D. It is made up of two six - membered heterocyclic rings

**Answer: B**



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12. Indium and thallium of III A group have nearly similar atomic radii due to poor screening effect shown by f-electrons in the

- A. Penultimate shell of thallium
- B. Anti penultimate shell of indium
- C. Anti penultimate shell of thallium
- D. Penultimate shell of indium

**Answer: C**



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### **PRACTICE SHEET (EXERCISE - I) LEVEL - II (ADVANCED)**

1. Reactivity of borazole is greater than that of benzene because

- A. borazole is non - polar compound
- B. borazole is polar compound

C. borazole is electron deficient compound

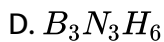
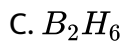
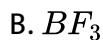
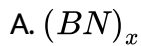
D. De localized electrons in it

**Answer: B**



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**2. Inorganic benzene is**



**Answer: D**



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3.  $H_3BO_3$  is

- A. monobasic and weak Lewis acid
- B. monobasic and weak Bronsted acid
- C. monobasic and strong Lewis acid
- D. tribasic and weak Bronsted acid

**Answer: A**



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4. Which statement is not true about potash alum

- A. It's empirical formula is  $KAl(SO_4)_2 \cdot 12H_2O$
- B. It's aqueous solution is basic in nature
- C. It is used in dyeing industries
- D. On heating it melts and loses its water of crystallization

**Answer: B**



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5. Be and Al exhibit many properties which are similar, but the two elements differ in

- A. exhibiting amphoteric nature in their oxides
- B. forming polymeric hydrides
- C. exhibiting maximum covalency in compounds
- D. forming covalent halides

**Answer: B**



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6. Aluminium powder is used in

A. The extraction of gold

B. Calico-printing

C. Sizing paper

D. In flash bulbs

**Answer: D**



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7. Melting point is higher for

A. B

B. Al

C. Ga

D. In

**Answer: A**



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8.  $AlCl_3$  exist as dimer because

- A. Al has greater IP
- B. Al has larger radius
- C. High charge nucleus
- D. Incomplete - P subshell

**Answer: D**



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9.  $BCl_3$  doesnot exist as dimer but  $BH_3$  exist as dimer ( $B_2H_6$ ) because

- A. chlorine is more electronegative than hydrogen
- B. there is  $p\pi - d\pi$  back bonding in  $BCl_3$  but  $BH_3$  doesnot contain such multiple bonds

C. large size chlorine atom donot fir in between small boran atoms  
where as small sized hydrogen atom get fitted in between boran atoms

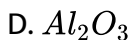
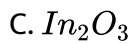
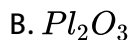
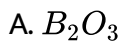
D. none of the above

**Answer: C**



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**10. Which of the following are basic**



**Answer: B::C**



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11. Ortho boric acid and metaboric acid differ in respect of

- A. Basicity
- B. Structure
- C. M.P
- D. oxidation state

**Answer: A::B::C**



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12. Possible oxidation states of boron family elements are

- A. +1
- B. +2
- C. +3



D. +4

**Answer: A::C**



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**13.** Which among the following is acts as reducing agent ?

A. GaCl

B. InCl

C. TlCl

D.  $TlCl_3$

**Answer: A::B**



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**14.** Which of the following statement is correct ?

A.  $\text{TI (III)}$  salt undergo disproportionation

B.  $\text{CO}$  is used as reducing agent

C.  $\text{CO}_2$  is a greenhouse gas

D.  $\text{SiO}_2$  is a covalent solid

**Answer: B::C::D**



**View Text Solution**

**15. Which of the following is basic in nature ?**

A.  $\text{Be}(\text{OH})_2$

B.  $\text{Mg}(\text{OH})_2$

C.  $\text{Al}(\text{OH})_3$

D.  $\text{B}(\text{OH})_3$

**Answer: A::B::C**



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16. Which of the following has lowest melting point ?

A. B

B. Al

C. Ga

D. Tl

**Answer: C**



**View Text Solution**

17. Which halides of element of group 13 exist as dimer in vapour state ?

A. Al

B. B

C. Ga

D. In

**Answer: A::C::D**



**Watch Video Solution**

**18. Which of the following does not exhibit inert pair effect ?**

A. B

B. Al

C. Tl

D. Sc

**Answer: A::B::D**



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**19.** The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state which is two unit less than the group OS. Down the group decreasing, the stability state of higher OS increasing, and that of lower OS increasing. The concept which is commonly called inert pair effect has been used to explain many physical and chemical properties of the element of these groups.

Heavier members of group 13 exhibit oxidation state.

- A. +3 only
- B. +1 only
- C. +1, +3 both
- D. +1, +2, +3

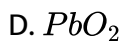
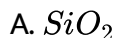
**Answer: C**



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20. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state which is two unit less than the group OS. Down the group decreasing, the stability state of higher OS increasing, and that of lower OS increasing. The concept which is commonly called inert pair effect has been used to explain many physical and chemical properties of the element of these groups.

Which among the following is the strongest oxidising agent ?



**Answer: D**



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21. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state which is two unit less than the group OS. Down the group decreasing, the stability state of higher OS increasing, and that of lower OS increasing. The concept which is commonly called inert pair effect has been used to explain many physical and chemical properties of the element of these groups.

Which among the following is the strongest reducing agent ?

A. GaCl

B. InCl

C.  $B\text{Cl}_3$

D. TlCl

**Answer: A**



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22. Boron forms a number of hydrides having the general formulae  $B_nH_{n+4}$  and  $B_nH_{n+6}$ . These are called boranes the simplest hydride of boron is diborane. Borane contains special types of bonds known as multicentric bonds. Boranes have high heat of combustion.

The type of hybridisation of boron in diborane is

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $sp^2$

**Answer: C**



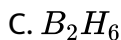
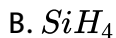
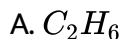
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23. Boron forms a number of hydrides having the general formulae  $B_nH_{n+4}$  and  $B_nH_{n+6}$ . These are called boranes the simplest hydride of boron is diborane. Borane contains special types of bonds known as



multicentric bonds. Borans have high heat of combustion.

Which of the following compound is electron deficient compound.



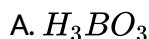
**Answer: C::D**

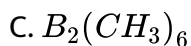
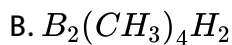


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**24.** Boran forms a number of hydrides having the general formulae  $B_nH_{n+4}$  and  $B_nH_{n+6}$ . These are called boranes the simplest hydride of boran is diborane. Borane contains special types of bonds known as multicentric bonds. Borans have high heat of combustion.

From  $B_2H_6$ , all the following can be prepared, except





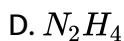
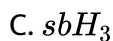
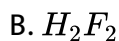
**Answer: C**



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**25.** Boran forms a number of hydrides having the general formulae  $B_nH_{n+4}$  and  $B_nH_{n+6}$ . These are called boranes the simplest hydride of boran is diborane. Borane contains special types of bonds known as multicentric bonds. Boranes have high heat of combustion.

Which hydrid doesnot exist.



Answer: A



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	Column - I	Column - II
	(A) Graphite	(P) Layered structure
26.	(B) Boric acid	(Q) Delocalization of electrons
	(C) Borazole	(R) Electrical conductor
	(D) Boron nitride	(S) Hydrogen bonds



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27. How many moles of  $NO_2$  are produced when mole of 'B' react with  $HNO_3$  ?



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28. How much nitrogen is evolved when one gm of  $NH_4Cl$  is heated with borax strongly ?



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29. Number of hexagonal rings in borax.



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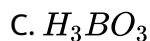
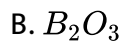
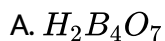
30. The number of hydrogen bonds that can be formed by each borax acid molecule.



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### PRACTICE SHEET (EXERCISE - II) LEVEL - I (MAIN)

1.  $Na_2B_4O_7 \cdot 10H_2O \xrightarrow{\text{conc. } HCl} A \xrightarrow{160^\circ C} B$ . Compound 'B' is



D.  $HBO_2$

**Answer: A**



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2. Indium and thallium of III A group have nearly similar atomic radii due to poor screening effect shown by f-electrons in the

- A. Penultimate shell of thallium
- B. Anti penultimate shell of indium
- C. Anti penultimate shell of thallium
- D. Penultimate shell of indium

**Answer: C**



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3. The III A group element that does not displace hydrogen from hydrochloric acid is

- A. B
- B. Al
- C. both (1) and (2)
- D. Tl

**Answer: A**



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4. In  $GaCl_2$ , oxidation state of Ga is

- A. +2
- B. +1 & +3
- C. 0
- D. -2

**Answer: B**



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**5.** Boron compounds behave as Lewis acids because of their

- A. Acidic nature
- B. Covalent nature
- C. Ionic nature
- D. Vacant orbital

**Answer: D**



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**6.** Among the halides

(a)  $BF_3$

(b)  $BCl_3$

(c)  $BBr_3$

(d)  $BI_3$

The order of decreasing Lewis acid character is

A. a,b,c,d

B. d,c,b,a

C. c,d,b,a

D. b,c,d,a

**Answer: B**



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7. When orthoboric acid ( $H_3BO_3$ ) is heated strongly the residue left is

A. boron

B. metaboric acid

C. boric anhydride



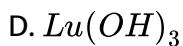
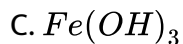
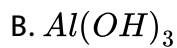
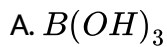
D. borax

**Answer: C**



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**8. An acid among the following is**

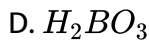
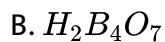
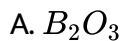


**Answer: A**



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**9. Boric acid on heating at  $150^\circ C$  gives**

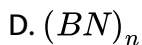
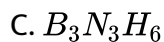
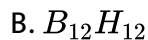
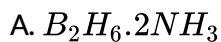


**Answer: B**



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**10.** Diborane react with ammonia under different conditions to give a variety of products. Which one among the following is not formed in these reactions



**Answer: B**



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11.  $B - H - B$  bridge in  $B_2H_6$  is formed by the sharing of

A. 2 electrons

B. 4 electrons

C. 1 electron

D. 3 electron

**Answer: A**



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12. There are two H-bridge bonds in diborane molecule because there are

A. only 12 electrons

B. 14 electrons

C. 2 electrons less than required to complete octet

D. two electrons more than required for bonding

**Answer: A**



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## **PRACTICE SHEET (EXERCISE - II) LEVEL - II (ADVANCED)**

1. Metal protected by a layer of its own oxide is

A. Al

B. Ag

C. Au

D. B

**Answer: A**



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2. In the electrolysis of alumina, cryolite is added to

- A. lower the melting point of alumina
- B. increase the electrical conductivity
- C. both (a) and (b)
- D. remove impurities from alumina

**Answer: C**



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3. Mineral of aluminium that does not contain oxygen is

- A. corundum
- B. diaspore
- C. bauxite

D. cryolite

**Answer: D**



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4. Conc.  $HNO_3$  can be stored in container of

A. Fe

B. Al

C. Zn

D. Sn

**Answer: B**



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5. Duralumin is an alloy of

A. Al and Mg

B. Mg and Cu

C. Al, Mg, Mn and Cu

D. Al nad Cu

**Answer: C**



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6.  $Al_2O_3$  formation involves large quantity of heat evolution which makes its use in

A. deoxidiser

B. confectionary

C. indoor photography

D. thermite welding

**Answer: D**

7.  $AlCl_3$  exist as dimer because

- A. Al has greater IP
- B. Al has larger radius
- C. High charge nucleus
- D. Incomplete p-orbital

**Answer: D**

8. Aluminium is obtained by

- A. reducing  $Al_2O_3$  with coke
- B. electrolysing  $Al_2O_3$  dissolved in  $Na_3AlF_6$
- C. reducing  $Al_2O_3$  with chromium



D. heating  $Al_2O_3$  and cryolite

**Answer: B**



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9. Aluminium vessels should not be washed with materials containing washing soda because

A. washing soda is expensive

B. washing soda is easily decomposed

C. washing soda reacts with aluminium to form soluble aluminate

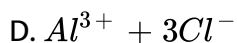
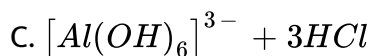
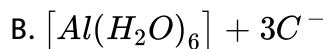
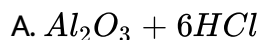
D. washing soda reacts with aluminium to form insoluble aluminium oxide

**Answer: C**



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10. Aluminium chloride exists as dimer,  $Al_2Cl_6$  in solid state as well as in solution of non - polar solvents such as  $C_6H_6$ . When dissolved in water it gives :

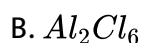


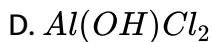
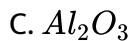
**Answer: C**



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11. Heating an aqueous solution of aluminium chloride to dryness will give :



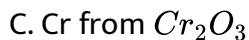
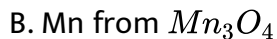


**Answer: C**



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12. Which of the following metal be extracted by using 'A' as a reducing agent ?



**Answer: A::B::C**



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13. Which of the following minerals does contains alluminium ?

- A. Cryolite
- B. Mica
- C. Feldspar
- D. Flourospar

Answer: A::B::C



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14.  $Al_2O_3$  can be converted to anhydrous  $AlCl_3$  by heating :

- A. A mixture of  $Al_2O_3$  and carbon in dry  $Cl_2$  gas
- B.  $Al_2O_3$  with HCl gas
- C.  $Al_2O_3$  with  $Cl_2$  gas
- D.  $Al_2O_3$  with NaCl in solid state

**Answer: A::B::C**



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**15. Alums are used for**

- A. Tanning of leather
- B. Purification of water
- C. Coagulation
- D. Catalyst in Friedel-Crafts reaction

**Answer: A::B::C**



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**16. Alum helps in purifying water by**

- A. Forming a complex with clay particles

- B. Sulphate part which combines with dirt and removes it
- C. Alluminium which coagulated the mud particles
- D. Making the mud water soluble

**Answer: C**



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**17.** Anhydrous  $AlCl_3$  is obtained when

- A. Alluminium oxide reacts with HCl
- B. Alluminium reacts with HCl
- C. Alluminium oxide with coke is heated in a current of dry  $Cl_2$
- D. Alluminium hydroxide reacts with HCl

**Answer: C**



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18. Identify the correct statements regarding the structure of  $Al(BH_4)_3$

- A. Aluminium is  $sp^2d^2$  and boron is  $sp^3$  hybridised
- B. It has 6 3C. 2e bonds
- C. It has 6 Al - H - B bonds
- D. It has 6 2C - 2e bonds

Answer: C



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19. Which of the following method can be used for preparation of anhydrous  $AlCl_3$

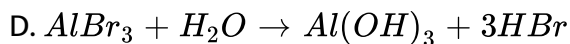
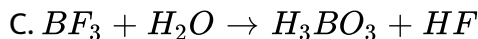
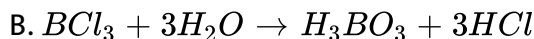
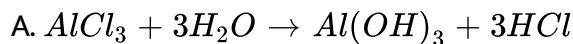
- A. heating  $AlCl_3 \cdot 6H_2O$
- B. heating of mixture of alumina and coke in a current of dry chlorine
- C. passing dry HCl gas over heated Al power
- D. passing dry Cl over head Al

**Answer: C**



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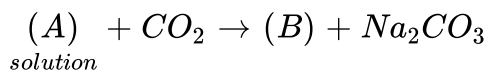
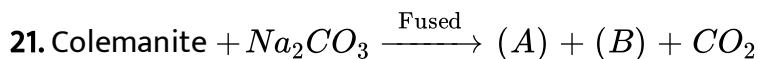
**20.** Which of the hydrolysis reaction of halides of III - A group elements is correct.



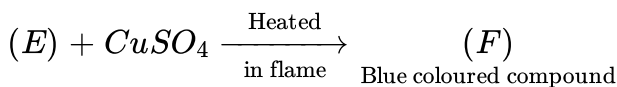
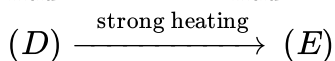
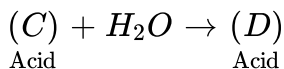
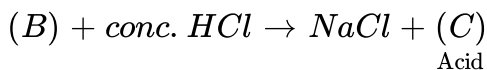
**Answer: A::B::D**



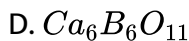
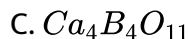
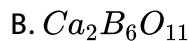
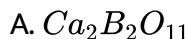
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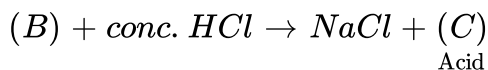
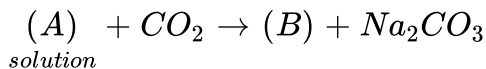
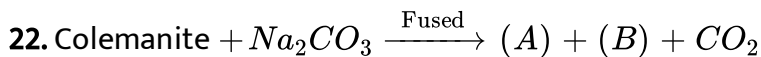
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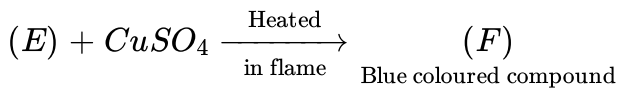
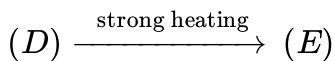
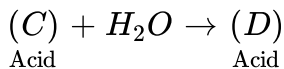


**Answer: B**

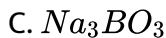
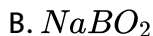
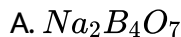


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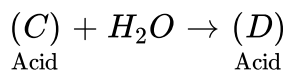
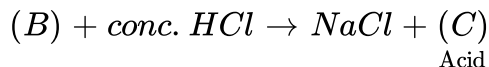
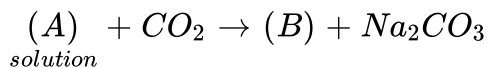
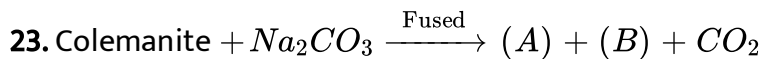
Compound (B) is

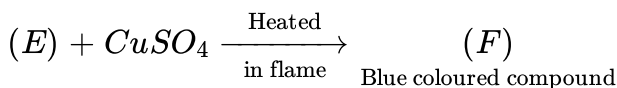
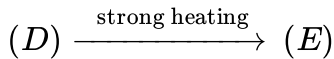


**Answer: A**

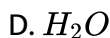
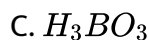
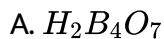


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Compound (D) is

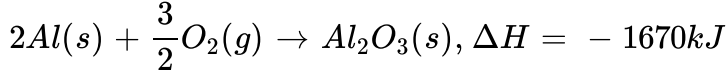


**Answer: C**



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**24.** Aluminium is stable in air and water inspite of the fact that it is reactive metal. The reason is that a thin film of its oxide, if formed on its surface which makes it passive for further attack. The layer is so useful that in industry, it is purposely deposited by an electrolytic process called anodizing. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction



Thermite reaction finds applications in the metallurgical extraction of many metals from their oxides and for welding of metals. The drawback is that to start the reaction, high temperature is required for which an ignition mixture is used.

Anodised aluminium is

- A. Al obtained at anode
- B. Al prepared electrolytically
- C. Alloy of Al containing 95% Al
- D. Al electrolytically coated with  $Al_2O_3$

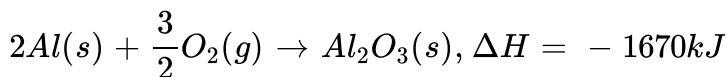
**Answer: D**



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**25.** Aluminium is stable in air and water inspite of the fact that it is reactive metal. The reason is that a thin film of its oxide, if formed on its surface which makes it passive for further attack. The layer is so useful

that in industry, it is purposely deposited by an electrolytic process called anodizing. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction



Thermite reaction finds applications in the metallurgical extraction of many metals from their oxides and for welding of metals. The drawback is that to start the reaction, high temperature is required for which an ignition mixture is used.

Thermite mixture used for welding is

A.  $Fe_2O_3$  and Al powder

B. BaO and Mg powder

C. Fe and Al

D. Cu and Al

**Answer: A**



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## Column - I

## Column - II

- (A)  $B_2H_6 + NH_3 \xrightarrow[\text{temperatures}]{\text{under different}}$
26. (B)  $2BF_3 + 6LiH \rightarrow$
- (C) Two electron four centre bond
- (D)  $sp^3$  hybrid orbitals
- (P)  $B_2H_6$
- (Q) Borazine
- (R)  $AlCl_3$  (vapour)
- (S) Inorganic graphite

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27. The number of hybrid orbitals involved in the formation of  $B_2H_6$ ,  $B_3N_3H_6$ ,  $BCl_3$ ,  $H_3BO_3$  are p, q, r & s, then the sum of  $(p + q + r + s)$  is 8y, then y = ?

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28. The number of moles of sulphate ions present in the general formula of 1 mole of alum ?

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29. The value of  $n$  in the molecular formula Ben  $Al_2Si_6O_{18}$  is \_\_\_\_\_



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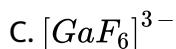
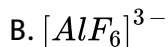
30. The number of bridge bonds, the maximum number of planar atoms and the number of electrons involved in the formation of bridge bonds in diborane are  $x$ ,  $y$  and  $z$  respectively, then  $(x+y-z) = ?$

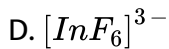


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### ADDITIONAL PRACTICE EXERCISE (LEVEL - I (MAIN))

1. Which species doesnot exist





**Answer: A**



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2. In commercial electro chemical process for Al extraction electrolyte used as

A.  $Al(OH)_3$  in NaOH solution

B. aq.  $Al_2(SO_4)_3$

C. Al molten mixture of  $Al_2O_3$  and  $Na_3AlF_6$

D. none of the above

**Answer: C**



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3. Thermite is a mixture of x parts of  $Fe_2O_3$  and y parts of aluminium powder, x, y respectively are

A. 3, 1

B. 3, 2

C. 1, 1

D. 2, 3

**Answer: A**



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4. Which pair of ions cannot be separated by  $H_2S$  in dil/HCl

A.  $Bi^{3+}$ ,  $Sn^{4+}$

B.  $Zn^{2+}$ ,  $Cu^{2+}$

C.  $Al^{3+}$ ,  $Ni^{2+}$

D.  $Ni^{2+}$ ,  $Cu^{2+}$

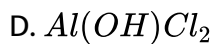
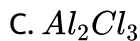
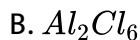
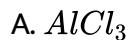
**Answer: C**



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5. Heating an aqueous solution of aluminium chloride to dryness will give

:



**Answer: B**



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6. Corundum is an ore of

A. Copper

B. Boran

C. Al

D. Na

**Answer: C**



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7. Among the halides (a)  $BCl_3$  (b)  $AlCl_3$  (c)  $GaCl_3$  (d)  $InCl_3$

The order of decreasing Lewis acid character is

A. a,b,c,d

B. d,c,b,a

C. b,d,a,c

D. b,c,d,a

**Answer: B**



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8. Thermite is a mixture of  $Fe_2O_3$  and

A. Zn powder

B. Na - metal

C. K - metal

D. Al - powder

Answer: D



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9. Which of the following has large size

A. Al

B.  $Al^+$

C.  $Al^{2+}$

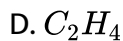
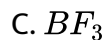
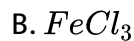
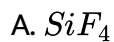


**Answer: A**



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**10.** Which of the following not a Lewis acid



**Answer: D**



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**11.**  $AlCl_3$  is

A. An hydrous and covalent

B. An hydrous and ionic

C. Covalent and basic

D. Co - ordinate and acidic

**Answer: A**



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**12.** Aluminium react with  $Na_2CO_3$  to form

A.  $Al(OH)_3$

B.  $Al_2O_3$

C.  $NaAlO_2$

D.  $Al_2CO_3$

**Answer: C**



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13. Aluminium react with concentrated HCl and concentrated NaOH to liberated the gases respectively

A.  $H_2$  and  $O_2$

B.  $O_2$  and  $H_2$

C.  $H_2$  and  $H_2$

D.  $O_2$  and  $O_2$

**Answer: C**



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### ADDITIONAL PRACTICE EXERCISE (LEVEL - II LECTURE SHEET (ADVANCED))

1. Aluminium exhibits diagonal relationship with

A. C

B. Si

C. Be

D. Ge

**Answer: C**



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2. Electronic structure acquired by compounds of IIIA group elements in bonding is

A. Doublet

B. Octet

C. Sextet

D. Super octet

**Answer: C**



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3. Thallous chloride is more stable than thallic chloride because of

- A. more ionic character
- B. Larger size of  $Tl^+$  ion
- C. High hydration energy of  $Tl^+$  ion
- D. Inertpair effect

**Answer: D**



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4. Element with gaint co - valent structure is

- A. B
- B. Al
- C. Ge
- D. Tl

**Answer: A**



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**5. Which of the following is used in high temperature thermometry ?**

A. Na

B. Ga

C. Tl

D. Hg

**Answer: B**



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**6. The maximum co - valency of aluminium is '6' where as that of boron is '4' because**

- A. 'Al' is more electropositive than boron
- B. 'Al' can form a cation where as boron cannot
- C. 'Al' contains vacant 'd' orbitals in it's valance shell where as boron does not
- D. 'Al' is a metal where as boron is a non - metal

**Answer: C**



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**7. Which element reacts with acids as well as alkalies.**

- A. Mg
- B. Si
- C. Al
- D. 'Cu'

**Answer: C**



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8. Which statements are correct.

- (1) I.P of 'Ga' is greater than 'Al'
- (2) I.P of 'B' is greater than 'Al'
- (3) I.P. of 'Tl' is greater than 'In'
- (4) I.P of 'Ga' is greater than 'In'

A. 3, 4

B. 1, 2, 3, 4

C. 4 only

D. 1, 2

**Answer: B**



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9. The electrical conductivity of aluminium is twice that of copper on the basis of

- A. weight to volume basis
- B. weight to weight basis
- C. volume to volume basis
- D. none of these

**Answer: B**



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10. 'Al' and its alloy can be given shapes of

- A. pipes
- B. tubes
- C. rods
- D. All the above

**Answer: D**



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**11. Which of the following minerals contain aluminium ?**

A. Fluorspar

B. Feldspar

C. Mica

D. Carborundum

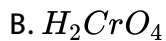
**Answer: B::C**



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**12. Aluminium becomes passive in**

A. *conc.  $HNO_3$*



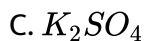
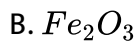
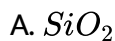
D. conc. HCl

**Answer: A::B::C**



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**13. The chief impurity not present in bauxite is**



D. NaF

**Answer: A::B**



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14.  $AlCl_3$  is an electron deficient compound but  $AlF_3$  is due to

- A. Atomic size of F is smaller than Cl, which makes  $AlF_3$  more covalent
- B.  $AlCl_3$  is a covalent compound while  $AlF_3$  is an ionic
- C. Al in  $AlCl_3$  is  $sp^3$  hybridised but in  $AlF_3$ , Al is  $sp^2$  hybridised
- D.  $AlCl_3$  is exists in dimer but  $AlF_3$  does not

**Answer: A::C::D**



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15. Which of the following element donot form carbide

- A. B
- B. Al
- C. In
- D. Ga



**Answer: C::D**



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**16.**  $Al_2(SO_4)_3 + NH_4OH \rightarrow X$ ,  $X$  is

- A. a white gelatinous precipitate
- B. In soluble in excess of  $NH_4OH$
- C. soluble in excess of NaOH
- D. amphoteric in nature

**Answer: A::B::C::D**



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**17.** An inorganic compound (A) shows the following reactions. It is white solid and exists as dimer

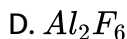
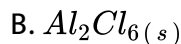
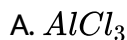
(i) gives fumes of (B) with much wet air

(ii) It sublimes on  $180^{\circ}C$  turns forms monomer if heated to  $400^{\circ}C$

(iii) Its aqueous solution turns blue litmus to red

(iv) Addition of  $NH_4OH$  and NaOH separately to a solution of (A) gives white precipitate which is however soluble in excess of NaOH

A may be



**Answer: A**



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**18.** An inorganic compound (A) shows the following reactions. It is white solid and exists as dimer

(i) gives fumes of (B) with much wet air

(ii) It sublimes on  $180^{\circ}C$  turns forms monomer if heated to  $400^{\circ}C$

(iii) Its aqueous solution turns blue litmus to red

(iv) Addition of  $NH_4OH$  and NaOH separately to a solution of (A) gives white precipitate which is however soluble in excess of NaOH

B may be

A.  $Cl_2$

B.  $F_2$

C. HCl

D. HF

**Answer: C**



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Column - I		Column - II	
(A)	Corundum	(P)	$Ca_aB_6O_{11} \cdot 5H_2O$
(B)	Cryolite	(Q)	$Al_2O_3 \cdot 2H_2O$
19. (C)	Potash alum	(R)	Sodium aluminium fluoride
(D)	Colemanite	(S)	$Al_2O_3$
(E)	Bauxite	(T)	$Na_2B_4O_7 \cdot 10H_2O$
(F)	Borax	(U)	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$



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20. How many of the following show borax bead test B, Be, Mg, Cu, Fe, Cr, Co, Mn, Ni

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21.  $Al[BH_4]_3$  contains how many 3 centered  $-2e^-$  bonds.

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### ADDITIONAL PRACTICE EXERCISE (PRACTICE SHEET (ADVANCED))

1. Aqueous solution of  $H_3BO_3$  is treated with salicylic acid which of the following are incorrect ?

A. No product is formed because both are acids.

B. Product is formed 4 - coordinate complex and optically resolvable

- C. Like organic benzene, borazine does not give addition product
- D. Products are formed 4 - co - ordinate complex and optically not resolvable

**Answer: A::C::D**



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**2. Pick out correct statements regarding crystalline form of boron**

- A. All allotropic forms of boron contains icosahedral units with boron atoms at all 12 corners.
- B. In  $B_{12}$  units each boron atom is bonded to five boron atoms as a distance of  $1.77\text{\AA}$
- C.  $\alpha$  - rhombohedral form of boron consists of layers of icosahedra linked with in each layer by three centre B-B bonds and between layers B-B bonds

D.  $\beta$  - rhombohedral form consists of  $12B_{12}$  icosahedra arranged icosahedral about central  $B_{12}$  unit ( $B_{12}(B_{12})_{12}$ )

**Answer: A::B::C::D**



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**3. Regarding Boricacid, which of the following statements is correct ?**

A. Boric acid has layered lattice structure

B. When excess of boricacid is added to a solution of acidic  $KHF_2$ , the solution becomes alkaline

C. Boric acid on heating at  $160^\circ$  forms pysoboric acid

D. Boric acid is quite good lubricant

**Answer: A::B::D**



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4. Which of the following statement are correct ?

A. Boron is used cleaning metals

B.  $Al_2O_3$  is amphoteric white  $B_2O_3$  is acidic

C. Boric acid on heating with CuO gives metaborate and boron bead test

D. Boron nitride is inorganic graphite

Answer: A::B::C::D



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5. Which of the following statement is correct ?

A. a) Tri methyl boron is a weak Lewis acid compared to boron halides

B. b) CO forms stable adduct with diborane than with  $BF_3$

C. c)  $TlI_3$  when added to aqueous sodium hydroxide give  $Tl_2O_3$  precipitate

D. d) If KI is added to  $TlI_3$  the compound formed  $K[TlI_4]$  contains

**Answer: A::B::C::D**



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6.  $Al_2(SO_4)_3 + NH_4OH \rightarrow X$ ,  $X$  is

A. a white gelatinous precipitate

B. insoluble in excess of  $NH_4OH$

C. soluble in excess of NaOH

D. amphoteric in nature

**Answer: A::B::C::D**



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7. Among the following statements the correct are :

A. The increasing Lewi's acidity is  $BF_3 < BCl_3 < AlCl_3$

B. When  $BF_3 \cdot N(CH_3)_3$  reacts with  $BCl_3$  the product formed is  $BCl_3 \cdot N(CH_3)_3$

C. When  $BH_3 \cdot CO$  reacts with  $BBr_3$  the product formed is  $BBr_3 \cdot CO$

D.  $BF_3$  is formed by the reaction of  $B_2O_3$  with  $CaF_2$  and conc.  $H_2SO_4$

Answer: A::B::D



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8. Which of the following statements are correct ?

- A. When  $BF_3$  is treated with excess of NaF in acidic aqueous solution gives  $NaBF_4$
- B. When  $BCl_3$  is treated with excess of NaCl in acidic aqueous solution gives  $H_3BO_3$
- C. When  $BBr_3$  is treated with  $NH(CH_3)_2$  in a hydrocarbon solvent gives  $B[N(CH_3)_2]_3$
- D. When  $B_2H_6$  is treated with  $BeH_2$  the product formed is  $Be(BH_4)_2$

**Answer: A::B::C::D**



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**9. Which of the following are incorrect statements ?**

- A.  $BH_3$  is stable compound
- B. Boron hydrides readily hydrolysed
- C. Boron hydrides are formed by the reaction of  $Mg_3B_2$

D. All B-H bonds in  $B_2H_6$  are equal

**Answer: A::D**



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10. Borax is  $Na_2B_4O_7 \cdot 10H_2O$  consider the following statements about boran

A. 2 boran atoms have 4 B - O bonds where as other two have 3 B - O bonds

B. Each boran has one OH - group

C. It is a salt of tetro boric acid

D. It is a cyclic meta borate havinf two six membered rings.

**Answer: A::B::C::D**



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11. Which of the following acts as Lewis acid ?



Answer: A::B::C



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12. Boron Nitride is not isoelectronic with ?



**Answer: B::C::D**



**Watch Video Solution**

**13.** Which one of the following is hardest compound of the following.

A. Boran carbide

B. Boran nitride

C. Magnesium bromide

D. Sillicon boride

**Answer: A**



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**14.** Borax bead test is not given by

A. Copper salts

B. Cobalts salts

C. Nickel salts

D. Aluminium salts

**Answer: A::B::C**



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**15. Which of the following pair contains with same structures.**

A. Borazine & Benzene

B. Biborane & Hydrazine

C. NaCl & NFO

D. Grphite & Boran nitride

**Answer: A::C::D**



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**16.** Diborane is simplest and most familiar hydride of boron. Its chemical formula is  $B_2H_6$ . Comparing with ethane, diborane is regarded as electron deficient molecule. In the excited state boron of diborane undergoes  $sp^3$  hybridisation. Bonding in diborane is described as tricentric two electron bonding.

Number of empty  $sp^3$  hybrid orbitals of each "B" atom in  $B_2H_6$

Each B contains one  $sp^3$  vacant hybrid orbital

A. 1

B. 2

C. 3

D. 4

**Answer: A**



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17. Diborane is simplest and most familiar hydride of boron. Its chemical formula is  $B_2H_6$ . Comparing with ethane, diborane is regarded as electron deficient molecule. In the excited state boron of diborane undergoes  $sp^3$  hybridisation. Bonding in diborane is described as tricentric two electron bonding.

Structure of  $-BH_2$  group is

- A. linear
- B. planar
- C. tetrahedral
- D. octahedral

**Answer: B**



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18. The number of atoms involved in bridged bonds in one diborane molecule is



A. 2

B. 3

C. 4

D. 6

**Answer: C**



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**19.** Group 13 of periodic table consists of boron or aluminium family. Boron being the first member, shows anomalous behaviour due to its small size and high nuclear charge/size ratio, high electronegativity and non availability of d-electrons. All the group 13 members form hydrides, hydroxides, halides showing +3 covalency, however boron forms electron deficient species.

Which of the following statement(s) is/are correct.

(I) Both B and Al form anionic hydrides

(II) Both form alkaline hydroxide of formula  $M(OH)_3$

(III) Both B and Al forms a series of polymeric hydrides

(IV) Both forms monoeeric halides  $MX_3$

A. I, IV

B. I, II, III

C. II, III

D. I, II, IV

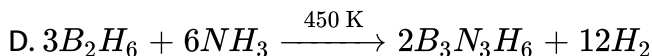
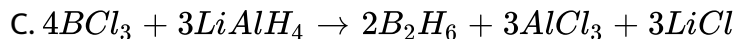
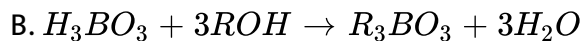
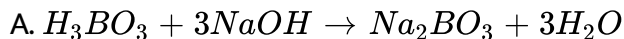
**Answer: A**



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**20.** Group 13 of periodic table consists of boron or aluminium family. Boron being the first member, shows anomalous behaviour due to its small size and high nuclear charge/size ratiom high electrone gastivity and non availability of d-electrons. All the group 13 members forms hydrides, hydroxides, halides showing +3 covalency, however boron forms electron deficient species.

Which one is not correct chemical change ?



Answer: A



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	Column - I	Column - II
	(A) Boric acid	(P) $Na_2[B_4O_5(OH)_4]$
	(B) Kernite	(Q) $K_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$
21.	(C) Feldspar	(R) $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
	(D) Mica	(S) $KAlSi_3O_8$
	(E) Kadonite	(T) $H_3BO_3$
	(F) Diaspar	(U) $Al_2O_3H_2O$



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22. Number of moles of  $OH^-$  produced by dissolving 1 mole of  $B(OH)_3$  in water ?



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23. Number of tetrahedral boron atoms in peroxoborate.



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24. Number of  $3c - 2e$  bonds (hydrogen bridges) in  $Be(BeH_4)_2$  is



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## LECTURE SHEET (Straight Objective Type Questions)

1. The order of abundance of IIIA group elements is

A.  $Al > Ga > B > Tl > In$

B.  $B > Ga > Al > In > Tl$

C.  $B > Al > Ga < In > Tl$

D.  $Al > Ga > Tl > B > In$

**Answer: A**



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**2. +1 oxidation state is stable for the element**

A. B

B. Al

C. Ga

D. Tl

**Answer: D**



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3. Among the III A group elements, the difference in the atomic radius is large in between

- A. Aluminium and Boron
- B. Gallium and Aluminium
- C. Thallium and Indium
- D. Gallium and Indium

**Answer: A**



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4. Which element can not form a cation ?

- A. Al
- B. B
- C. Cs

D. Bi

**Answer: B**



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5. Which of the following pair of elements have same atomic radius

A. B,Al

B. Al,Ga

C. Ga,In

D. In , Tl

**Answer: B**



**Watch Video Solution**

6. The nature of  $B_2O_3$  is

A. Neutral

B. Amphoteric

C. Acidic

D. Basic

**Answer: C**



**Watch Video Solution**

7. When KBr is treated with conc.  $H_2SO_4$  reddish-brown gas is evolved.

The gas is

A.  $B_2O_3$

B.  $SO_2$

C.  $O_2$

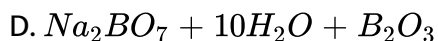
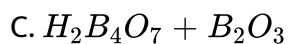
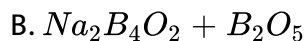
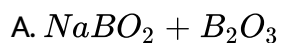
D.  $SO_3$

**Answer: B**



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8. Borax glass is a mixture of

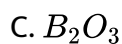
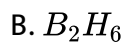


Answer: A

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9. On strong heating Boric acid gives

A. B



D.  $BO_2$

**Answer: C**



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**10.** Glassy bead is obtained by heating

A.  $Na_2B_4O_7 \cdot 10H_2O$

B.  $H_3BO_3$

C.  $B_2H_6$

D.  $Ca_2B_6O_{11}$

**Answer: A**



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**11.** The H - B - H bridged angle in diborane is

A.  $121.5^\circ$

B.  $97^\circ$

C.  $119^\circ$

D.  $133^\circ$

**Answer: B**



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**12.** The bonds not present in diborane is

A. B - H

B. B - H - B

C. B - B

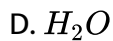
D. H - B - H

**Answer: C**



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13. Which of the following does not react with diborane

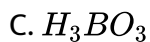
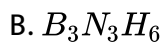
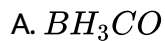


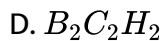
**Answer: C**



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14. Diborane reacts with carbon monoxide to form



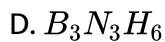
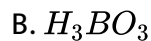


**Answer: A**



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**15.** Diborane on hydrolysis gives

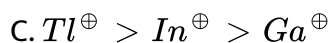
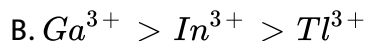
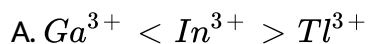


**Answer: B**



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1. Stability of monovalent and trivalent cations of Ga. In lie the following sequence



Answer: B::C



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2. Which of the following minerals contain aluminium ?

A. Fluorspar

B. Feldspar

C. Mica

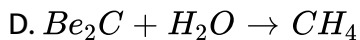
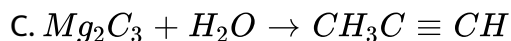
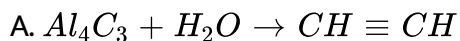
D. Carborundum

Answer: B::C



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3. When metal carbides react with  $H_2O$ , the correct equations are



Answer: B::C::D



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4. Which of the following statements are true for  $H_3BO_3$  ?

A. It is mainly monobasic acid and a Lewis acid

- B. It does not act as a proton donor but acts as an acid by accepting hydroxyl ions
- C. It has layer structure in which  $BO_3$  units are joined by hydrogen bonds
- D. It is obtained by treating borax with conc.  $H_2SO_4$

**Answer: A::B::C::D**



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5. Which of the following statements(s) is/are correct regarding the structure of borax ?

- A. Number of B - B bonds are zero
- B. Hybridization of each boron atom is  $sp^2$
- C. Number of B - O bonds are five
- D. Borax contain two different types of B - O bonds

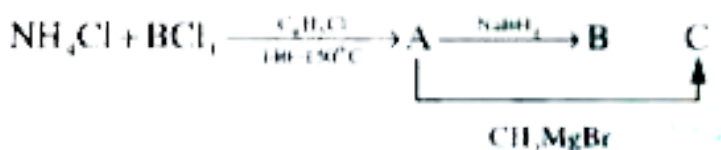


Answer: A::C::D



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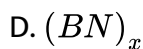
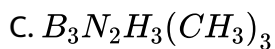
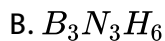
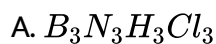
## LECTURE SHEET (Linked Comprehension Type Questions)



1.

On the basis of reaction sequence given above, answer the following

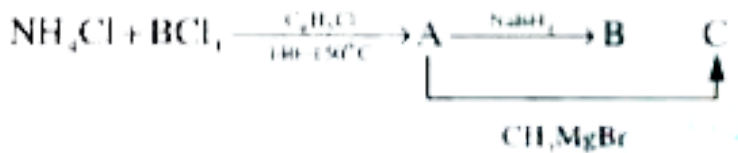
A is



Answer: A



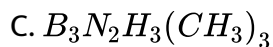
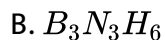
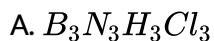
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2.

On the basis of reaction sequence given above, answer the following

B is

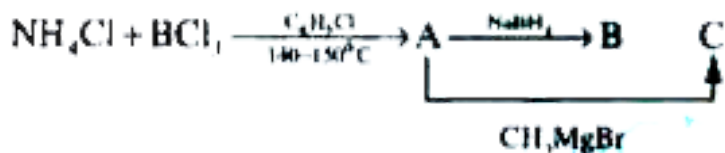


D. Inorganic graphite

Answer: B



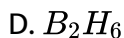
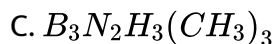
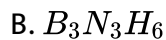
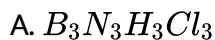
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3.

On the basis of reaction sequence given above, answer the following

C is



**Answer: C**



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4. An inorganic compound (A) shows the following reactions. It is white solid and exists as dimer

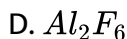
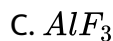
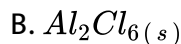
(i) gives fumes of (B) with much wet air

(ii) It sublimes on  $180^{\circ}C$  turns forms monomer if heated to  $400^{\circ}C$

(iii) Its aqueous solution turns blue litmus to red

(iv) Addition of  $NH_4OH$  and NaOH separately to a solution of (A) gives white precipitate which is however soluble in excess of NaOH

B may be



**Answer: A**



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5. An inorganic compound (A) shows the following reactions. It is white solid and exists as dimer

(i) gives fumes of (B) with much wet air

(ii) It sublimes on  $180^{\circ}C$  turns forms monomer if heated to  $400^{\circ}C$

(iii) Its aqueous solution turns blue litmus to red

(iv) Addition of  $NH_4OH$  and NaOH separately to a solution of (A) gives white precipitate which is however soluble in excess of NaOH

B may be

A.  $Cl_2$

B.  $F_2$

C. HCl

D. HF

**Answer: C**



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## LECTURE SHEET (Integer Type Questions)

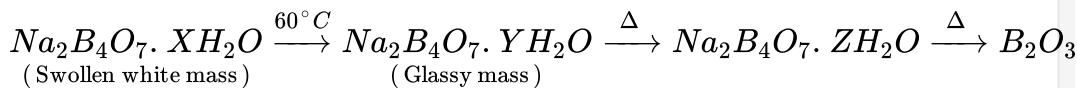
1. How many of the following are non - metals B, Al, Ga, In, Tl, C, Si, Ge, Sn, Pb.



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2.



, then the value of  $(x - y + z)$  is

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3. How many moles of hydrochloric acid react with one mole of borax to convert all boranes to boric acid.

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4. In the borax compound, if the (a) Number of B - O - B bonds is 'x' , (b) Number of B - B bonds is 'y' , (c ) Number of  $sp^2$  hybridised 'B' atoms is 'Z' then calculate the value of  $(x + y + z)$ .  $(x + y + z)$

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5. How many of the following show borax bead test B, Be, Mg, Cu, Fe, Cr, Co, Mn, Ni



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### PRACTICE SHEET (LEVEL - I) (Straight Objective Type Questions )

1. Thallium shows different oxidation states because

- A. It is transition element
- B. Of inert pair effect
- C. Of its amphoteric character
- D. Of its higher reactivity

**Answer: B**



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2. Which of the following is used in high temperature thermometry ?

A. Na

B. Ga

C. Tl

D. Hg

**Answer: B**



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3. The electropositive character increases from B to Al and then decreases from Al to Tl because of

A. Increase in the size of the elements

B. Decrease in the ionization energy of the elements

C. Decrease in the electronegativity of the elements



D. Ineffective shielding of the nuclear charge by d - electrons in the case of Ga, In and Tl

**Answer: D**



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4. III A group element with highest density is

A. B

B. Al

C. In

D. Tl

**Answer: D**



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5. Electronegativity is least for

A. Tl

B. Al

C. Ga

D. B

Answer: A



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6. The hybridisation of boron in ortho boric acid is

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $sp^3d$

**Answer: B**



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7. Boric acid ( $H_3BO_3$ ) has

A. Trigonal structure

B. Tetrahedral structure

C. Layer structure, , in which  $BO_3$  units are linked by oxygen

D. Layer structure, in which planar  $BO_3$  units are linked by hydrogen bonding

**Answer: D**



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8. Boric acid is polymer due to

- A. its acidic nature
- B. the presence of hydrogen bonds
- C. its mono basic nature
- D. its geometry

**Answer: D**



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**9. Least basic among the following is**

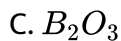
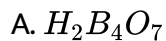
- A.  $\text{InOH}$
- B.  $\text{TlOH}$
- C.  $\text{B}(\text{OH})_3$
- D.  $\text{Al}(\text{OH})_3\text{Al}(\text{OH}_3)$

**Answer: C**



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10.  $H_3BO_3 \xrightarrow{\text{Red heat}} X$ . 'X' in the reaction is

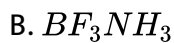


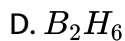
**Answer: C**



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11. Which of the following does not exist ?



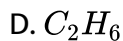
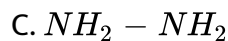
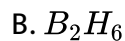
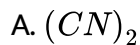


**Answer: C**



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**12.** The following has a potential to be used as a rocket fuel



**Answer: B**



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**13.** The number of 3 centered, 2 electron bonds in diborane is

A. 2

B. 4

C. 3

D. 6

**Answer: A**



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**14.** The non planar molecule among the following is

A.  $B_2H_6$

B.  $C_2H_4$

C.  $C_6H_6$

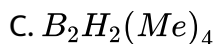
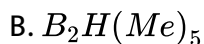
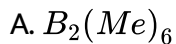
D.  $BCl_3$

**Answer: A**



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15. Methylation of diborane gives [Me = methyl group]



D. All the above

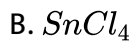
**Answer: C**



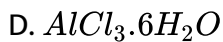
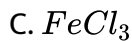
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### PRACTICE SHEET (LEVEL - II) (Straight Objective Type Questions )

1. Which of the following is not a Lewis acid ?





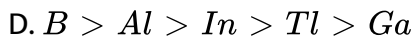
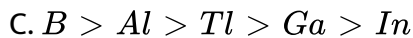
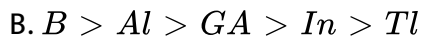
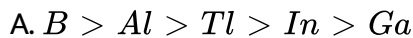


**Answer: D**



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2. The correct order of melting points of IIIA group elements is



**Answer: A**



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3.  $Na_2B_4O_7 \cdot 10H_2O$  can also be represented as

- A.  $Na_2[B_4O_5(OH)_4] \cdot 8H_2O$
- B.  $2NaBO_2 \cdot Na_2B_2O_3 \cdot 10H_2O$
- C.  $Na_2[B_4(H_2O)_4 \cdot O_7] \cdot 6H_2O$
- D. All the above

**Answer: A**



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4.  $B_2H_6 + NH_3 \xrightarrow{120^\circ C} X$ . Where X is

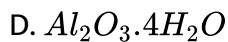
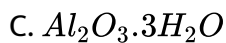
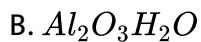
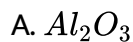
- A.  $[BH_2(NH_3)_2]^+ [BH_4]^-$
- B.  $[BH_2(NH_3)_2]^+ [BH_3]^-$
- C.  $(BH_4)^+ [BH_2(NH_3)_2]^-$
- D.  $(BH_3)^+ [BH_3(NH_3)_2]^-$

**Answer: A**



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**5. Diaspore is**



**Answer: B**



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**6. Dihydrate of alumina is called**

A. Diaspore

B. Cryolite

C. Bauxite

D. Gypsum

**Answer: C**



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7. Regarding 'Al' the wrong statement is

A. It reacts with both acids and bases

B. Its maximum covalency is '6'

C. It is strong reducing agent

D. It becomes passive with Conc. HCl

**Answer: D**



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8. The gas liberated when aluminium reacts with conc.  $H_2SO_4$  is

A.  $H_2S$

B.  $O_2$

C.  $SO_2$

D.  $H_2$

**Answer: C**



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9. In  $Al_2Cl_6$ , the covalency of aluminium is

A. 6

B. 4

C. 3

D. 2

**Answer: B**



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**10.** The number of electrons shared between the two Boron atoms directly in the formation of bonds in diborane molecule

A. 4

B. 2

C. 0

D. 8

**Answer: C**



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**11.** Which of the following is not correct ?

- A. Anhydrous  $AlCl_3$  exists as  $Al_2Cl_6$
- B. Anhydrous  $AlCl_3$  sublimes on heating
- C. Anhydrous  $AlCl_3$  fumes in air
- D. Anhydrous  $AlCl_3$  is ionic

**Answer: D**



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**12. An aqueous solution of alum is**

- A. Acidic
- B. Basic
- C. Neutral
- D. Amphoteric

**Answer: A**



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13. All alums

- A. Contain same ions
- B. Have similar crystal structure
- C. Contain same atoms
- D. Have the same molecular weight

Answer: B



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14.  $Na_2B_4O_7 \cdot 10H_2O \xrightarrow{\text{conc. HCl}} A \xrightarrow{160^\circ C} B$ . Compound 'B' is

- A.  $H_2B_4O_7$
- B.  $B_2O_3$
- C.  $H_3BO_3$



D.  $HBO_2$

**Answer: A**



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**15.** Indium and thallium of III A group have nearly similar atomic radii due to poor screening effect shown by f-electrons in the

- A. Penultimate shell of thallium
- B. Anti penultimate shell of indium
- C. Anti penultimate shell of thallium
- D. Penultimate shell of indium

**Answer: C**



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1. Select the correct statements about diborane

- A.  $B_2H_6$  has three centre two electron bond
- B. Each boron atom lies in  $sp^3$  hybrid state
- C.  $H_t \cdots B \cdots H_t$  bond angle is  $122^\circ$
- D. All hydrogens in  $B_2H_6$  lie in the same plane

Answer: A::B::C



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2.  $Al_2(SO_4)_3 + NH_4OH \rightarrow X$ ,  $X$  is

- A. a white gelatinous precipitate
- B. insoluble in excess of  $NH_4OH$
- C. soluble in excess of NaOH
- D. amphoteric in nature

**Answer: A::B::C**



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**3. Al and Ga have nearly the same covalent radius, incorrect reason is**

- A. Greater shielding effect of s-electrons of Ga atoms
- B. Poor shielding effect of s-electrons of Ga atoms
- C. Poor shielding effect of d-electrons of Ga atoms
- D. Greater shielding effect of d-electrons of Ga atoms

**Answer: A::B::D**



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**4. Borazine is called 'inorganic benzene' in view of its ring structure with alternate BH and NH groups. Which of the following statements is correct about borazine ?**

- A. Each B and N atom is  $sp^2$  hybridized
- B. Borazine satisfies the  $(4n+2)$  Huckel's rule
- C. Organic benzene, borazine both does not posses polar bonds
- D. Borazine is isoelectronic with benzene

**Answer: A::B::D**



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5. In which of the following molecules, vacant orbitals take part in hybridization ?

- A.  $B_2H_6$
- B.  $Al_2Cl_6$
- C.  $H_3PO_3$
- D.  $H_3BO_3$

**Answer: A::B**

**PRACTICE SHEET (LEVEL - II) (Linked Comprehension Type Questions)**

1. Boric acid  $B(OH)_3$  is weak monobasic acid reacts with alkali to form borates. The most common borate of boric acid is borax represented as  $Na_2(B_4O_5(OH)_{4.8}H_2O)$  which is made up of two tetrahedral and two triangular units. On dissolution in water, these tetrahedral and triangular units are separated. Borax is useful primary standard for titration against acids

The number of B - O - B linkage in borax is/are

- A. 2
- B. 5
- C. 4
- D. 6

**Answer: B**

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2. Boric acid  $B(OH)_3$  is weak monobasic acid reacts with alkali to form borates. The most common borate of boric acid is borax represented as  $Na_2(B_4O_5(OH)_4) \cdot 8H_2O$  which is made up of two tetrahedral and two triangular units. On dissolution in water, these tetrahedral and triangular units are separated. Borax is useful primary standard for titration against acids.

Oxidation state of boron atom in borax is / are

- A. +3 only
- B. three atoms +3 and one atom +2
- C. +2 only
- D. two atoms +3 and two atoms +4

**Answer: A**

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3. Boron reacts with oxygen at  $700^{\circ}C$  to give (A). Compound (A) reacts with carbon and dry chlorine to give (B) an carbon monoxide. (B) on reduction with  $LiAlH_4$  gives (C ) along with LiCl and  $AlCl_3$ . (C ) on reaction with ammonia at  $200^{\circ}C$  gives (D).

In compound (B) :

- A. Boron is  $sp^2$  hybridised
- B. B is triangular planar molecule
- C. It is a Lewis base
- D. Dimer

**Answer: A::B**



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4. Boron reacts with oxygen at  $700^{\circ}C$  to give (A). Compound (A) reacts with carbon and dry chlorine to give (B) an carbon monoxide. (B) on reduction with  $LiAlH_4$  gives (C ) along with LiCl and  $AlCl_3$ . (C ) on

reaction with ammonia at  $200^{\circ}\text{C}$  gives (D).

Compound (C) is

A. an electron - deficient compound

B. cation (3c, 2e) bond

C. has ethane like structure

D. an ionic compound

**Answer: A::B**



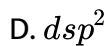
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5. Boron reacts with oxygen at  $700^{\circ}\text{C}$  to give (A). Compound (A) reacts with carbon and dry chlorine to give (B) an carbon monoxide. (B) on reduction with  $\text{LiAlH}_4$  gives (C) along with  $\text{LiCl}$  and  $\text{AlCl}_3$ . (C) on reaction with ammonia at  $200^{\circ}\text{C}$  gives (D).

Compound (D) has B in \_\_\_\_\_ hybridised state

A. sp





**Answer: B**



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## PRACTICE SHEET (LEVEL - II) (Matrix Matching Type Questions)

### Column - I

- A) Corundum
- B) Cryolite
- C) Potash alum
- D) Colemanite
- E) Bauxite
- F) Borax

### Column - II

- P)  $\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$
- Q)  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
- R) Sodium aluminium fluoride
- S)  $\text{Al}_2\text{O}_3$
- T)  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$
- U)  $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$

1.



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Column - I

- A)  $\text{H}_3\text{BO}_3$
- B)  $\text{Na}_2\text{B}_4\text{O}_7$
- C)  $\text{Al}_2\text{O}_3$
- D)  $\text{TiOH}$

Column - II

- P) Hydrogen bonds
- Q) Amphoteric
- R) Basic
- S) Lewis acid

2.



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ADDITIONAL PRACTICE EXERCISE (LEVEL - I (MAIN)) (Straight Objective Type Questions)

1. The IIIA group element that does not displace hydrogen from hydrochloric acid is

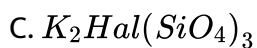
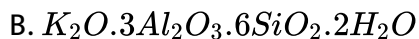
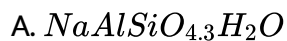
- A. B
- B. Al
- C. both B and Al
- D. Ti

**Answer: A**



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2. The composition of mica is



Answer: B



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3. In  $GaCl_2$ , oxidation state of Ga is

A. +2

B. +1 & +3

C. 0

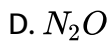
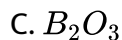
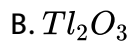
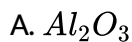
D.  $-2$

**Answer: B**



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**4.** Which is pure basic oxide



**Answer: B**



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**5.** The number of  $\sigma$  and  $\pi$  bonds present in inorganic benzene

- A.  $9\sigma, 6\pi$
- B.  $6\sigma, 3\pi$
- C.  $9\sigma, 3\pi$
- D.  $12\sigma, 3\pi$

**Answer: D**



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**6. Boron compounds behave as Lewis acids because of their**

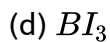
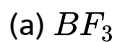
- A. Acidic nature
- B. Covalent nature
- C. Ionic nature
- D. Vacant orbital

**Answer: D**



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7. Among the halides



The order of decreasing Lewis acid character is

A. a,b,c,d

B. d,c,b,a

C. c,d,b,a

D. b,c,d,a

**Answer: B**



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8. When orthoboric acid ( $H_3BO_3$ ) is heated strongly the residue left is

A. boron

B. metaboric acid

C. boric anhydride

D. borax

**Answer: C**



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**9. An acid among the following is**

A.  $B(OH)_3$

B.  $Al(OH)_3$

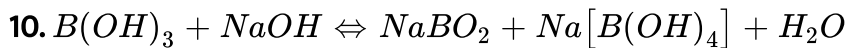
C.  $Fe(OH)_3$

D.  $Lu(OH)_3$

**Answer: A**



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How can this reaction is made to proceed in forward direction ?

- A. addition of cis - 1, 2 diol
- B. addition of borax
- C. addition of trans-1, 2 diol
- D. addition of  $Na_2HPO_4Na_2HPO_4$

**Answer: A**



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11. Boric acid is prepared from borax by the action of

- A. hydrochloric acid
- B. sodium hydroxide
- C. carbon dioxide



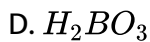
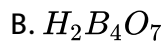
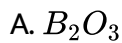
D. sodium carbonate

**Answer: A**



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**12.** Boric acid on heating at  $150^{\circ}C$  gives



**Answer: B**



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13. The main factor responsible for weak acidic nature of B - F bonds in  $BF_3$  is

- A. large electronegativity of F
- B. three centered two electron bonds in  $BF_3$
- C.  $p\pi - p\pi$  back bonding
- D. small size of B atom

**Answer: C**



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14. B - F bond order of  $BF_3$  is

- A. 1
- B. 2
- C. 3
- D.  $4/3$

**Answer: D**



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**15.** The two type of bonds present in  $B_2H_6$  are covalent and

- A. ionic
- B. co-ordinate
- C. hydrogen bridge bond
- D. metallic bond

**Answer: C**



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**16.** The green coloured borax bead obtained from copper salts is

- A. Cupric metaborate

B. Copper orthoborate

C. Copper boride

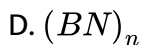
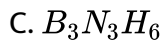
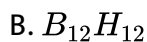
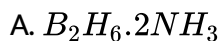
D. Cuprous metaborate

**Answer: A**



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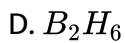
17. Diborane react with ammonia under different conditions to give a variety of products. Which one among the following is not formed in these reactions



**Answer: B**

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18. Borazole on strong heating gives



**Answer: B**

[Watch Video Solution](#)

19. B-H-B bridge in B<sub>2</sub>H<sub>6</sub> is formed by the sharing of

A. 2 electrons

B. 4 electrons

C. 1 electron

D. 3 electron

**Answer: A**



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**20.** There are two H-bridge bonds in diborane molecule because there are

A. only 12 electrons

B. 14 electrons

C. 2 electrons less than required to complete octet

D. two electrons more than required for bonding

**Answer: A**



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**21.** Boron carbide,  $B_4C$  is widely used

- A. in making acetylene
- B. in making plaster of paris
- C. as a hardest substance after diamond
- D. in making boric acid

**Answer: C**



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**22.** Reactivity of borazole is greater than that of benzene because

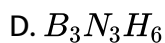
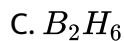
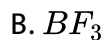
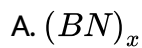
- A. borazole is non-polar compound
- B. borazole is polar compound
- C. borazole is electron deficient compound
- D. of localized electrons in it

**Answer: B**



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23. Inorganic benzene is



Answer: D



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24. Metal protected by a layer of its own oxide is





D. B

**Answer: A**



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**25.** In the electrolysis of alumina, cryolite is added to

- A. lower the melting point of alumina
- B. increase the electrical conductivity
- C. both (a) and (b)
- D. remove impurities from alumina

**Answer: C**



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**26.** Mineral of aluminium that does not contain oxygen is

A. corundum

B. diaspore

C. bauxite

D. cryolite

**Answer: D**



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**27.** Conc.  $HNO_3$  can be stored in container of

A. Fe

B. Al

C. Zn

D. Sn

**Answer: B**



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28. Duralumin is an alloy of

- A. Al and Mg
- B. Mg and Cu
- C. Al, Mg, Mn and Cu
- D. Al and Cu

**Answer: C**



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29.  $Al_2O_3$  formation involves large quantity of heat evolution which makes its use in

- A. deoxidiser
- B. confectionary
- C. indoor photography

D. thermite welding

**Answer: D**



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**30.**  $AlCl_3$  exist as dimer because

- A. Al has greater I.P
- B. Al has larger radius
- C. High charge nucleus
- D. Incomplete p-orbital

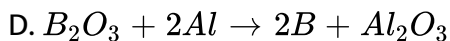
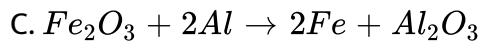
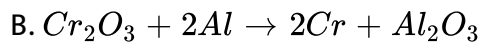
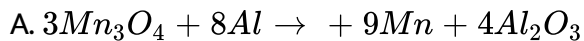
**Answer: D**



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**ADDITIONAL PRACTICE EXERCISE (LEVEL - II LECTURE SHEET (ADVANCED))**  
**(More than One correct answer Type Questions)**

1. Which of the following reaction(s) is/are involved in thermit process ?

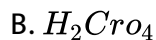
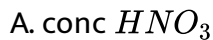


Answer: A::B::C



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2. Aluminium becomes passive in

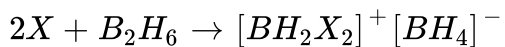


Answer: A::B::C

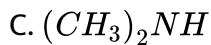
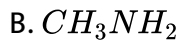


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3. In the reaction



the amines (s) X is/are



Answer: A::B::C



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4. Orthoboric acid ( $H_3BO_3$ ) and metaboric acid ( $HBO_2$ ) differ in respect of

- A. Basicity
- B. Structure
- C. Melting point
- D. Oxidation

**Answer: A::B::C**



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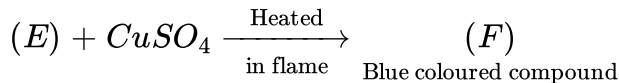
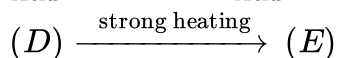
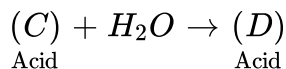
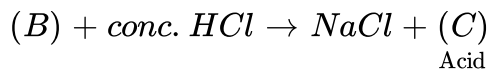
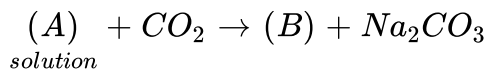
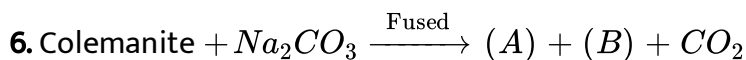
5.  $BF_3$

- A. Electron - deficient compound
- B. Lewis acid
- C. Used as rocket fuel
- D. Ionic compound

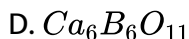
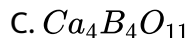
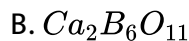
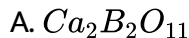
Answer: A::B



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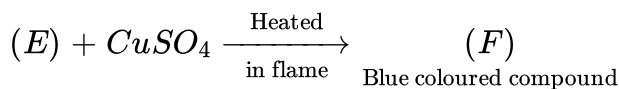
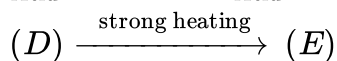
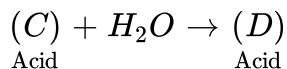
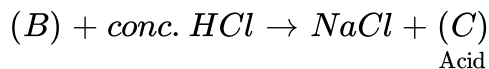
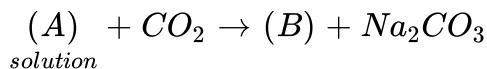
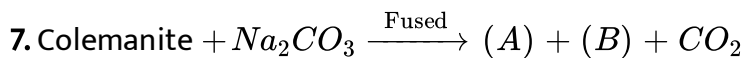


Compound (B) is

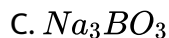
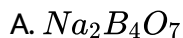


Answer: B



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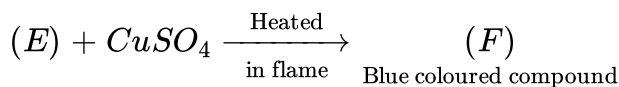
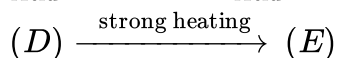
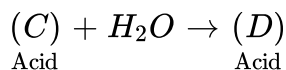
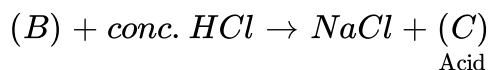
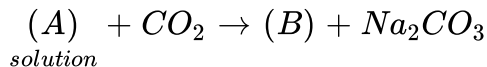
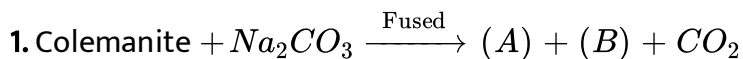
Compound (D) is



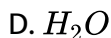
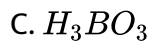
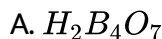
**Answer: A**

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ADDITIONAL PRACTICE EXERCISE (LEVEL - II LECTURE SHEET (ADVANCED))  
(Linked Comprehension Type Questions )



Compound (D) is

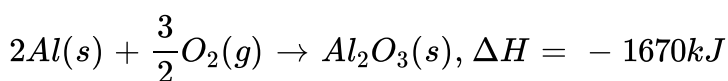


Answer: C



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2. Aluminium is stable in air and water inspite of the fact that it is reactive metal. The reason is that a thin film of its oxide, if formed on its surface which makes it passive for further attack. The layer is so useful that in industry, it is purposely deposited by an electrolytic process called anodizing. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction



Thermite reaction finds applications in the metallurgical extraction of many metals from their oxides and for welding of metals. The drawback is that to start the reaction, high temperature is required for which an ignition mixture is used.

Anodised aluminium is

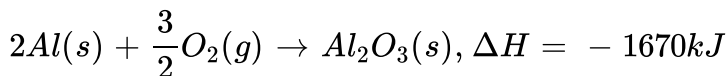
- A. Al obtained at anode
- B. Al prepared electrolytically
- C. Alloy of Al containing 95% Al
- D. Al electrolytically coated with  $Al_2O_3$

**Answer: D**



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3. Aluminium is stable in air and water inspite of the fact that it is reactive metal. The reason is that a thin film of its oxide, if formed on its surface which makes it passive for further attack. The layer is so useful that in industry, it is purposely deposited by an electrolytic process called anodizing. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction



Thermite reaction finds applications in the metallurgical extraction of many metals from their oxides and for welding of metals. The drawback is that to start the reaction, high temperature is required for which an ignition mixture is used.

Thermite mixture used for welding is

A.  $Fe_2O_3$  and Al powder

B. BaO and Mg powder

C. Fe and Al

D. Cu and Al

**Answer: A**



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**ADDITIONAL PRACTICE EXERCISE (LEVEL - II LECTURE SHEET (ADVANCED))**  
**(Integer Type Questions )**

1. The number of bridge bonds, the maximum number of planar atoms and the number of electrons involved in the formation of bridge bonds in diborane are  $x$ ,  $y$  and  $z$  respectively, then  $(x+y-z) = ?$



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2. The number of hybrid orbitals involved in the formation of  $B_2H_6$ ,  $B_3N_3H_6$ ,  $BCl_3$  are  $H_3BO_3$  are  $p$ ,  $q$ ,  $r$  &  $s$ , then the sum of

$(p+q+r+s)$  is  $8y$ , then  $y = ?$



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3. The number of moles of sulphate ions present in the general formula of 1 mole of alum ?



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4. The value of 'n' in the molecular formula  $Be_nAl_2Si_6O_{18}$  is



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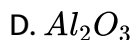
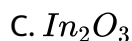
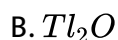
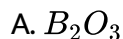
5. Number of moles of  $OH^-$  produced by dissolving 1 mole of  $B(OH)_3$  in water ?



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**ADDITIONAL PRACTICE EXERCISE (LEVEL - II PRACTICE SHEET (ADVANCED))**  
**(More than One correct answer Type Questions) )**

1. Which of the following oxides are basic ?



**Answer: B::C**



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2. Alumina is

A. A bad conductor of electricity

B. Good conductor of electricity

C. A dehydrating agent

D. Insoluble in water

**Answer: A::D**



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**3. Potash alum is used as a**

A. Disinfectant

B. Water softner

C. Mordant in textile industry

D. Fibre in polymer industry

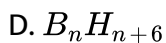
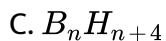
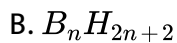
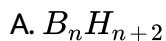
**Answer: B::C**



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4. Boranes have general formula



Answer: C::D



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5. Hydrated  $AlCl_3$  is used as

A. Catalyst in cracking of petroleum

B. Catalyst in Friedel-Crafts reaction

C. Mordant

D. All of the above

Answer: C



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ADDITIONAL PRACTICE EXERCISE (LEVEL - II PRACTICE SHEET (ADVANCED))  
(Linked Comprehension Type Questions )

1. Diborane is simplest and most familiar hydride of boron. Its chemical formula is  $B_2H_6$ . Comparing with ethane, diborane is regarded as electron deficient molecule. In the excited state boron of diborane undergoes  $sp^3$  hybridisation. Bonding in diborane is described as tricentric two electron bonding.

Number of empty  $sp^3$  hybrid orbitals of each "B" atom in  $B_2H_6$

Each B contains one  $sp^3$  vacant hybrid orbital

A. 1

B. 2

C. 3

D. 4

**Answer: A**



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2. Diborane is simplest and most familiar hydride of boron. Its chemical formula is  $B_2H_6$ . Comparing with ethane, diborane is regarded as electron deficient molecule. In the excited state boron of diborane undergoes  $sp^3$  hybridisation. Bonding in diborane is described as tricentric two electron bonding.

Structure of  $-BH_2$  group is

A. linear

B. planar

C. tetrahedral

D. octahedral

**Answer: B**



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3. The number of atoms involved in bridged bonds in one diborane molecule is

A. 2

B. 3

C. 4

D. 6

**Answer: C**



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4. Group 13 of periodic table consists of boron or aluminium family. Boron being the first member, shows anomalous behaviour due to its small size and high nuclear charge/size ratio, high electronegativity and non availability of d-electrons. All the group 13 members form hydrides,

hydroxides, halides showing +3 covalency, however boron forms electron deficient species.

Which of the following statement(s) is/are correct.

- (I) Both B and Al forms anionic hydrides
- (II) Both form alkaline hydroxide of formula  $M(OH)_3$
- (III) Both B and Al forms a series of polymeric hydrides
- (IV) Both forms monoeric halides  $MX_3$

A. I, IV

B. I, II, III

C. II, III

D. I, II, IV

**Answer: A**

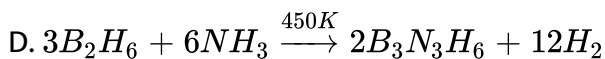
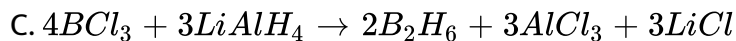
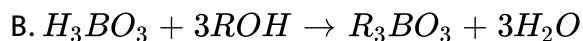
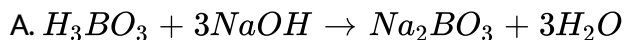


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5. Group 13 of periodic table consists of boron or aluminium family. Boron being the first member, shows anomalous behaviour due to its small size

and high nuclear charge/size ratio high electronegativity and non availability of d-electrons. All the group 13 members form hydrides, hydroxides, halides showing +3 covalency, however boron forms electron deficient species.

Which one is not correct chemical change ?



**Answer: A**



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**ADDITIONAL PRACTICE EXERCISE (LEVEL - II PRACTICE SHEET (ADVANCED)  
(Matrix Matching Type Questions) )**

Column - I

- A) Graphite
- B) Boric acid
- C) Borazole
- D) Boron nitride

Column - II

- P) Layered structure
- Q) Delocalization of electrons
- R) Electrical conductor
- S) Hydrogen bonds

1.



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Column - I

- A)  $B_2H_6 + NH_3 \xrightarrow[\text{temperatures}]{\text{under different}}$
- B)  $2BF_3 + 6LiH \longrightarrow$
- C) Two electron three centre bond
- D)  $sp^3$  hybrid orbitals

Column - II

- P)  $B_2H_6$
- Q) Borazine
- R)  $AlCl_3$  (vapour)
- S) Inorganic graphite

2.



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ADDITIONAL PRACTICE EXERCISE (ADDITIONAL QUESTIONS)

1. Aluminium is obtained by

A. reducing  $Al_2O_3$  with coke

B. electrolysing  $Al_2O_3$ , dissolved in  $Na_3AlF_6$

C. reducing  $Al_2O_3$  with chromium

D. heating  $Al_2O_3$  and cryolite

**Answer: B**



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2. Aluminium vessels should not be washed with materials containing washing soda because

A. washing soda is expensive

B. washing soda is easily decomposed

C. washing soda reacts with aluminium to form soluble aluminate

D. washing soda reacts with aluminium to form insoluble aluminium oxide

**Answer: C**



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3. Which statement is not true about potash alum

- A. It's empirical formula is  $KAl(SO_4)_2 \cdot 12H_2O$
- B. It's aqueous solution is basic in nature
- C. It is used in dyeing industries
- D. On heating it melts and loses its water of crystallization

**Answer: B**



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4.  $H_3BO_3$  is

- A. monobasic and weak Lewis acid
- B. monobasic and weak Bronsted acid
- C. monobasic and strong Lewis acid
- D. tribasic and weak Bronsted acid

**Answer: A**



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5. Be and Al exhibit many properties which are similar, but the two elements differ in

- A. exhibiting amphoteric nature in their oxides
- B. forming polymeric hydrides
- C. exhibiting maximum covalency in compounds
- D. forming covalent halides

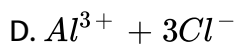
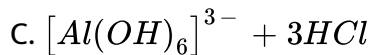
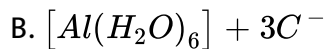
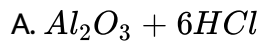
**Answer: B**



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6. Aluminium chloride exists as dimer,  $Al_2Cl_6$  in solid state as well as in solution of non - polar solvents such as  $C_6H_6$ . When dissolved in water it

gives :

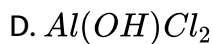
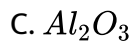
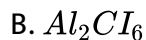


**Answer: C**



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7. Heating an aqueous solution of aluminium chloride to dryness will give :



**Answer: C**



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8. Which one of the following is the correct statement for respiration in humans?

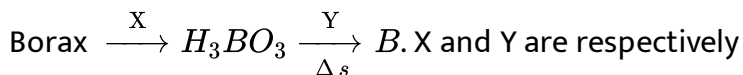
- A. Boric acid is a protonic acid
- B. Beryllium exhibits coordination number of six
- C. Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase
- D.  $B_2H_6 \cdot 2NH_3$  is known as 'inorganic benzene'

**Answer: C**



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9. Borax is converted into crystalline boron by the following steps



A. HCl, Cu

B. HCl, C

C. C, Al

D. HCl, Al

**Answer: D**



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10. Which is not true about borax ?

A. It is a useful primary standard for titrating against acids

B. Borax forms basic buffer solution

C. Aqueous solution of borax can be used as buffer

D. It is made up of two six-membered heterocyclic rings

**Answer: B**



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### SUBJECTIVE EXERCISE 1 (LONG ANSWER QUESTIONS)

1. What properties in the group IIIA elements do not show gradation ?

Explain the irregularity .



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2. Write a short note on the anomalous behaviour of boron in the group - 13.



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3. Write any two forms of borax that occur in nature. Give their formula. Explain the principle of borax bead test with atleast one example.



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4. Name all boric acids and give their formulae. Discuss the preparation of orthoboric acid from Colemanite.



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5. Write an essay on the preparation and chemical activity of diborane.



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6. What do you mean by electron deficient molecules ? Give two examples. Explain the structure of diborane.



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7. Explain any two methods of preparation of diborane. Write the reactions of  $B_2H_6$  with a)  $H_2O$  b)  $CO$ . Give equations.



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### SUBJECTIVE EXERCISE 1 (SHORT ANSWER QUESTIONS)

1. Write the Boron family elements in the order. Write the electronic configurations of  $2^{nd}$ ,  $3^{rd}$  and  $4^{th}$  elements of the group.



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2. Explain the following sequence of IE's in group IIIA.  
 $B(801), Al(577), Ga(579), In(558), Tl(589) kJmol^{-1}$ .



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3. Explain why the electronegativity of Ga, In and Tl will not vary very much.



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4. The oxidation state of Al in cryolite



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5. Draw the structure of a metaborate ion.



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6. Explain with a suitable example borax bead test.



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7. Mention any 3 uses of borax.



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8. Write the formulas of all the boric acids.



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9. What are boranes ? How are they classified ?



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10. A mixture of a hydride of Boron and ammonia are passed through a hot tube. What is the result?



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11. What is the orbital structure of  $B_2H_6$  ? Explain the structure.



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12. How can you prove chemically the bridge structure of  $B_2H_6$  ?

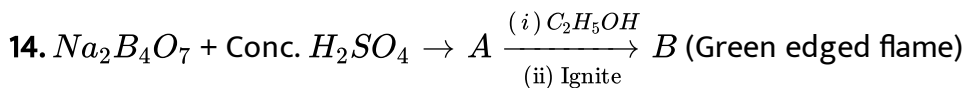


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13. Name an amphoteric oxide of 13 group elements, explain with suitable reactions.



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Identify A and B .



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## SUBJECTIVE EXERCISE 1 (VERY SHORT ANSWER QUESTIONS)

1. Write the general electronic configuration of group IIIA elements.



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2. What is the common oxidation state of group IIIA elements ? How does it change down the group ?



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3. What is inert pair effect ?



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4. Identify the inert pair in indium.



[Watch Video Solution](#)

5. Give the formula and structure of borazine.



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6. Boron does not occur in the free state. Why?



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7. What happens when  $\text{LiAlH}_4$  and  $\text{BCl}_3$  mixture in dry ether is warmed



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8. Write the conditions required for diborane to react with CO ?



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9. What is the orbital structure of diborane ?



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10. Write the names of alloying metals with aluminium.



Watch Video Solution

11. Write the structure of  $AlCl_3$  as a dimer.



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12. How is boron-10 isotope used in nuclear chemistry ?



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1. The order of abundance of IIIA group elements is

A. Al > Ga > B

B. B > Ga > Al

C. B > Al > Ga

D. Ga > Al > B

**Answer: A**



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2. IIIA group element which forms only covalent compounds either in anhydrous state or in aqueous state is

A. Al

B. Ga

C. In

D. B

**Answer: D**



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**3. Which of the following is most abundant in the earth crust ?**

A. Boron

B. Aluminium

C. Gallium

D. Thallium

**Answer: B**



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**4. (A): Concentrated nitric acid makes metal aluminium passive**

**(R): A protective layer of aluminium oxide is formed on the surface**



- A. Both A and R are true, and R is correct explanation of A
- B. Both A and R are true, and R is not the correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

**Answer: A**



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**5. +1 oxidation state is stable for the element**

- A. B
- B. Al
- C. Ga.
- D. Tl

**Answer: D**



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6. The element that exhibits negative oxidation state in IIIA group is

A. B

B. Al

C. Ga.

D. Tl

**Answer: A**



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7. Among the III A group elements, the difference in the atomic radius is large in between

A. Aluminium and Boron

B. Gallium and Aluminium

C. Thallium and Indium

D. Gallium and Indium

**Answer: A**



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**8. Aluminium exhibits diagonal relationship with**

A. Beryllium

B. Silicon

C. Carbon

D. Germanium

**Answer: A**



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**9. Which element cannot form a cation ?**

A. Al

B. B

C. Cs

D. Bi

**Answer: B**



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**10.** Electronic structure acquired by compounds of IIIA group elements in bonding is

A. Sextet

B. Doublet

C. Octet

D. Super octet

**Answer: A**

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11. The nature of  $B_2O_3$  is

- A. Neutral
- B. Amphoteric
- C. Acidic
- D. Basic

**Answer: C**

 [Watch Video Solution](#)

12. Thallous chloride is more stable than thallic chloride because of

- A. More ionic character
- B. Larger size of  $Tl^+$  ion
- C. High hydration energy of  $Tl^+$  ion

D. Inert pair effect

**Answer: D**



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**13.** Which of the following pair of group 13 elements have similar atomic radius

A. *B, Al*

B. *In, Tl*

C. *Ga, In*

D. *B, Tl*

**Answer: B**



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14. Thallium shows different oxidation states because

- A. It is transition element
- B. Of inert pair effect
- C. Of its amphoteric character
- D. Of its higher reactivity

**Answer: B**



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15. Which of the following is used in high temperature thermometry ?

- A. *Na*
- B. *Ga*
- C. *Tl*
- D. *Hg*

**Answer: B**



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**16.**  $AlCl_3$  is

- A. Anhydrous and covalent
- B. Anhydrous and ionic
- C. Covalent and basic
- D. Coordinate and acidic

**Answer: A**



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**17.** Which one is a non-metal in group 13 ?

- A.  $B$



B. *Al*

C. *Ga*

D. *In*

**Answer: A**



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**18.** The electropositive character increases from B to Al and then decreases from Al to Tl because of

A. Increase in the size of the elements

B. Decrease in the ionization energy of the elements

C. Decrease in the electronegativity of the elements

D. Ineffective shielding of the nuclear charge by d-electrons in the case of Ga, In and Tl

**Answer: D**

19. When boron atom undergoes  $sp^3$  hybridization

- A. all the four  $sp^3$  orbitals contain one electron in each of them
- B. three orbitals contain one electron in each of them and the fourth one is vacant
- C. two orbitals contain one electron in each of them and two others are vacant
- D. one  $sp^3$  orbital contains one electron pair while others have lone electrons

**Answer: B**

20. Boron exhibits diagonal relationship with

A. *Si*

B. *C*

C. *Al*

D. *Be*

**Answer: A**



**Watch Video Solution**

**21.** The atomic radius of which element is least

A. *B*

B. *Al*

C. *Ga*

D. *Tl*

**Answer: A**



**Watch Video Solution**

22. (A): Gallium is used as a thermometric liquid

(R): Gallium has wide liquid range of temperature

- A. A and R are true, and R is the correct explanation of A
- B. A and R are true, but R is not the correct explanation of A
- C. A is true and R is false
- D. A is false and R is true

**Answer: A**



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23. Statement I:  $BCl_3$  and  $AlCl_3$  are both Lewis acids and  $BCl_3$  is stronger than  $AlCl_3$

Statement II :  $H_3BO_3$  is strong tribasic acid

- A. Both the statements are true

B. Both the statements are false

C. I is false and II is true

D. I is true and II is false

**Answer: D**



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**24.** Boron does not form  $B^{3+}$  ions whereas Al forms  $Al^{3+}$  ions. This is because

A. The size of B atom is larger than that of Al

B. The sum of  $IE_1 + IE_2 + IE_3$  of B is much higher than that of Al

C. The sum of  $IE_1 + IE_2 + IE_3$  of Al is much higher than that of B

D. Both 1 and 2

**Answer: B**



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25. Which is true for an element R present in group 13 of the periodic table

- A. It is a gas at room temperature
- B. It has oxidation state of  $+4$
- C. It forms  $R_2O_3$
- D. It forms  $RX_2$

**Answer: C**



**Watch Video Solution**

26. Boron compounds behave as Lewis acids because of their

- A. Acidic nature
- B. Covalent nature
- C. Electron deficient character

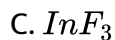
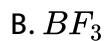
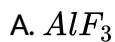
D. Ionization property

**Answer: C**



**Watch Video Solution**

**27. Which of the following is not an ionic trihalide?**



**Answer: B**



**Watch Video Solution**

28. The electropositive character increases from B to Al and then decreases from Al to Tl because of

- A. Increase in the size of the elements
- B. Decrease in the ionization energy of the elements
- C. Decrease in the electronegativity of the elements
- D. Ineffective shielding of the nuclear charge by d-electrons in the case of Ga, In and Tl

**Answer: C**



**Watch Video Solution**

29. (A): The oxidation number of boron in  $BF_3$  is +3

(R) : Boron can not form a cation

- A. Both A and R are correct. R is the correct explanation of A.
- B. Both A and R are correct. R is not the correct explanation of A.



C. A is true, but R is false

D. A is false, but R is true

**Answer: B**



**Watch Video Solution**

**30.** Borax when dissolved in water exhibits

A. alkaline nature

B. acidic nature

C. neutral nature

D. amphoteric nature

**Answer: A**



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31. On strong heating, Boric acid gives

A. B

B.  $B_2H_6$

C.  $B_2O_3$

D.  $BO_2$

Answer: C



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32. Glassy bead is obtained by heating

A.  $Na_2B_4O_7 \cdot 10H_2O$

B.  $H_3BO_3$

C.  $B_2H_6$

D.  $Ca_2B_6O_{11}$

**Answer: A**



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**33.** Borax bead test is not given by

A. Aluminium salt

B. Cobalt salt

C. Copper

D. Nickel salt

**Answer: A**



**Watch Video Solution**

**34.** Boric acid is prepared from borax by the action of

A.  $HCl$

B.  $\text{NaOH}$

C.  $\text{CO}_2$

D.  $\text{Na}_2\text{CO}_3$

**Answer: A**



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**35.** The hybridisation of boron in ortho boric acid

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $sp^3d$

**Answer: B**



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36. Boric acid ( $H_3BO_3$ ) has

- A. Trigonal structure
- B. Tetrahedral structure
- C. Layer structure, in which  $BO_3$  units are linked by oxygen
- D. Layer structure, in which planar  $BO_3$  units are linked by hydrogen bonding

**Answer: D**



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37. Which of the following is unreactive in air on heating ?

- A. Amorphous boron
- B. Crystalline boron
- C. Both 1 and 2

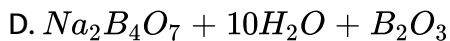
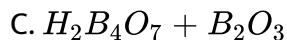
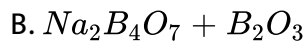
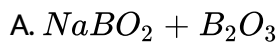
D. Aluminium

**Answer: B**



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**38.** Borax bead is a mixture of



**Answer: A**



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**39.** The  $H - B - H$  bridged angle in diborane is

A.  $121.5^\circ$

B.  $97^\circ$

C.  $119^\circ$

D.  $133^\circ$

**Answer: B**



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**40.** Boric acid is polymer due to

A. its acidic nature

B. the presence of hydrogen bonds

C. its mono basic nature

D. its geometry

**Answer: B**



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41. The number of atoms involved in bridged bonds in one diborane molecule is

A. 4

B. 2

C. 6

D. 5

Answer: A



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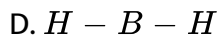
42. The bonds not present in diborane are

A.  $B - H$

B.  $B - H - B$

C.  $B - B$





**Answer: C**



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**43. (A) :** Diborane is electron deficient molecule

(R): In the formation of diborane molecule, boron atom uses  $sp^3$  - hybrid orbitals

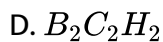
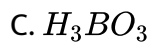
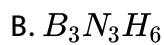
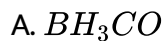
- A. Both A and R are true and R is the correct explanation of A
- B. Both A and R are true and R is not correct explanation of A
- C. A is true and R is false
- D. A is false and R is true

**Answer: B**



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44. Diborane reacts with carbon monoxide to form

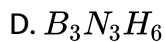
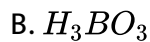
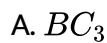


**Answer: A**



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45. Diborane on hydrolysis gives



**Answer: B**



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**46.** The number of bridge hydrogen atoms in diborane is

A. 1

B. 2

C. 3

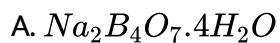
D. 4

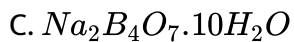
**Answer: B**



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**47.** The formula of kernite or razorite is



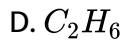
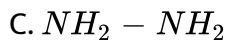
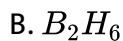
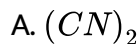


**Answer: A**



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**48.** The following has a potential to be used as a rocket fuel



**Answer: B**



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49. In diborane, the hybridisation of Boron is

A.  $sp$

B.  $sp^2$

C.  $sp^3$

D.  $sp^3d$

Answer: C



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50. The number of three centred, 2 electron bonds in diborane is

A. 2

B. 4

C. 3

D. 6

**Answer: A**



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**51.** Reduction of  $BCl_3$  with lithium aluminium hydride gives

A. Borazole

B. Borazine

C. Diborane

D. All

**Answer: C**



**Watch Video Solution**

**52.** Basicity of  $H_3BO_3$  is

A. 1

B. 2

C. 3

D. 0

**Answer: A**



**Watch Video Solution**

**53.** Diborane undergo cleavage reactions with .... to give borane adducts.

A.  $H_2O$

B.  $NaH$

C.  $(CH_3)_3N$

D.  $NH_3$  at high temperature

**Answer: C**



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54. Borax on heating strongly above its melting point melts to a liquid which then solidifies to a transparent mass commonly known as borax bead. The transparent glassy mass consists of

- A. Mixture of sodium metaborate and boric anhydride
- B. Boric anhydride
- C. Sodium metaborate
- D. Sodium pyroborate

**Answer: A**



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55. Identify the statement that is not correct as far as structure of diborane is concerned

- A. There are two bridging hydrogen atoms and four terminal hydrogen atoms in diborane



- B. Each boron atom forms four bonds in diborane
- C. The hydrogen atoms are not in the same plane in diborane
- D. All  $B - H$  bonds in diborane are similar

**Answer: D**



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56. On the addition of mineral acid to an aqueous solution of borax, the compound formed is

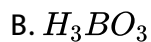
- A. borohydride
- B. orthoboric acid
- C. metaboric acid
- D. pyroboric acid

**Answer: B**



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57. Diborane reacts with water to form



Answer: C

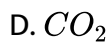


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58. Diborane does not undergo cleavage reaction with

A. trimethyl amine

B. ammonia



**Answer: D**



**Watch Video Solution**

**59.** Which metal forms a protective oxide layer to prevent corrosion ?

A. *Au*

B. *Cu*

C. *Al*

D. *Ag*

**Answer: C**



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**60.** In metallurgy, the substance which can act as de-oxidizer is

A. *B*

B.  $Al_2O_3$

C.  $AlN$

D.  $Al$

**Answer: D**



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**61.** Dihydrate of alumina is present in

A. Diaspore

B. Cryolite

C. Bauxite

D. Gypsum

**Answer: C**



**Watch Video Solution**

62. Regarding 'All the wrong statement is

- A. It reacts with both acids and bases
- B. Its maximum covalency is 67
- C. It is a strong reducing agent
- D. It becomes passive with con  $HCl$

Answer: D



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63. Which of the following has no reaction with  $HCl$  ?

- A. B
- B. Al
- C. Ga
- D. Tl

**Answer: A**



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**64.** In the aluminothermic process, aluminium acts as

A. an oxidizing agent

B. a flux

C. a solder

D. a reducing agent

**Answer: D**



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**65.** Alum is not used

A. as a mordant in dyeing

- B. as an insecticide
- C. in the purification of water
- D. in tanning of leather

**Answer: B**



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**66.** Which of the following processes does not involve a catalyst

- A. Thermite process
- B. Ostwald process
- C. Contact process
- D. Haber process

**Answer: A**



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67. The hybridisation of 'Al' in  $[Al(H_2O)_6]^{3+}$  is

A.  $sp^3d^2$

B.  $d^2sp^3$

C.  $dsp^3$

D.  $sp^3$

**Answer: A**



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68. (A) : White fumes appear around the bottle of anhydrous aluminium chloride.

(R) : Anhydrous aluminium chloride is partially hydrolysed with atmospheric moisture to liberate HCl gas. Moist HCl appears white in colour.

A. Both A and R are correct and 'R' is the correct explanation of A



- B. Both A and R are correct and 'R' is not the correct explanation of A
- C. A is correct but R is false
- D. A is false but R is correct

**Answer: A**



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**69.** In  $Al_2Cl_6$ , the covalency of aluminium is

- A. 6
- B. 4
- C. 3
- D. 2

**Answer: B**



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70. a)  $AlCl_3$  fumes in moist air due to its hydro lysis
- b) Al metal is stable in dry air because of protective oxide layer.
- c)  $p\pi - p\pi$  back bonding does not occur in halides of aluminium because of larger size.
- d)  $AlCl_3$  achieves stability by forming a dimer.

Correct statements are

- A. a, b only
- B. b, c only
- C. a, c, d only
- D. All of these

**Answer: D**



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71. Which of the following statement about aluminium chloride is not correct ?

- A. It exists as a dimer
- B. It is a covalent compound
- C. It involves back bonding between  $Cl$  and  $Al$
- D. Its aqueous solution conducts electricity

**Answer: C**



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**72.** Which of the following is not correct?

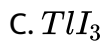
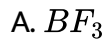
- A. Anhydrous  $AlCl_3$  exists as  $Al_2Cl_6$
- B. Monomeric trihalide ( $AlCl_3$ ) is Lewis acid
- C. Anhydrous  $AlCl_3$  fumes in air
- D.  $TlI_3$  is highly stable

**Answer: D**



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73. Which of the following can't exist ?



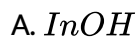
Answer: C

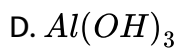
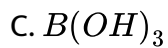


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## OBJECTIVE EXERCISE - 2

1. Least basic among the following is





**Answer: C**



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2. IIIA group element with highest density is

A. B

B. Al

C. In

D. Tl

**Answer: D**



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3. Electronegativity is least for

A. Tl

B. Al

C. Ga

D. B

Answer: B



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4. Which of the following is ionic

A.  $AlF_3$

B.  $AlCl_3$

C.  $AlBr_3$

D.  $AlI_3$

**Answer: A**



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**5. Among the following most electropositive element is**

A. Al

B. Ga

C. In

D. Tl

**Answer: A**



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**6. Al and Ga have nearly the same covalent radii, because of**

A. Greater shielding effect of 's' electrons of 'Ga' atoms

- B. Poor shielding effect of 's' electrons of 'Ga' atoms
- C. Poor shielding effect of 'd' electrons of 'Ga' atoms
- D. Greater shielding effect of 'd' electrons of 'Ga' atoms

**Answer: C**



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7. The maximum covalency of aluminium is '6' where as that of boron is '4' because

- A. Aluminium is more electropositive than boron
- B. 'Al' can form a cation where as boron can not
- C. 'Al' contains vacant orbitals in its valence shell where as boron does not
- D. 'Al' is a metal where as boron is a non metal

**Answer: C**





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8. Which one of the following has the lowest melting point

A. B

B. Al

C. Ga

D. Tl

Answer: C



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9.  $H_3BO_3 \xrightarrow{\text{Red heat}} X$  X in the reaction is

A.  $H_2B_4O_7$

B.  $HBO_2$

C.  $B_2O_3$

D.  $B$

**Answer: C**



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**10.** The element of IIIA group with least density

A.  $Tl$

B.  $Al$

C.  $Ga$

D.  $B$

**Answer: D**



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11. The statements regarding 'B' and Al are

I) Boron is a bad conductor of heat and electricity

II) Aluminium hydrides are stable

III) Maximum covalency of Boron is 4

The correct statements are

A. Only I is correct

B. I and III are correct

C. All are correct

D. III is only correct

**Answer: B**



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12. The correct order of melting points of IIIA group elements is

A. B gt Al gt Tl gt In gt Ga

B. B > Al > Ga > In > Tl

C. B > Al > Tl > Ga > In

D. B > Al > In > Tl > Ga

**Answer: A**



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13. The IIIA group element that does not displace hydrogen from hydrochloric acid is

A. B

B. Al

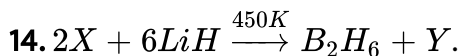
C. both B and Al

D. Tl

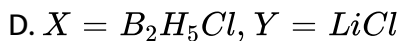
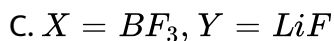
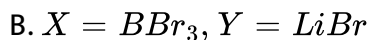
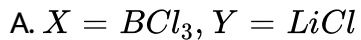
**Answer: A**



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The compounds, X and Y are



**Answer: C**



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15. Among the III A group elements, the difference in the atomic radius is large in between

A. Aluminium and Boron

B. Gallium and Aluminium

C. Thallium and Indium

D. Gallium and Indium

**Answer: A**



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**16.** The correct order of ionization potential  $[IP_1]$  among the IIA group elements is

A.  $B > Ga > Al > Tl > In$

B.  $B > Tl > Al > Ga > In$

C.  $B > Tl > Al > Ga = In$

D.  $B > Tl > Ga > Al > In$

**Answer: D**



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17. (A) : Increase in the atomic radius from B to Al is more than that of consecutive elements of the same group

(R) : Electrons in penultimate shell have greater screening effect

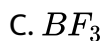
- A. Both A and R are correct. R is the correct explanation of A.
- B. Both A and R are correct. R is not the correct explanation of A.
- C. A is true, but R is false
- D. A is false, but R is true

**Answer: C**



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18. Which of the following does not undergo hydrolysis?



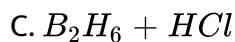
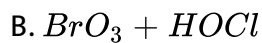
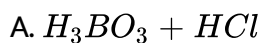
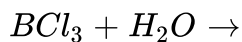
D.  $BI_3$

**Answer: C**



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**19.** The product formed in the reaction



D. No reaction

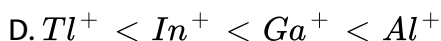
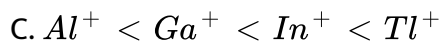
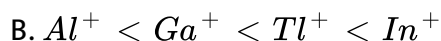
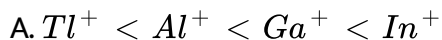
**Answer: A**



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20. The correct increasing order of the stability of  $Al$ ,  $Ga^+$ ,  $In^+$ ,  $Tl^+$  ions is

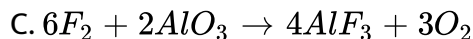
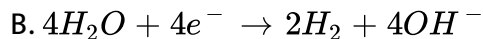
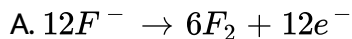


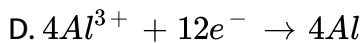
**Answer: B**



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21. In the electrolysis of alumina using cryolite, the reaction that takes place at cathode is





**Answer: B**



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**22.** Hydrogen gas is liberated when aluminium is treated with

A) Air

B) Dilute  $HCl$  ( or )  $H_2SO_4$

C)  $NaOH$  (or)  $KOH$

D) conc.  $HNO_2$

A. All the above

B. only A, B and C

C. Only B, C and D

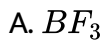
D. only B and C

**Answer: D**



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23. Which of the following is weakest Lewis acid ?



Answer: A



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24. Aluminium reacts with concentrated  $H_2SO_4$  to liberate  $SO_2$  gas. In this process, the element in  $H_2SO_4$  that has changed its oxidation state is

A. H

B. S

C. O

D. none

**Answer: B**



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**25.** In the reaction between boron and sodium hydroxide to liberate hydrogen gas, boron acts as

A. an oxidizing agent

B. a reducing agent

C. a precipitating agent

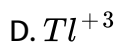
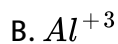
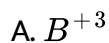
D. a deoxidizer

**Answer: B**



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26. Strongest oxidant among the following is



Answer: D



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27. Electronegativity of aluminium is 1.5. Electro negativity of thallium is

A. 1.5

B. 1.8

C. 1.0

D. 4.0

**Answer: B**



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**28.** The products formed when boron trichloride is reduced with lithium aluminium hydride are

A.  $B_2H_6$  and  $HCl$

B.  $B_2H_6$  and  $AlCl_3$

C.  $BCl_3$  and  $AlCl_3$

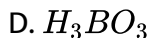
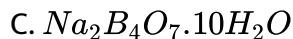
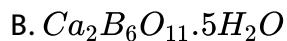
D.  $B_2H_6$ ,  $AlCl_3$  and  $LiCl$

**Answer: D**



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**29.** Borax is chemically

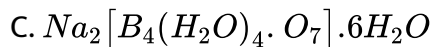
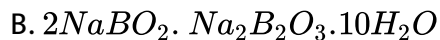
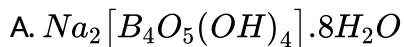


**Answer: C**



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**30.**  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$  can also be represented as



D. All the above

**Answer: A**



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31. Which of the following is a correct match?

A. Orthoboric acid -  $HBO_2$

B. Metaboric acid -  $H_6B_4O_7$

C. Pyroboric acid -  $H_3BO_3$

D. Tetraboric acid -  $H_2B_4O_7$

Answer: D



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32.  $BCl_3$  does not exist as dimer but  $BH_3$  exist as dimer because

A. Cl is more electropositive than H

B. There is  $p\pi - p\pi$  back bonding in  $BCl_3$  but  $BH_3$  does not contain such multiple bonding



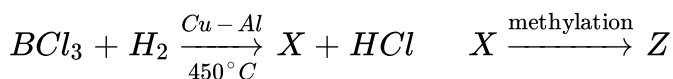
- C. Large sized chlorine atoms do not fit in between small sized boron atoms whereas small sized hydrogen atoms get fitted in between boron atoms
- D. None of these

**Answer: B**



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**33.** What is Z in the following reactions?



- A.  $CH_3BH_2$
- B.  $(CH_3)_4B_2H_2$
- C.  $(CH_3)_3B_2H_3$
- D.  $(CH_3)_6B_2$

**Answer: B**



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**34.** Observe the following statements :

- 1)  $H_3BO$  is used as antiseptic
- 2) In  $B_2H_6$  each boron is  $sp^2$  hybridized
- 3) Aqueous solution of borax is alkaline in nature

The correct statements are :

A. 2 and 3

B. 1, 2 and 3

C. 1 and 3

D. 1 and 2

**Answer: B**



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**35.** Which of the following statements are correct?

- i) Boron reacts with concentrated  $HNO_3$  to form nitric oxide and boric acid
- ii) Boron reacts with fused NaOH to form  $H_2O_2$  and boric acid
- iii) Boron reacts with  $SiO_2$  to form Si and  $B_2O_3$

A. i and ii

B. i, ii and iii

C. ii and iii

D. i and iii

**Answer: C**



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**36.** Diborane reacts with HCl in the present of  $AlCl_3$  and liberates

A.  $H_2$

B.  $Cl_2$

C.  $BCl_3$

D. Both 2 and 3

**Answer: B**



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**37. Which of the following statements is correct?**

A.  $BCl_3$  and  $AlCl_3$  are both Lewis acids and  $BCl_3$  is stronger than  $AlCl_3$ ,

B.  $BCl_3$  and  $AlCl_3$  are both Lewis acids and  $AlCl_3$  is stronger than  $BCl_2$

C.  $BCl_3$  and  $AlCl_3$  are both equally strong Lewis acids

D.  $BCl_3$  and  $AlCl_3$  are both not Lewis acids

**Answer: A**



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**38.** Slippery nature of orthoboric acid is due to

- A. The presence of hydrogen bonds
- B. The presence of covalent bonds
- C. Electron deficient nature
- D. The layers held by van der Waals forces

**Answer: D**



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**39.** The maximum number of atoms present in the same plane in diborane molecule is

- A. 2
- B. 6

C. 4

D. 3

**Answer: B**



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**40.** The colour developed for  $Co^{2+}$  basic radical in borax bead test is

A. green

B. violet

C. yellow

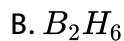
D. blue

**Answer: D**



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41. Orthoboric acid on heating above 370K gives



C. Borax

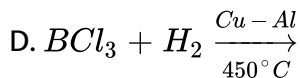
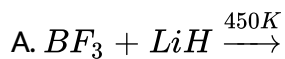


Answer: D



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42. A convenient laboratory preparation of Diborane is



**Answer: C**



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**43.** Which of the following aqueous solution used as antiseptic

A. Ortho boric acid

B. Meta boric acid

C. Pyro boric acid

D. Tetra boric acid

**Answer: A**



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**44.** Boric acid ( $H_2BO_3$ ) has

A. Trigonal structure



B. Tetrahedral structure

C. Layer structure, in which  $BO_3$  units are linked by  $O_2$

D. Layer structure, in which planar  $BO_3$  units are linked by Hydrogen Bonding

**Answer: D**



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**45.** The non planar molecule among the following

A.  $B_2H$

B.  $C_2H_4$

C.  $C_6H_6$

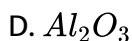
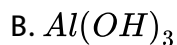
D.  $BCl_3$

**Answer: A**



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46. White fumes appear around the bottle of anhyd.  $AlCl_3$  due to the formation of

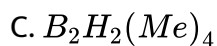
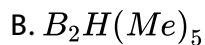
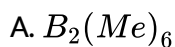


**Answer: A**



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47. Methylation of diborane gives [Me = methyl group]



D. All the above

**Answer: C**



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**48.** The number of  $\sigma$  and  $\pi$  bonds present in inorganic benzene

A.  $9\sigma$ ,  $6\pi$

B.  $6\sigma$ ,  $3\pi$

C.  $9\sigma$ ,  $3\pi$

D.  $12\sigma$ ,  $3\pi$

**Answer: D**



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**49.** The number of electrons shared between the two Boron atoms directly in the formation of bonds in diborane molecule

- A. 4
- B. 2
- C. 0
- D. 8

**Answer: C**



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**50.** When strongly heated, orthoboric acid leaves a residue of

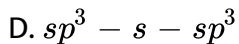
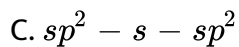
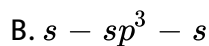
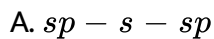
- A. Metaboric acid
- B. Tetraboric acid
- C. Boric anhydride
- D. Boron

**Answer: C**



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**51.** Tau bonds are formed by overlapping of



**Answer: D**



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**52.** Borax bead test is not given by



B. Cobalt salt

C. Copper salt

D. Nickel salt

**Answer: A**



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53.  $H_3BO_3 \xrightarrow{\text{Red heat}} X$ . 'X' in the reaction is

A.  $H_3B_4O_7$

B.  $HBO_2$

C.  $B_2O_3$

D.  $B$

**Answer: C**



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54. The hybridisation of boron in borax is

- A. Two borons in  $sp^2$  and two borons in  $sp^3$
- B. One boron in  $sp^3$  and three borons in  $sp^3$
- C. Three borons in  $sp^2$  and one boron in  $sp^3$
- D. All are in  $sp^3$  hybridisation

Answer: A



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55.  $BCl_3$  on hydrolysis forms

- A. Square planar  $[B(OH)_4]^-$
- B. Octahedral  $[B(H_2O)_6]^{+3}$
- C. Tetrahedral  $[B(OH)_4]^-$
- D. Tetrahedral  $[BCl_4]^-$

**Answer: C**



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**56.** The maximum number of atoms present in the same plane in diborane molecule is

A. 2

B. 6

C. 4

D. 3

**Answer: B**



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**57.** Diborane does not liberate  $H_2$  gas with



A.  $H_2O$

B.  $KOH$

C.  $NH_3$  at  $120^\circ C$

D.  $NH_3$  at  $200^\circ C$

**Answer: C**



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**58.** The statements regarding Diborane are

- i) Diborane contains 2-centred - 3-electron bonds
- ii) B - H bond is formed by  $sp^3 - s$  overlapping
- iii) It contains two coplanar  $BH_2$  groups

The correct statements in above are

A. i and ii are correct

B. ii and iii are correct

C. i and iii are correct

D. ii is only correct

**Answer: B**



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**59.** The hybridisation of boron and oxygen atoms in a molecule of boric acid are respectively

A.  $sp^3$  and  $sp^2$

B.  $sp^2$  and  $sp^3$

C.  $sp^2$  and  $sp^2$

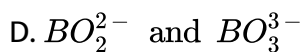
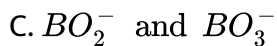
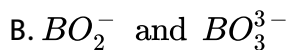
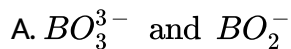
D.  $sp^3$  and  $sp^3$

**Answer: B**



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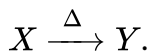
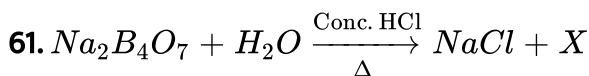
60. Formulae of metaborate and borate ions respectively are



Answer: B



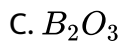
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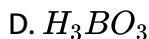


The product Y in the reaction is

A. Crystalline B

B. Amorphous B





Answer: C



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62. Some statements about the structure of diborane are given below

(A) Studies have confirmed that four hydrogens of diborane are one type and remaining two are of another type

(B) Diborane contains two coplanar  $BH_2$  groups

(C) Diborane is a planar molecule

(D) Boron of diborane undergoes  $sp^2$  hybridization The correct statements above are

A. Only A, B, C

B. Only A and B

C. Only B, C, D

D. All are correct

**Answer: B**



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**63.** Hot and concentrated solution of borax is treated with hydrochloric acid to give A and B. "B" on strong heating undergoes dehydration to give C. then "C" is

- A. An acidic oxide
- B. A basic oxide
- C. An amphoteric oxide
- D. Salt of a strong acid and strong base

**Answer: A**



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**64.** What is the nature of aqueous borax solution ?

A. Neutral

B. Acidic

C. Alkaline

D. Amphoteric

**Answer: C**



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**65.** An alkali metal hydride (NaH) reacts with diborane in 'A' to give a tetrahedral compound 'B' which is extensively used as reducing agent in organic synthesis. The compounds 'A' and 'B' respectively are

A.  $CH_3COCH_3$  and  $B_3N_3H_6$

B.  $(C_2H_5)_2O$  and  $NaBH_4$

C.  $C_2H_6$  and  $C_2H_5Na$

D.  $C_6H_6$  and  $NaBH_4$

**Answer: B**



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**66.** The products of the reaction between  $Ca_2B_6O_{11}$  and  $Na_2CO_3$  are

- A.  $Na_2B_4O_7$  and  $CaCO_3$
- B.  $Na_2B_4O_7$ ,  $NaBO_2$  and  $CaCO_3$
- C.  $NaBO_2$  and  $CaCO_3$
- D.  $Na_2B_4O_7$ ,  $B$  and  $CaCO_3$

**Answer: B**



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**67.** In  $Al_2Cl_6$  the number of covalent and co-ordinate bonds are

- A. 3,3

B. 2,4

C. 6,2

D. 6,0

**Answer: C**



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**68.** Correct statement regarding  $B_2H_6$  and  $Al_2Cl_6$

A. Both have three centred two electron bonds

B. Hybridisation of 'B' in  $B_2H_6$  is  $sp^2$  where as Al in  $Al_2Cl_6$  is  $sp^3$  hybridised

C.  $B_2H_6$  has hydrogen bridge bonds and  $Al_2Cl_6$  has halogen bridging

D. Both have two centred three electron bonds

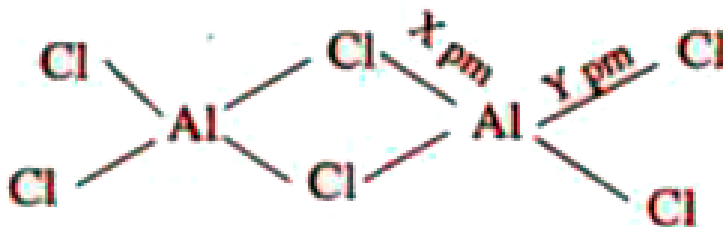
**Answer: C**





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69. Dimeric aluminium chloride and respective bond lengths are given below



A.  $x = y$

B.  $x > y$

C.  $x < y$

D.  $2x = y$

Answer: C



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70. The aqueous solution of  $AlCl_3$  contains  $Al^{+3}$  ions because

- A. Its higher hydration energy compensates its high ionisation energy
- B. Its higher ionisation energy compensates its higher hydration energy
- C. Its hydration energy is same as its ionisation energy
- D. Al is amphoteric metal

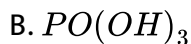
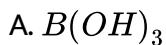
**Answer: A**

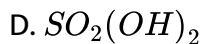
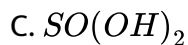


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### OBJECTIVE EXERCISE - 3

1. Which one of the following compounds is not a protonic acid ?



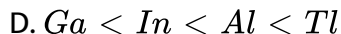
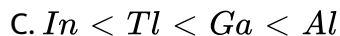
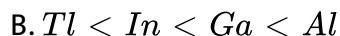
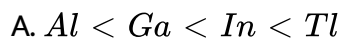


**Answer: A**



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2. The stability of +1 oxidation state among  $Al$ ,  $Ga$ ,  $In$  and  $Tl$  increases in the sequence

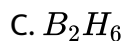
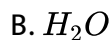


**Answer: A**



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3. Which one of the following molecular hydrides acts as a Lewis acid

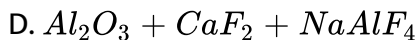
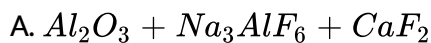


Answer: C



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4. Aluminium is extracted from alumina ( $Al_2O_3$ ) by electrolysis of a molten mixture of



**Answer: A**



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5. Which of the following structure is similar to graphite ?

A.  $B$

B.  $B_4C$

C.  $B_2H_6$

D.  $BN$

**Answer: D**



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6. The stability of +1 oxidation state among  $Al$ ,  $Ga$ ,  $In$  and  $Tl$  increases in the sequence

A.  $Ti < In < Ga < Al$

B.  $In < Ti < Ga < Al$

C.  $Ga < In < Al < Ti$

D.  $Al < Ga < In < Ti$

**Answer: D**



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7. Boric acid is an acid because its molecule

A. Contains replaceable  $H^+$  ion

B. Gives up a proton

C. Accepts  $OH^-$  from water releasing proton

D. Combines with proton from water molecule

**Answer: C**



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## EXAMPLES

1. Why there is sudden decreases in first ionisation energy from boron to aluminium?

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2. Why boron cannot form  $B^{3+}$  ion ?

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3. Which is more stable among  $Tl^{+3}$  and  $Tl^{+1}$ . Why?

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4. Why the maximum covalency of boron is only four where as that of aluminium is six ?



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5. Which is more metallic among the elements of IIIA group? Why?



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6. Write the correct order of reducing character of 13th group elements in +3 states.



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7.  $Tl(OH)_3$  is less basic than  $TlOH$ . Why ?



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8. Draw the structure of dimeric aluminium chloride?



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9. How ionic nature of trihalides of IIIA elements is related to their acidic character?



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10. Gallium does not exhibit +2 oxidation state, but the empirical formula of its chloride is  $GaCl_2$ . Explain.



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11. In a molecule of diborane how many atoms are present in a plane?



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12. What is the hardest compound of boron known?



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13. What is the formula of the binary compound of boron and sulphur?



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14. Why is boric acid considered as a weak acid?



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15. Diborane molecule has six hydrogen atoms, but all atoms cannot be substituted in methylation. Why?



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**16.** When boron trifluoride forms and adduct with ammonia , what are the changes in the hybridisation and geometry?



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**17.** How many tricentric bonds are present in a diborane molecule?



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**18.** Write similarities between benzene and borazole.



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**19.** Reactivity of borazole is greater than that of benzene because



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20. How to prepare amorphous boron from borax? Write equations?



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21. Aluminium vessels should not be washed with materials containing washing soda because



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22. The  $p\pi - p\pi$  back bonding occurs in the halides of boron and not in those of aluminium. Explain.



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23. Anhydrous aluminium chloride fumes in air. Give reasons.



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**24.** Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water Why?



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**25.** One of the alloys of aluminium is looking like gold and was used for preparing coins in France. Write the compositions of the alloy.



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### EXERCISE 1.1

**1.** Discuss the oxidation state of the elements of boron family.



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2. Arrange elements of group 13 in the order of increasing their electronegativity.



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3. Discuss on the electropositivity of elements of boron family.



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4. B-Cl bond has a bond moment. Explain why  $BCl_3$  molecule has zero dipole moment.



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5. Write any three important similarities between boron and aluminium.



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6. The oxidation state +1 is more stable is thallium. Why?



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7. Why boron along among IIIA group elements, exhibits -3 oxidation state?



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8. Compare the acidic character of trihalides of boron.



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9. Write any three important similarities between boron and aluminium.



**Watch Video Solution**

10. Mention any three important differences between boron and aluminium.



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11. How do you explain higher stability of  $TlCl_3$  ?



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12. Why borontrihalides behave as Lew's acids?



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13. Compare the acidic strength of various boron trihalides.



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14. The atomic radius of gallium is less than that of aluminium why?



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15. Though B-Cl bond is polar, why  $BCl_3$  molecule has zero dipole moment?



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16. Explain why the electronegativity of Ga, In and Tl will not vary very much.



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17. Give brief account on the anomalous behaviour of boron in IIIA group elements.



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## EXERCISE 1.2

1. What are the basic unit of the layer structure of orthoboric acid? How are they bonded to one another?



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2. Give the structure of orthoboric acid and discuss its basicity?



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3. What type of bonds are present in diborane molecule?



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4. What is borax bead test? How is it useful in qualitative analysis.



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5. What happens when boric acid is heated ?



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6. Which compound of boron is called inorganic benzene? Why is it so called?



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7. How does diborane react with halogens under different conditions.



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8. Discuss the reaction between diborane and ammonia.



**Watch Video Solution**

9. Discuss the electron deficient bonding in diborane molecule.



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10. Write the important uses of borax and boric acid.



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11. Explain the protic acid behaviour of boric acid.



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12. Why is boric acid polymeric ?



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13. Write any two methods of preparation of diborane. How does it react with (i) Carbon monoxide and (ii) Ammonia ?



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14. Explain the structure of borazole.



**Watch Video Solution**

15. Explain the structure of borazole.



**Watch Video Solution**

16. How does diborane react with water and with trimethyl amine?



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### EXERCISE 1.3

1. Write reactions to justify amphoteric nature of aluminium .



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2. Explain why  $AlCl_3$  is essentially covalent whereas  $AlF_3$  is predominantly ionic.



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3.  $AlCl_3$  is covalent when anhydrous. However, in solution it ionises in spite of its high ionisation energy. Explain.



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4. Why pure alumina cannot be electrolysed for the extraction of aluminium metal?



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5. Explain the reactions of aluminium with acids.



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6. Though aluminium reacts with dil.  $HNO_3$  why it does not react with conc.  $HNO_3$ ?



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7. What happens when aluminium is heated with dilute NaOH and hydrated alumina is treated with aqueous sodium hydroxide solution?



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8. Mention any three important uses of aluminium with their formulae.



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9. Give any two uses of potash alum.



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10. Write any four uses of aluminium.



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11. Mention two important alloys of aluminium? What is the main importance of alloys of aluminium.



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**QUESTIONS FOR DESCRIPTIVE ANSWERS**



1. Why boron cannot form  $B^{3+}$  ion ?



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2. How  $B(OH)_3$  behaves as an acid in water?



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3. What happens when boric acid is heated? Write equation?



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4. Write the formulae of borax . Give tetra nuclear unit of borax.



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5. Explain the action of ammonia on diborane.



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6. What are the banana bonds. Discuss the formation of these bonds in diborane.



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7. Give equations for all reactions of aluminium metals with dil. HCl conc. HCl dil  $H_2SO_4$  and *conc.*  $H_2SO_4$ .



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8. How does aluminium react with dil. NaOH and fused NaOH?



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9. Give the dimetric structure of aluminium chloride . It is electron deficient?



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10. Describe the shape of  $BF_3$  and  $BH_4^-$  What type of hybridisation can be assigned to boron in each of these compounds?



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11. Explain the realative stability between  $BCl_3$  and  $TlCl_3$  and also between  $TlCl_3$  and  $TlCl$ .



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12. Suggest reasons why the B-F bonds lengths in  $BF_3(1.3A^\circ)$  and  $BF_4^-(1.43A^\circ)$  differ.



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13.  $AlCl_3$  forms a dimer but  $BCl_3$  does not form dimer. Why?



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14. Borazine is more reactive than benzene, though both are isostructural. Why?



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15. The hybridisation of boron in borax is



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16. Aqueous solution of borax acts as acidic buffer. Why?



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17. In the reaction between aluminium and *dil.*  $HNO_3$  one mole of aluminium can reduce how many moles of  $HNO_3^-$



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18. What is the hybridisation of B and N in borazole?

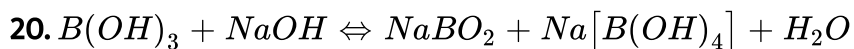


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19. What is the bond length of B-F bond in  $BF_3$ .



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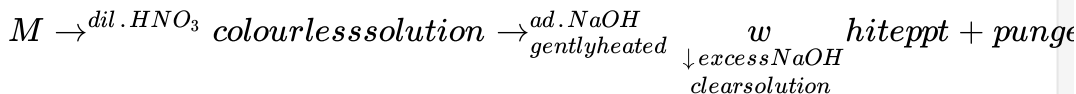


How can this reaction is made to proceed in forward direction ?



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21.



What is the metal M in the above equation?



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22. Why parts of aircrafts are manufactured by using aluminium alloys?



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23. Even though aluminium is more reactive than iron, aluminium will not be corroded as easily as iron. Why?



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24. Aluminium forms  $[AlF_6]^{3-}$  ion but boron does not form  $[BF_6]^{3-}$  ion. Why?



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25. Why  $AlF_3$  is a high melting point solid while  $AlCl_3$  is low melting point volatile solid?



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