

CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (HINGLISH)

P-BLOCK GROUP 13 - BORON FAMILY

Illustration

1. (a) Standard electrode potential value E° for Al^{3+} / Al is $-1.66V$ and that of Tl^{3+} / Tl is $+1.26V$. Predict about the formation of M^{3+} ion in solution and compare the electropositive character of the two metals.
- (b) White fumes appear around the bottle of anhydrous

aluminium chloride. Give reason.

(c) Boron is unable to form BF_6^{3-} ion. Explain.

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2. Explain the following :

(a) Boron has high melting and boiling points.

(b) The $p\pi - p\pi$ back bonding occurs in the halides of boron and not in those of aluminium.

(c) Boron and aluminium halides behave as Lewis acids.

(d) Aluminium forms $[AlF_6]^{3-}$ ion, but boron does not form $[BF_6]^{3-}$ ion.

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3. The first ionisation enthalpy of group 13 elements are :

Element	Boron	Aluminium	Gallium	Indium	Thallium
Symbol	B	Al	Ga	In	Tl
IE₁ (kJmol⁻¹)	801	577	579	558	589

Explain this deviation from the general trend.

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4. Answer the following :

(a) Name of element of group 13 which forms the most stable compound in +1 oxidation state.

(b) Name the element of group 13 which has the highest first ionisation enthalpy.

(c) Name the element of group 13 which is used as a reducing agent in metallurgical processes.

(d) Name of element of group 13 which can show convalency maximum of four only.

Name the compound of aluminium which is used as a germicide and coagulant of the purification of water.

(f) Name the first two elements of group 13.



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5. Give reasons for the following

(a) No visible reaction occurs when aluminium is left in contact with *concHNO*₃.

(b) The hydroxides of *Al* and *Fe* are insoluble in water. However, *NaOH* is used to distinguish one from another.

(c) Anhydrous *AlCl*₃ cannot prepared by heating hydrated aluminium chloride.

(d) Aluminium vessels should not be cleaned with cleansing agent containing washing soda.

(e) Duralumin is used in aircraft industry.



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6. Explain the following :

(a) Aluminium vessel can be used to store *concHNO₃*.

(b) *AlCl₃* forms a dimer, but *BCl₃* does not.

(c) *Al* metal is frequently used as a reducing agent for the extraction of metal such as *Cr*, etc.

(d) *Al* cannot be prepared by the electrolysis of aqueous solution of its salt.

(e) The *B – X* distance is shorter than what is expected theoretically in *BX₃* molecule (*X = F, Cl, Br, I*).

(f) Although the ionisation potential of $B(8.30eV)$ is less than gold ($9.22eV$), yet B is a non-metal while gold is a metal.

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7. (a) What are the special features of structures of boron ?

(b) Which alloy of aluminium is used in air-craft industry ?

(c) When finely powdered Al is suddenly exposed to air, it catches fire. Why ?

(d) Write a balanced equation for the preparation of elemental boron by reduction of BBr_3 with dihydrogen.

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8. In a regular B_{12} icosahedron :

(a) How many boron atoms are equidistant from a given boron atom ?

(b) How many edges are there ?

(c) How many valence electrons are there ?

(d) Can each edge line represent pair bond ?

(e) Explain the type of bonding involved in elemental boron ?



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9. Predict whether Tl^{\oplus} will disproportionate in aqueous

solution :



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10. (a) Al is a good reducing agent. Explain.

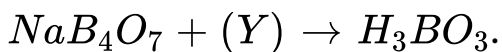
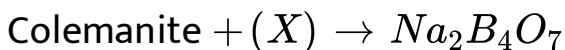
(b) A metallic element, M , forms two stable chlorides with formula MCl and MCl_3 respectively. Where the element M is to be placed in the periodic table ?

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

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12. Identify (X) and (Y) in the following reactions :



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13. Starting from boric acid prepare :

(a) Boric anhydride

(b) Boron trichloride

(c) Boron trifluoride

(d) Metaboric acid

(e) Ethyl borate.



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14. Give reasons for the following :

(a) Aluminium wire is used in transmission cables.

(b) Aluminium utensils should not be used to store drinking water for long time.

(c) A mixture of Al pieces and $NaOH$ is used to open the drain.

(d) Aluminium alloys are used to make aircraft bodies.



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15. What happens when :

(a) Borax is heated strongly.

(b) Water is added to aluminium nitride.

(c) Dry chlorine gas is added over not mixture of

aluminium and coke.

(d) Water is added to aluminium carbide.

(e) Alum is heated.

(f) Aluminium is added to copper sulphate solution .

(g) Aluminium reacts with HNO_3 .

(h) Excess of caustic soda is added to a solution of aluminium chloride.

(i) Aluminium is heated with caustic soda solution.

(j) A mixture of borax and cobalt oxide is heated.



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16. Starting from borax, how would you obtain :

(a) Boric acid

(b) Boron trioxide

(c) Boron

(d) Boron nitride

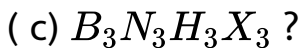
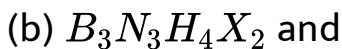
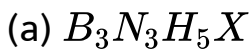
(e) Boron trichloride.

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17. A mixture of boron trichloride and hydrogen is subjected to silent electric discharge to form (*A*) and *HCl*. (*A*) is mixed with ammonia and heated to $200^{\circ}C$ to form (*B*). Identify (*A*) and (*B*).

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18. How many isomers are possible for the following compounds of borazole



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19. Benzene or borazine, which is more reactive and why ?



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20. Assuming that each has icosahedral structure, determine how many isomers are possible for the $B_{10}C_2H_{12}$ molecule ?



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21. Diborane, B_2H_6 , reacts with water to form boric acid and hydrogen, What is the pH of the solution which results when 1.104g of B_2H_6 reacts with 100mL water ?

Assume the final volume to be 100mL.

Given : K_a of $H_3BO_3 = 8 \times 10^{-10}$ pK_a , Atomic weight of $B = 10, 8g$, MW of $B_2H_6 = 27.6gmol^{-1}$.



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Solved Examples

1. When an inorganic compound (X) having $(3c, 2e)$ as well as $(2c, 2e)$ bonds reacts with ammonia gas at a certain temperature and gives a compound (Y). Which is

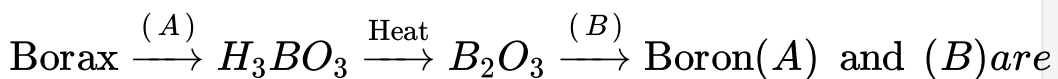
isostructural with benzene. Compound (X) with ammonia at very high temperature gives (Z) also known as inorganic graphite. Identify (X), (Y) and (Z).

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2. Boric acid on heating at $100^{\circ}C$, gives (X). (X) on heating at $160^{\circ}C$ gives (Y) and (Y) on heating at red hot gives (Z). Identify (X), (Y) and (Z).

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3. Amorphous boron is extracted from borax by the following steps :



(a) H_2SO_4 , Al

(b) HCl , Carbon

(c) H_2SO_4 , Mg

(d) HCl , Fe .



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4. A certain salt (X) gives the following tests :

(a) Its aqueous solution is alkaline to litmus.

(b) On strong heating. It swells to give a glassy bead.

(c) When conc H_2SO_4 is added to a hot concentrated solution of (X), white crystals of a weak acid separates out. Identify (X) and write down the chemical equations for reaction at steps a , b and c .



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5. A white crystalline compound (X) swells on heating and gives a violet-coloured flame. Its aqueous solution gives the following reactions :

(a) A white precipitate is formed, with $BaCl_2$ in presence of HCl .

(b) When treated with excess of NH_4OH , it gives a white gelatinous precipitate. The white precipitate dissolves in $NaOH$ and reappears on boiling with a concentrated solution of NH_4Cl .

(c) It gives a yellow precipitate with cobaltinitrite solution.

Identify (X) and explain the reaction at steps a , b and c .



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6. The metallic salt (XY) is soluble in water.

(a) When the aqueous soluble of (XY) is treated with $NaOH$ solution, a white precipitate (A) is formed. In excess of $NaOH$ solution, a white precipitate (A) is formed. In excess of $NaOH$ solution, white precipitate (A) dissolves to form a compound (B). When this solution is boiled with solid NH_4Cl , a precipitate of compound (C) is formed.

(b) An aqueous solution on treatment with $BaCl_2$ solution gives a white precipitate (D) which is insoluble in conc HCl .

(c) The metallic salt (XY) forms a double salt (E) with potassium sulphate.

Identify (XY), (A), (B), (C), (D) and (E).



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7. An inorganic compound (X) shows the following reactions :

(a) It is white solid, exists as dimer and fumes in moist air.

(b) It sublimes at $180^{\circ}C$ and forms monomer on heating to $400^{\circ}C$.

(c) Its aqueous solution turns blue litmus red and gives a white precipitate with $AgNO_3$ solution which is soluble in excess of NH_4OH .

(d) Addition of $NaOH$ to the solution of (A) gives a white gelatinous precipitate which is, however, soluble on excess of $NaOH$.

Identify the compound (A).



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8. Compound (X) on reduction with $LiAlH_4$ gives a hydride (Y) containing 21.72% hydrogen along with other products. The compound (Y) reacts with air explosively resulting in formation of boron trioxide. Identify (X) and (Y).

Give balanced reactions involved in the formation of (Y) and its reaction with air. Give the structure of (Y).



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9. An inorganic Lewis acid (X) shows the following reactions :

(a) It fumes in moist air.

(b) The intensity of fumes increase when a rod dipped in NH_4OH is brought near it.

(c) To an aqueous solution of (X), addition of NH_4Cl and NH_4OH gives a precipitate which dissolves in $NaOH$ solution.

(d) An acidic solution of (X) does not give a precipitate with H_2S .

Identify (X) and give chemical reactions for (a) to (d).



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10. (a) On boiling a mineral (A) with $NaCO_3$ solution, a white precipitate (B) is formed.

(b) The precipitate is filtered and the filtrate contains two compounds (C) and (D). The compound (C) is removed

by crystallisation and when CO_2 is passed through the mother liquor left, (D) changes to (C).

(c) On strongly heating (C), two compounds (D) and (E) are formed.

(d) (E) on heating with cobalt oxide provides blue-coloured substance (F).

Identify (A) to (F) and give chemical reaction for (a) to (d).

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11. Identify $(A) + N_2 \xrightarrow{\Delta} (B) \xrightarrow{H_2O} (C) \downarrow (D)_{(g)}$
White ppt.

White precipitate (C) dissolves in $NaOH$ solution the gas (D) gives white fumes with HCl .

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12. A colourless mixture of two salts (A) and (B) (excess) is soluble in H_2O . (A) turns blue litmus red and (B) turns red litmus blue. (A) gives white precipitate with (B), which dissolves in excess of (B) forming (C). (A) when placed in atmosphere gives fumes and can form dimer. (A) gives white precipitate with NH_4Cl and NH_4OH which is soluble in (B). Identify (A), (B) and (C). Explain reactions.



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13. $B_{10}C_2H_{12}$ is isoelectronic with



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14. Draw possible structures of B_4H_{10} and B_5H_{11} molecules, showing the existence of $(3c, 2e)$ bridge bonds.

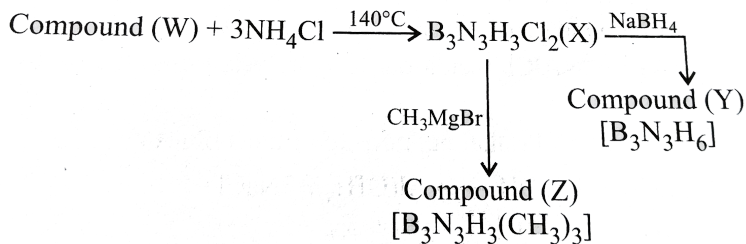
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15. How many the electrical conductivity of Al_2Cl_6 changes on heating ?

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16. Complete the following :

a.



(a)

(b) 



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Ex 6 1 Subjective

1. Why boron does not exist as B^{2+} ion in solution or in compound ?



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2. The +1 oxidation state is more stable than +3 oxidation state for thallium. Give reason.

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3. Aluminium chloride exists as dimer. Give reason.

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4. Why boron halides do not exist as a dimer. While $AlCl_3$ exists as Al_2Cl_6 ?

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5. Give reaction for the following :

(a) In (*III*) is more stable than in (*I*) in aqueous solution.

(b) $InCl_3$ undergoes disproportionation but $InCl$ does not.

(c) Unlike In^{\oplus} , Tl^{\oplus} is more stable with respect to disproportionation.

(d) Ga^{\oplus} undergoes disproportionation reaction.

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6. Why boron and aluminium tend to form covalent compounds ?

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7. Molten aluminium bromide is a poor conductor of electricity. Give reason.

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8. Why $B - X$ bond distance in BX_3 is shorter than theoretically expected value ?

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9. Boric acid can be titrated against sodium hydroxide using phenolphthalein as an indicator only in the

presence of polyhydroxy compounds like glycol. Glycerol etc. Give reason.

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10. Which one is more soluble in diethyl ether : anhydrous $AlCl_3$ or hydrated $AlCl_3$? Explain in terms of bonding.

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11. How is boron obtained from borax ? Give the chemical reactions involved. Draw the structure of B_2H_6 and give its reaction with HCl .

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12. Unlike ordinary fire, thermite reaction cannot be stopped by pouring water. Explain.

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13. (a) Explain why BF_3 exists whereas BH_3 does not.

(b) Compare the B-F bond length in BF_3 and BF_4^-

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14. State with equations what happens when borax is heated on a platinum wire loop and to resulting transparent mass, a mixture amount of CuO is added and the mixture is again heated.

(a) First in the oxidising flame and

(b) Then in the reducing flame of a Bunsen burner ?

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15. What is inorganic benzene ? Why is it so called ? How will you get it from diborane ?

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16. AlF_3 is insoluble in anhydrous HF but dissolves on addition of NaF . AlF_3 precipitates out of the resulting solution when gaseous BF_3 is bubbled through. Give reasons.

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17. What do you understand by :

(a) Ammonal

(b) Bentonite

(c) Rubies and Sapphire

(d) Laps lazuli

(e) Emery paper.



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Ex 6 1 Objective

1. How does BF_3 act as a catalyst in industrial process?

- A. Strong reducing nature
- B. Weak reducing nature
- C. Strong Lewis acid nature
- D. Weak Lewis acid character

Answer:



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2. Thallium shows different oxidation states because:

- A. Inert pair effect
- B. Amphoteric nature
- C. Transition metal

D. High reactivity

Answer:

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3. Specify the coordination geometry around and the hybridisation of N and B atoms in 1:1 complex of BF_3 and NH_3 .

A. N : tetrahedral, sp^3 , B : tetrahedral, sp^3

B. N : pyramidal, sp^3 , B : pyramidal, sp^3

C. N : pyramidal, sp^3 , B : planar, sp^3

D. N : pyramidal, sp^3 , B : tetrahedral, sp^3 .

Answer: option 1

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4. Which one of the following is the correct statement ?

A. $B_2H_6 \cdot 2NH_3$ is known as inorganic benzene.

B. Boric acid is a protonic acid

C. Beryllium exhibits a coordination number of six.

D. Chlorides of both beryllium and aluminium have
bridge chloride structures in solid phase.

Answer: option 4

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

A. Washing soda reacts with aluminium to form soluble aluminate.

B. Washing soda is expensive.

C. Washing soda is easily decomposed.

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

Answer: option 1



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6. In the structure of $[B_4O_5(OH)_4]^{2-}$.

A. All four B atoms are trigonal planar.

B. One B atom is tetrahedral and the other three B atoms are trigonal planar.

C. Three B atoms are tetrahedral and one B atom is trigonal planar.

D. Two B atoms are tetrahedral and other two are trigonal planar.

Answer: option 4



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7. The pH an aqueous solution of Al^{3+} is likely to be.

- A. Neutral
- B. Acidic
- C. Slightly basic
- D. Highly basic

Answer: option 4



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8. B_2H_6 and B_4H_{10} respectively are examples of.

- A. Nido and arachno boranes
- B. Nido and closo boranes

C. Closo and arachno boranes

D. Nido boranes

Answer: a

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9. In the thermite process, iron oxide is reduced to molten iron by Al powder because

A. The melting point of Fe is low

B. The reaction is highly endothermic

C. Larger amount of heat is liberated in the formation of Al_2O_3 .

D. *Al* is an amphoteric element.

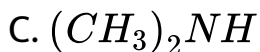
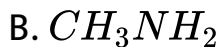
Answer: c

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10. In the following reaction.



The amine (*s*)*x* is /are.

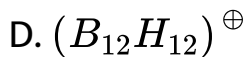
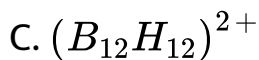
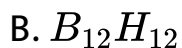
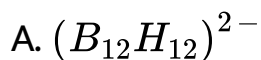


Answer:



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11. $B_{10}C_2H_{12}$ is isoelectronic with



Answer:



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12. The correct order of the atoms in terms of their IE_1 is :

A. $Li < B < Be < C$

B. $Li < Be < B < C$

C. $Li > B > Be > C$

D. $Li > Be > B > C$

Answer:



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13. Thallium (Tl) exhibits monovalency whereas Al exhibits trivalency. This is due to :

- A. The energy required to unpair outer s-electrons in Tl exceeds the energy involved in bond formation.
- B. Tl has only one electron in its outermost orbital.
- C. Al can use its vacant d-orbitals for the bond formation.
- D. Tl is a non-metal.

Answer: option 1



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14. Which of the following atom would likely form a cation.

A. B

B. Si

C. Al

D. C

Answer:



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Exercise Linked Comprehension

1. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state.

Down the group (↓), the stability of higher oxidation

state increases. This 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 and + 3 both
- D. + 1, + 2, + 3

Answer: C

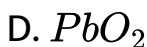


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2. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state.

Down the group (↓), the stability of higher oxidation state increases. This 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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3. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state.

Down the group (\downarrow), the stability of lower oxidation state increases. This 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. BCl_3

D. $TlCl$

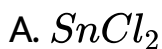
Answer: A

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4. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state.

Down the group (\downarrow), the stability of higher oxidation state increases. This concept which is commonly called inert pair effect has been used to explain many physical and chemical properties of the element of these groups.

The strongest reductant among the following is



Answer: D



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5. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state. Down the group (↓), the stability of higher oxidation state increases. This 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 of the following statement is wrong ?

- A. $Tl(III)$ salt undergo disproportionation.
- B. CO is used as a reducing agent.
- C. CO_2 is a greenhouse gas.
- D. SiO_2 is a covalent solid.

Answer: A



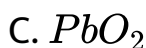
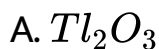
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6. The heavier members of 13 and 14 groups besides the group oxidation state also show another oxidation state.

Down the group (↓), the stability of higher oxidation

state increases. This 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 of the following acts as the strongest acid ?

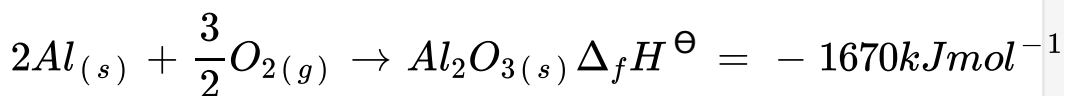


Answer: D



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7. Despite the fact that aluminium is a reactive metal, it is a stable in air as well as in water. This is due to the formation of thin layer of oxide on the surface of aluminium metal which makes it passive for further attack. The layer is so useful, that in industry, it is purposely deposited by an electrolytic process called anodising. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction.



This reaction finds application for welding of metal and in the metallurgical extraction of many metals from their oxides.

The limitation is that to start the reaction, high temperature is required for which an ignition mixture is required.

Which of the following metals cannot be extracted by using Al as a reducing agent ?

A. W from WO_3

B. Mn from Mn_3O_4

C. Cr from Cr_2O_3

D. Na from Na_2O

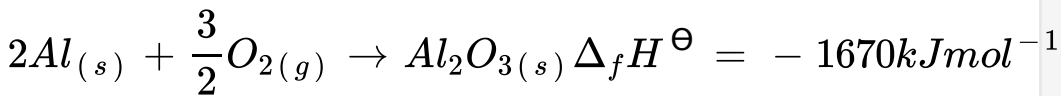
Answer: D



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8. Despite the fact that aluminium is a reactive metal, it is a stable in air as well as in water. This is due to the formation of thin layer of oxide on the surface of

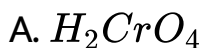
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The limitation is that to start the reaction, high temperature is required for which an ignition mixture is required.

Aluminium becomes passive in :



B. *concHNO*₃

C. *HClO*₄

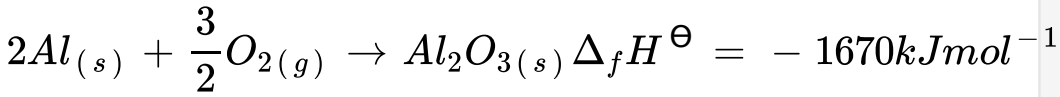
D. *NaOH*

Answer: A::B::C

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9. Despite the fact that aluminium is a reactive metal, it is a stable in air as well as in water. This is due to the formation of thin layer of oxide on the surface of aluminium metal which makes it passive for further attack. The layer is so useful, that in industry, it is purposely deposited by an electrolytic process called

anodising. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction.



This reaction finds application for welding of metal and in the metallurgical extraction of many metals from their oxides.

The limitation is that to start the reaction, high temperature is required for which an ignition mixture is required.

Anodising can be done by electrolysing dil H_2SO_4 with Al as anode. This results in :

A. Formation of $Al_2(SO_4)_3$ on the surface of Al anode

B. Formation of Al_2O_3 on the surface of Al anode

C. Formation of polymertic aluminium hydride film on the surface of Al anode.

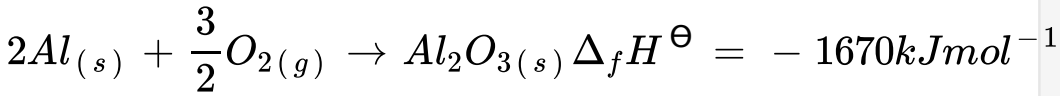
D. None of the above

Answer: A

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10. Despite the fact that aluminium is a reactive metal, it is a stable in air as well as in water. This is due to the formation of thin layer of oxide on the surface of aluminium metal which makes it passive for further attack. The layer is so useful, that in industry, it is purposely deposited by an electrolytic process called

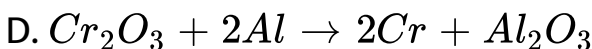
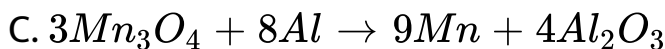
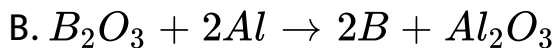
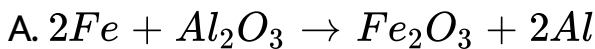
anodising. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction.



This reaction finds application for welding of metal and in the metallurgical extraction of many metals from their oxides.

The limitation is that to start the reaction, high temperature is required for which an ignition mixture is required.

The reaction which is not involved in thermite process is

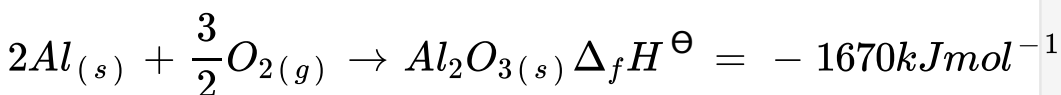


Answer: A



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11. Despite the fact that aluminium is a reactive metal, it is a stable in air as well as in water. This is due to the formation of thin layer of oxide on the surface of aluminium metal which makes it passive for further attack. The layer is so useful, that in industry, it is purposely deposited by an electrolytic process called anodising. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction.



This reaction finds application for welding of metal and in the metallurgical extraction of many metals from their

oxides.

The limitation is that to start the reaction, high temperature is required for which an ignition mixture is required.

Thermite mixture used for welding is

A. Fe_2O_3 and Al powder

B. BaO and Mg powder

C. Fe and Al

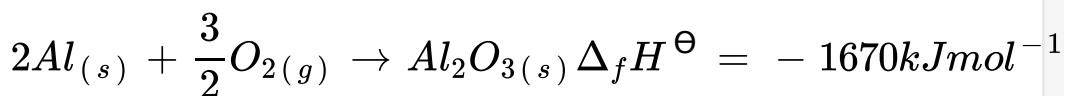
D. Cu and Al

Answer: A



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12. Despite the fact that aluminium is a reactive metal, it is stable in air as well as in water. This is due to the formation of a thin layer of oxide on the surface of aluminium metal which makes it passive for further attack. The layer is so useful, that in industry, it is purposely deposited by an electrolytic process called anodising. Reaction of aluminium with oxygen is highly exothermic and is called thermite reaction.



This reaction finds application for welding of metal and in the metallurgical extraction of many metals from their oxides.

The limitation is that to start the reaction, high temperature is required for which an ignition mixture is

required.

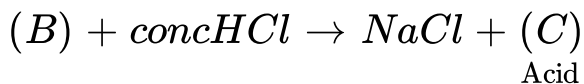
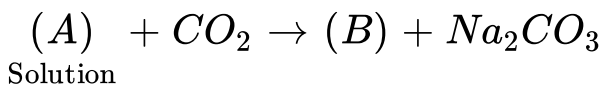
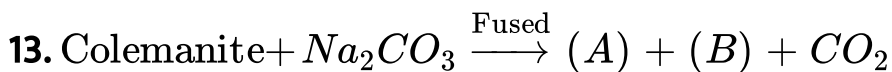
Anodised aluminium is.

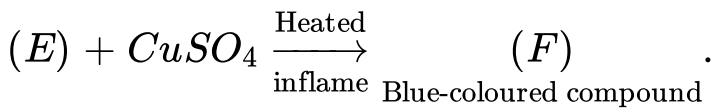
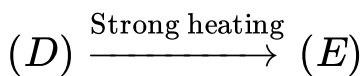
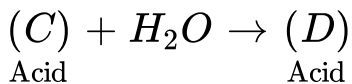
- A. Al obtained at anode
- B. Al prepared electrolytically
- C. Alloy of Al containing 95 % Al
- D. Al electrolytically coated with Al_2O_3 .

Answer: D

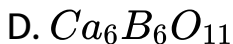
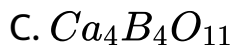
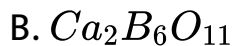
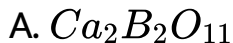


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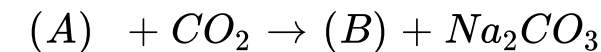
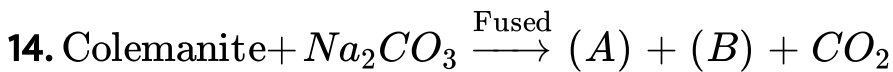
Colemanite is.



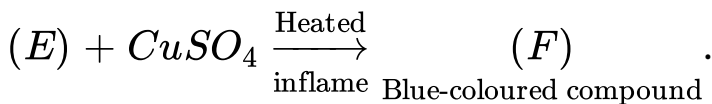
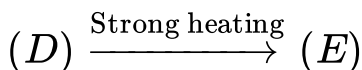
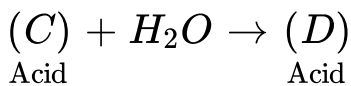
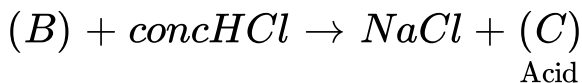
Answer: B



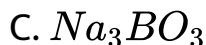
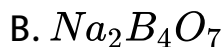
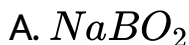
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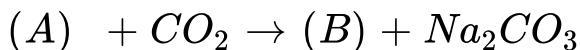
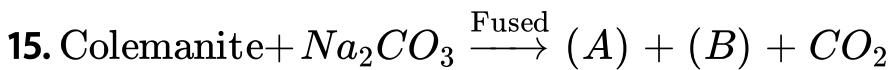
Solution



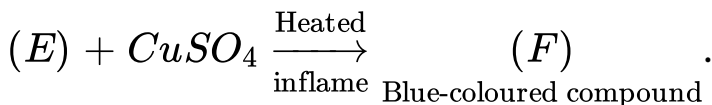
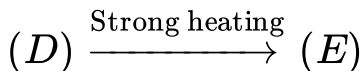
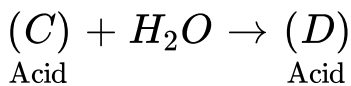
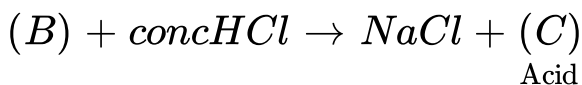
Compound (A) is.



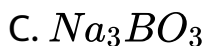
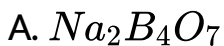
Answer: A



Solution

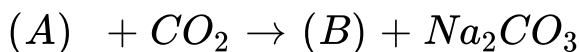
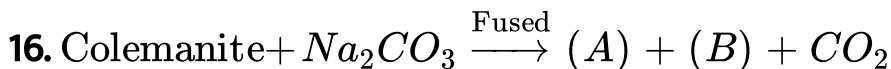


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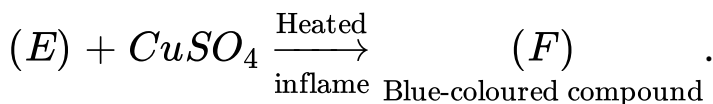
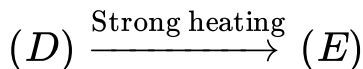
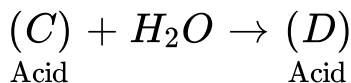
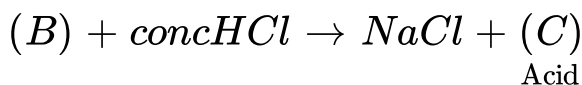


Answer: A

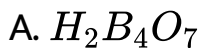
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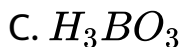


Solution



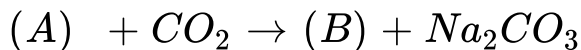
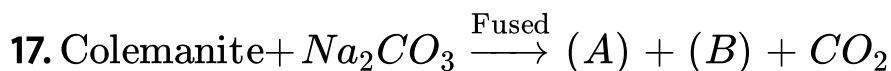
Compound (C) is.



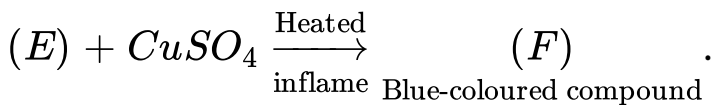
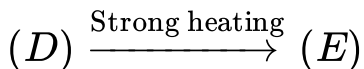
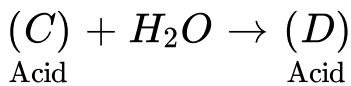
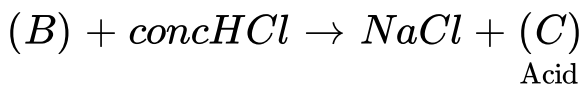


Answer: A

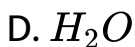
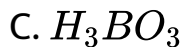
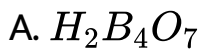
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Solution

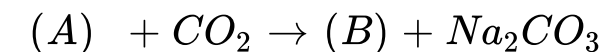
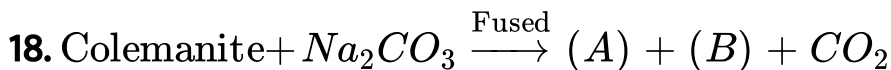


Compound (D) is.

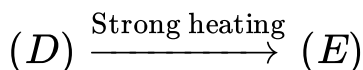
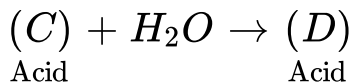
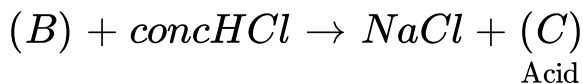


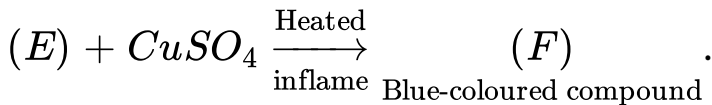
Answer: C

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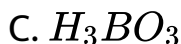
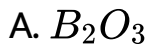


Solution





Compound (*E*) is.

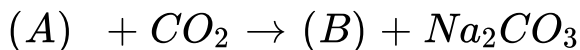
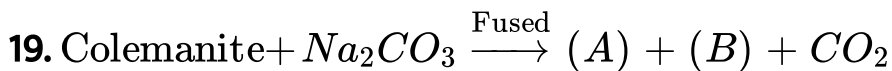


D. None of these

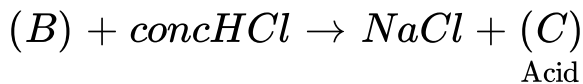
Answer: A

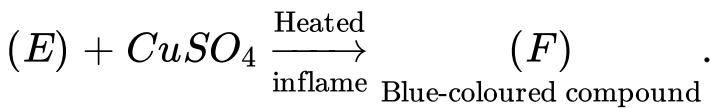
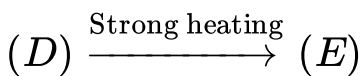
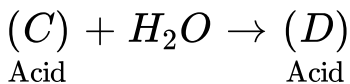


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Solution





Compound (F) is.



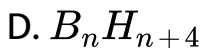
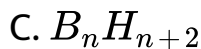
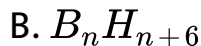
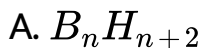
Answer: D



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20. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closoboranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

General formula of closoboranes is.



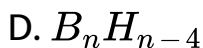
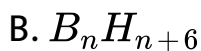
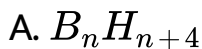
Answer: A



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21. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closo-boranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

General formula of nido-boranes is.



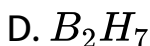
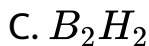
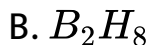
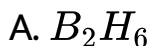
Answer: A



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22. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closo-boranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

Three centre two electron $(3c, 2e)$ bond is present in :



Answer: A

23. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closoboranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

Boron in diborane is ___ hybridised.

A. sp

B. sp^2

C. sp^3

D. dsp^2

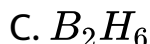
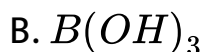
Answer: C



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24. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closoboranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

Three centre two electron $(3c, 2e)$ bond is present in :



D. B_4H_{10}

Answer: C::D

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25. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closoboranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

In B_2H_6 ,

A. There is $B - B$ bond

B. All the atoms are in one plane

C. The boron atoms are linked through hydrogen bridges

D. All the $B - H$ bond distances are equal

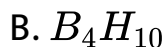
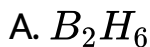
Answer: C

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26. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are classified into closoboranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

Which of the following is an electron-deficient compound

?



Answer: A::B



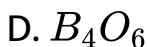
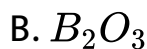
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27. Boron reacts with oxygen at $700^\circ C$ to give (A).

Compound (A) reacts with carbon and dry chloride to give (B) and carbon monoxide. (B) on reduction with

$LiAlH_4$ gives (C) along with $LiCl$ and $AlCl_3$. (C) on reaction with ammonia gives (D). Which on heating gives (E). (C) on reaction with NaH gives (F).

Compound (A) is



Answer: B



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28. Boron reacts with oxygen at 700°C to give (A). Compound (A) reacts with carbon and dry chloride to give (B) and carbon monoxide. (B) on reduction with LiAlH_4 gives (C) along with LiCl and AlCl_3 . (C) on reaction with ammonia gives (D). Which on heating gives (E). (C) on reaction with NaH gives (F).

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



29. Boron reacts with oxygen at 700°C to give (A). Compound (A) reacts with carbon and dry chloride to give (B) and carbon monoxide. (B) on reduction with LiAlH_4 gives (C) along with LiCl and AlCl_3 . (C) on reaction with ammonia gives (D). Which on heating gives (E). (C) on reaction with NaH gives (F).

Compound (C) is

- A. An electron-deficient compound
- B. Contain $(3c, 2e)$ bond
- C. Has ethane like structure
- D. An ionic compound.

Answer: A:B



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30. Boron reacts with oxygen at $700^{\circ}C$ to give (A).

Compound (A) reacts with carbon and dry chloride to

give (B) and carbon monoxide. (B) on reduction with

$LiAlH_4$ gives (C) along with $LiCl$ and $AlCl_3$. (C) on

reaction with ammonia gives (D). Which on heating gives

(E). (C) on reaction with NaH gives (F).

Compound (D) has B in ___ hybridised state.

A. sp

B. sp^2

C. sp^3

D. dsp^2

Answer: c

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31. Boron reacts with oxygen at $700^\circ C$ to give (A). Compound (A) reacts with carbon and dry chloride to give (B) and carbon monoxide. (B) on reduction with $LiAlH_4$ gives (C) along with $LiCl$ and $AlCl_3$. (C) on reaction with ammonia gives (D). Which on heating gives (E). (C) on reaction with NaH gives (F). Compound (E) is.

A. Inorganic benzene

B. Borazine

C. Borazon

D. Diborane

Answer: A:B



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32. Boron reacts with oxygen at 700°C to give (A). Compound (A) reacts with carbon and dry chloride to give (B) and carbon monoxide. (B) on reduction with LiAlH_4 gives (C) along with LiCl and AlCl_3 . (C) on reaction with ammonia gives (D). Which on heating gives

(E). (C) on reaction with NaH gives (F).

Compound (F) behaves as.

A. Reducing agent

B. Oxidising agent

C. Complexon

D. Buffer

Answer: A



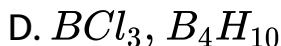
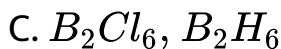
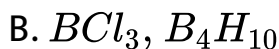
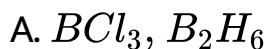
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33. Boron reacts with oxygen at $700^{\circ}C$ to give (A).

Compound (A) reacts with carbon and dry chloride to give (B) and carbon monoxide. (B) on reduction with

$LiAlH_4$ gives (C) along with $LiCl$ and $AlCl_3$. (C) on reaction with ammonia gives (D). Which on heating gives (E). (C) on reaction with NaH gives (F).

Compound (B) and (C) are _____ and _____ respectively.



Answer: A



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34. Borax is actually made of two tetrahedra and two triangular units joined together and should be written as $Na_2[B_4O_5(OH)_4] \cdot 8H_2O$.

Consider the following statements about borax :

A : Each boron atom has four $B - O$ bonds.

B : Each boron atom has three $B - O$ bonds.

C : Two boron atoms have four $B - O$ bonds while other two have three $B - O$ bonds.

D : Each boron atom has one-OH group.

Select correct statement (s) :

A. A, B

B. B, C

C. C, D

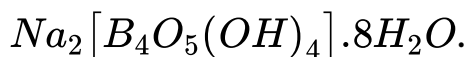
D. A, C

Answer: C



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35. Borax is actually made of two tetrahedra and two triangular units joined together and should be written as



Select the correct statement (s) :

A. Borax is used as a buffer.

B. $1M$ borax solution reacts with equal volumes of $2MHCl$ solution.

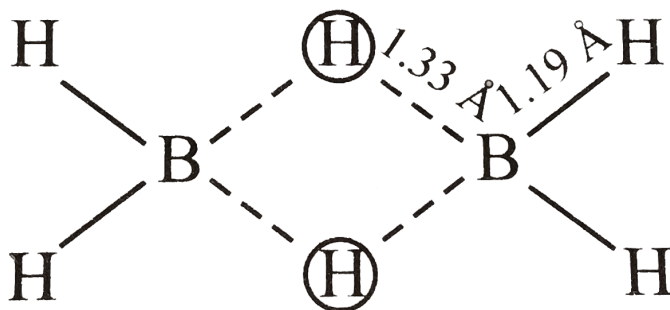
C. Titration of borax can be done by using methyl orange as the indicator.

D. Coloured bead obtained in borax-bead test contains metaborate.

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

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36. The molecular shapes of diborane is shown below :



Consider the following statements for diborane :

(i) Boron is approximately sp^3 hybridised.

(ii) $B - H - B$ angle is 180°

(iii) There are two terminal $B - H$ bonds for each boron atom.

(iv) There are only 12 bonding electrons available of

These statements :

A. (i),(iii) and (iv) are correct

B. (i),(ii) and (iii) are correct

C. (ii),(iii) and (iv) are correct

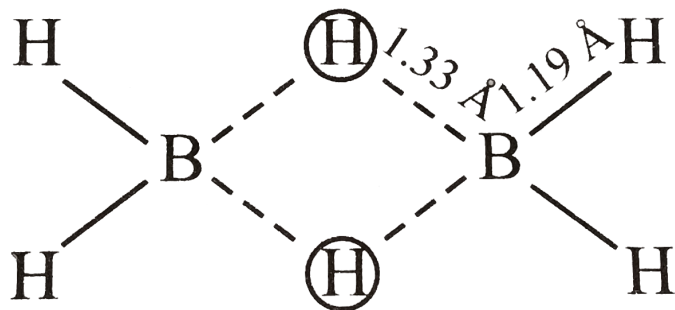
D. (i),(ii) and (iv) are correct

Answer: A



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37. The molecular shapes of diborane is shown below :



Select correct statement about B_2H_6 :

- A. Bridging groups are electron-deficient with 12 valence electrons.
- B. It has $(2c, 2e) B - H$ bonds.
- C. It has $(3c, 2e) B - H - B$ bonds.
- D. All of the above are correct statements.

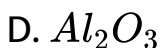
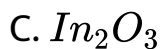
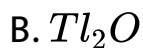
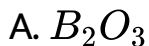
Answer: D



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Exercise Multiple Correct

1. Which of the following oxides are basic ?

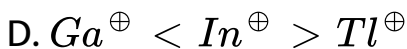
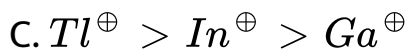
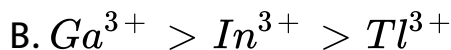
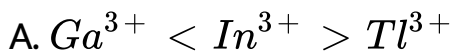


Answer: B::C



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2. Stability of monovalent and trivalent cations of Ga , In , Tl lie in following sequence :



Answer: B::C



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

- A. A white gelatinous precipitate
- B. Soluble in excess of NH_4OH
- C. Soluble in excess of $NaOH$
- D. Amphoteric in nature.

Answer: A::C::D



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4. Which of the following metals are extracted by using Al as reducing agent ?

A. Na from Na_2O

B. Cr from Cr_2O_3

C. W from WO_3

D. Mg from MgO

Answer: B::C



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5. Aluminium becomes passive in :

A. conc HNO_3

B. H_2CrO_4

C. $HClO_4$

D. conc HCl

Answer: A::B::C



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6. Which of the following statements are true for H_3BO_3 ?

- A. It is weak 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 van der Waals forces of attraction.

D.

Answer: A::B::D

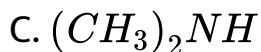
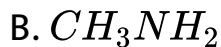


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7. In the following reaction.



The amine (*s*)*x* is /are.



Answer: A::B::C

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8. Possible oxidation states of boron family elements are :

A. +1

B. +2

C. +3

D. +4

Answer: A::C

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9. 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. $H_b \dots B \dots H_b$ bond angle is 122° .
- D. All hydrogens in B_2H_6 lie in the same plane.

Answer: A::B::C



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10. Orthoboric acid (H_3BO_3) and metaboric acid (HBO_2) differ in respect of :

- A. acidity

B. Structure

C. Melting point

D. Oxidation

Answer: A::B::C



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11. Which of the following element do not form carbide ?

A. B

B. Al

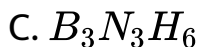
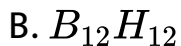
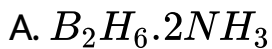
C. In

D. Ga

Answer: C::D

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12. Diborane reacts with ammonia under different conditions to give :



Answer: A::C::D

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13. Why the atomic radius of gallium is less than that of Al?

- A. Poor shielding power of d electrons of Ga atom
- B. Poor shielding power of s electrons of Ga atom
- C. Greater shielding power of s electrons of Al atom
- D. Greater shielding power d electrons of Ga atom.

Answer: A::B::C



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14. 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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15. Which of the following compounds (s) undergo disproportionation in aqueous solution ?

A. $TlCl_3$

B. $GaCl$

C. $InCl$

D. $TlCl$

Answer: B::C

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16. Which of the following statements are correct for Al ?

A. Bad conductor of electricity

B. Malleable and ductile

C. Found free in nature

D. Alloys of Al are light

Answer: B::D



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

A. HCl

B. $NaOH$

C. CO_2

D. H_2SO_4

Answer: A::D



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18. Alumina is.

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

Answer: A::D



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19. Which of the following are incorrect statements ?

- A. BH_3 is a stable compound
- B. Boron hydrides are readily hydrolysed

C. Boron hydrides are formed by the reaction of

Mg_3B_2 and dil HCl .

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

Answer: A::D



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20. Potash alum is used as a

A. Disinfectant

B. Water softener

C. Mordant in textile industry

D. Fibre in polymer industry

Answer: A::B



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21. Which of the following minerals contain aluminium ?

A. Fluorspar

B. Feldspar

C. Mica

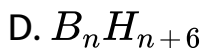
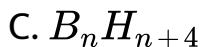
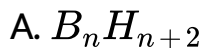
D. Carborundum

Answer: B::C



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22. Boranes have general formula :



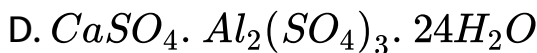
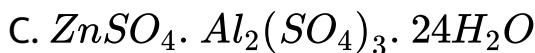
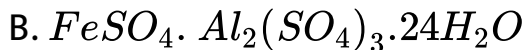
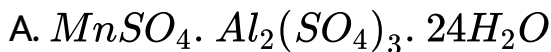
Answer: C::D



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23. Double sulphates of a divalent and trivalent metal crystallised with 24 molecules of water of crystallisation

are called pseudoalums and are not isomorphous with true alums. Which of them is//are pseudoalums ?



Answer: A::B



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Exercise Single Correct

1. Boron behaves as :

A. Non-metal

B. Metal

C. Metalloid

D. Transition metal

Answer: A



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2. On strong heating boric acid yields

A. B

B. B_2

C. B_2O_3

D. B_2H_6

Answer: C



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3. Boron trichloride on reaction with water produces 'X' along with HCl 'X' is.

A. $BOCl_3$

B. B_2H_6

C. $B(OH)_3$

D. B_2O_3

Answer: C



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4. Which of the following is not a mineral of boron ?

A. Colemanite

B. Kernite

C. Boric anhydride

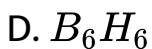
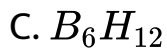
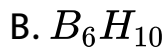
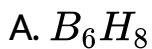
D. Borax

Answer: C



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5. Hexaborane (10) is.



Answer: B



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6. The name and formula of the compound of boron which is called 'inorganic benzene' are



C. Borazine, $B_3N_3H_6$

D. Borazine, $B_6N_3H_3$

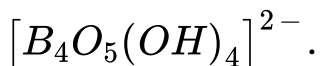
Answer: C

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7. What is not true about borax ?

A. Molecular formula is $Na_2B_4O_7 \cdot 10H_2O$.

B. Crystalline borax contains tetranuclear unit of



C. It hydrolyses to give an acidic solution.

D. White crystalline solid.

Answer: C

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8. Which hybrid state of boron best explains the structures in B_2H_6 ?

A. sp^2

B. sp^3

C. dsp^2

D. sp

Answer: B

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9. The unexpected order of acidic strength of the trihalides of boron can best be explained by.

- A. $p\pi - p\pi$ back bonding
- B. Hybridisation
- C. Trigonal planar structure
- D. None of the above

Answer: A



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10. Borax bead test is based upon the formation of

A. Metaborate

B. Tetraborate

C. Double oxide

D. Orthoborate

Answer: A



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11. Which of the following minerals does not contain aluminium ?

A. Cryolite

B. Mica

C. Feldspar

D. Flourspar

Answer: D

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12. In which of the following, a salt of the type KMO_2 is obtained ?



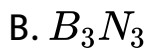
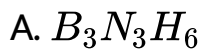
C. Both

D. None

Answer: C

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13. Inorganic graphite is



Answer: B

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14. 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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15. Borax is used as a cleansing agent because on dissolving in water, it gives

- A. Alkaline solution

- B. Acidic solution
- C. Bleaching solution
- D. Neutral solution

Answer: A

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16. Boric acid is polymeric due to :

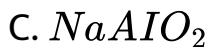
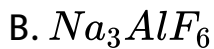
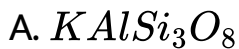
- A. Its monobasic nature
- B. Its acidic nature
- C. The presence of hydrogen bonds
- D. Its geometry

Answer: C



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17. The chemical formula of feldspar is

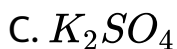
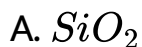


Answer: A



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18. The chief impurity present in bauxite is



Answer: B



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19. 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



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20. Boric acid is used in carrom boards for smooth gliding of pawns because

A. H_3BO_3 molecules are loosely chemically bonded and hence soft.

B. Its low density makes it fluffy.

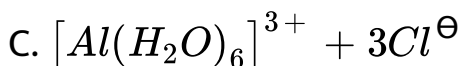
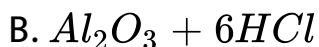
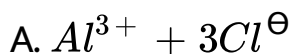
C. It is chemically inert with plywood.

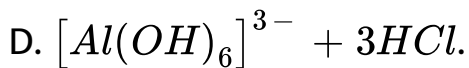
D. H-bonding in H_3BO_3 gives it a layered structure.

Answer: A

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





Answer: C



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22. In which of the following molecules is hydrogen bridge bond present ?

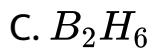
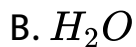
- A. Water
- B. Inorganic benzene
- C. Diborane
- D. Methanol

Answer: C



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23. Which of the following molecular hydride act as a Lewis acid ?

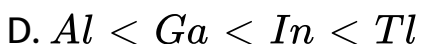
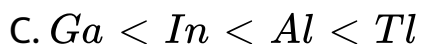
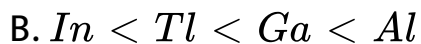
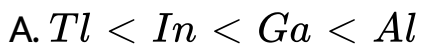


Answer: C



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24. The stability of +1 oxidation state increases in the sequence :

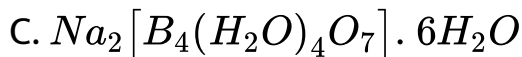
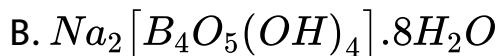
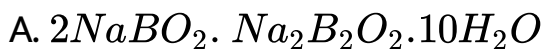


Answer: D



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25. $Na_2B_4O_7 \cdot 10H_2O$ is correctly represented as



D. All of the above

Answer: B



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26. $AlCl_3$ is an electron-deficient compound but AlF_3 is not, 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 compound.

C. Al in $AlCl_3$ is sp^3 hybridised but in AlF_3 , Al is sp^3 hybridised.

D. $AlCl_3$ exists as a dimer but AlF_3 does not.

Answer: B



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27. Bauxite ore is generally contaminated with impurity of oxides of two elements X and Y . Which of the following statement is correct ?

- A. X is a non-metal and belongs to the third period while Y is a metal and belongs to the fourth period.
- B. One of two oxides has three-dimensional polymeric structure.
- C. both (a) and (b) are correct.
- D. None of the above

Answer: C



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28. Boron does not form B^{3+} ion, due to.

- A. Energy required to form B^{3+} ion is very high which will not be compensated by lattice enthalpies or hydration enthalpies of such ion.
- B. Boron is a non-metal
- C. Boron is a metalloid
- D. None of the above

Answer: A



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29. The number of isomers possible for disubstituted borazine, $B_3N_3H_4X_2$ is

A. 3

B. 4

C. 6

D. 5

Answer: B



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30. Aqueous solution of borax acts as a buffer because

A. It contains tribasic acid and strong base.

B. It contains weak acid and its salt with strong base.

C. It contains number of neutral water molecules.

D. None of the above

Answer: B

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31. Correct match is :

A. Ordinary form of borax : $Na_2B_4O_7 \cdot 5H_2O$

B. Colemanite : $Ca_2B_6O_{11} \cdot 5H_2O$

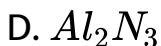
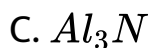
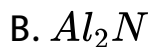
C. Beronarocalcite : $2Mg_3B_8O_{15} \cdot MgCl_2$

D. Octahedral form of borax : $Na_2B_4O_7 \cdot 10H_2O$.

Answer: B

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32. When aluminium is heated in atmosphere of nitrogen it forms :



Answer: A



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33. Which one of the following is more abundant in the earth's crust ?

A. B

B. Al

C. Ga

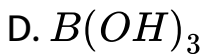
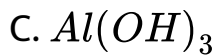
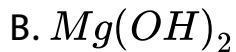
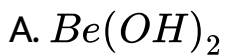
D. In

Answer: B



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34. Which of the following is acidic in nature ?



Answer: D



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35. alums are used for :

A. Tanning of leather

B. Purification of water

C. Coagulation

D. All of these

Answer: D



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36. The liquified metal expanding on solidification is :

A. Al

B. Ga

C. Zn

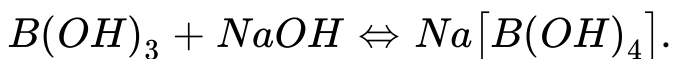
D. Cu

Answer: B



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37. How can the following reaction be made to proceed in forward direction ?



A. By 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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38. Borax bead test is responded by :

- A. Divalent metals
- B. Heavy metals
- C. Light metals
- D. Metals which form coloured metaborates

Answer: D



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39. Which excess of $NaOH$ solution is added in potash alum the product is.

A. A bluish precipitate

B. Clear solution

C. White precipitate

D. Greenish precipitate

Answer: B



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40. ($3c, 2e$) bond is present in

A. B_2H_6

B. BCl_3

C. Al_2Cl_6

D. NH_3

Answer: A



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41. Boron carbide, B_4C , is widely used for :

- A. Making plaster of paris
- B. Making acetylene
- C. As hardest substance after diamond
- D. Making boric acid

Answer: C



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42. BCl_3 does not exist as a dimer but BH_3 exists as B_2H_6 because :

- A. Chlorine is more electronegative than hydrogen.
- B. Large size of chlorine atom does not fit between small-sized boron atoms, while small-sized hydrogen atoms occupy the space between boron atoms.
- C. There is $p\pi - p\pi$ back bonding in BCl_3 .
- D. Both (b) and (c).

Answer: D



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43. Aluminium chloride exists as a dimer because aluminium has :

- A. Greater ionisation enthalpy
- B. Incomplete p-orbital
- C. High nuclear charge
- D. Larger radius

Answer: B



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44. Al_2O_3 formation from aluminium and oxygen involves evolution of a large quantity of heat, which makes aluminium use in :

- A. Deoxidiser
- B. Confectionary
- C. Thermite welding
- D. Indoor photography

Answer: C



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45. A blue coloured mineral 'lapis lazuli' which is used as a semi-precious stone is a mineral of the following class :

A. Sodium aluminosilicate

B. Zinc cobaltate

C. Basic copper

D. Prussian blue

Answer: A



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46. Alum helps in purifying water by :

- A. Formation Si complex with clay particles.
- B. Sulphate part which combines with the dirt and removes it.
- C. Aluminium which coagulates the mud particles.
- D. Making the mud water soluble.

Answer: C



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47. Boron halides behave as Lewis acid because of their ___ nature.

A. Proton donor

B. Covalent

C. Ionic

D. Electron deficient

Answer: D



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48. 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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49. Which of the following is not a Lewis acid ?



Answer: D

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50. Which is used in high temperature thermometry ?

A. Na

B. Ti

C. Ga

D. Hg

Answer: C



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51. The colour of ferric metaborate is

A. Yellow

B. Blue

C. Green

D. Grey

Answer: A

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52. The Lewis acid character of boron trihalides decreases as: $BBr_3 > BCl_3 > BF_3$. Explain ?

A. $BCl_3 > BE_3 > BBr_3$

B. $BBr_3 > BCl_3 > BF_3$

C. $BF_3 > BCl_3 > BBr_3$

D. $BBr_3 > BF_3 > BCl_3$

Answer: B

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53. Anhydrous $AlCl_3$ is obtained when :

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

Answer: C

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54. Alumina is not used as :

- A. Refractory material
- B. A medium in chromatography
- C. Abrasive
- D. White pigment

Answer: D



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55. Aluminium is more reactive than iron. But aluminium is less easily corroded than iron because.

- A. Iron forms mono and divalent ions.

B. Iron undergoes reaction easily with water

C. Oxygen forms a protective oxide layer on aluminium.

D. Aluminium is a noble metal.

Answer: C



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56. Boron has an extremely high melting point because of

A. Allotropy

B. Its ionic crystal structure

C. Strong van der Waals forces between its atoms

D. Strong binding forces in the covalent polymer.

Answer: D

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57. Which one of the following structures is correctly represented.

A. 

B. 

C. 

D. 

Answer: A



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58. Which one of the following has lowest *m. pt* ?

A. B

B. Tl

C. Al

D. Ga

Answer: D



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59. Which one of the following has highest *m. pt* ?

A. B

B. Al

C. Ga

D. Tl

Answer: A



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60. In which of the following element +1 oxidation state is more stable :

A. B

B. Al

C. Ga

D. Tl

Answer: D

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61. Which one is not a borane ?

A. B_5H_9

B. B_5H_{10}

C. B_5H_{11}

D. B_6H_{10}

Answer: B



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62. Boron nitride is isoelectronic with

A. C_2

B. B_2

C. N_2

D. O_2

Answer: A



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63. Which one of the following is hardest compound of boron ?

- A. Boron carbide
- B. Boron nitride
- C. Magnesium bromide
- D. Silicon boride

Answer: A



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64. The structure of boron nitride resembles that of

A. Boric acid

B. Graphite

C. Borazine

D. Borazole

Answer: B



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65. When orthoboric acid is heated to red heat the residue is

A. Boron

B. Boron oxide

C. Pyroboric acid

D. Metaboric acid

Answer: B

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66. Boric acid is weak monobasic acid and acts as Lewis acid

A. By donating H^{\oplus}

B. By accepting OH^{\ominus}

C. By donating lone pair of electrons

D. By accepting lone pair of electrons

Answer: B



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67. Among group 13 elements the one forming an amphoteric oxide is

A. Tl

B. Al

C. B

D. In

Answer: B



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68. The stability of monohalides of group 13 elements

- A. Increases down the group
- B. Decreases down the group
- C. First increases and then decreases
- D. First decreases and then increases

Answer: A



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69. Which halides of the element of group 13 do not exist as dimer in the vapour state, the element is

A. Al

B. B

C. Ga

D. Tl

Answer: B



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70. Which is correct for the structure of diborane ?

A. It contains four $(2c, 2e)$ covalent bonds and two $(3c, 2e)$ covalent bonds.

B. It contains three $(2c, 2e)$ covalent bonds and three $(3c, 2e)$ covalent bonds.

C. It contains two $(2c, 2e)$ covalent bonds and four $(3c, 2e)$ covalent bond.

D. It contains six $(2c, 2e)$ covalent bonds.

Answer: A



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71. Which of the following exhibits inert pair effect ?

A. B

B. Al

C. TI

D. Sc

Answer: C



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72. Which one is borazole or borazine (inorganic benzene) ?

A. B

B. $B_3N_3H_6$

C. B_2H_6

D. B_6H_6

Answer: B



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73. Which one of the following is correct statement ?

- A. The hydroxides of Al is more acidic than that of B
- B. The hydroxides of B is basic while that of Al is amphoteric.
- C. The hydroxide of B is acidic, while that of Al is amphoteric
- D. The hydroxides of B and Al are amphoteric.

Answer: C



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74. When Al is added to $NaOH$ solution

- A. No action takes place
- B. $NaAlO_2$ is formed and H_2 is evolved.
- C. $Al(OH)_3$ is formed and H_2 is evolved
- D. Na_2AlO_2 is formed and H_2 is evolved.

Answer: B



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75. Aluminium becomes passive in :

A. Cr_2O_3

B. *conc* HNO_3

C. $HClO_4$

D. All of the above

Answer: B



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76. Aluminium carbide on hydrolysis produces

A. Acetylene gas

B. Methane gas

C. Carbon dioxide gas

D. All of the above

Answer: B



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77. The trihalides of group 13 are hydrolysed by water and they fume in moist air due to the

- A. Formation of hydrogen halide
- B. Formation of haloboric acid
- C. Formation of halogen gases
- D. None of the above

Answer: A



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78. Silicon resembles B due to

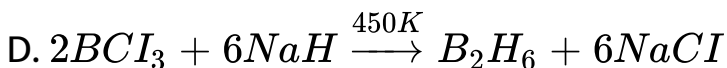
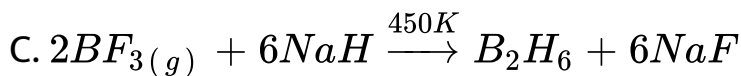
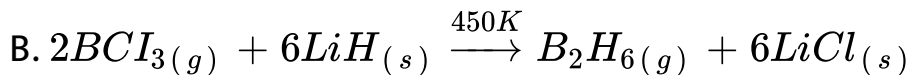
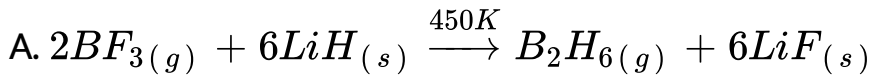
- A. Similar values of atomic radii
- B. Similar values of EN
- C. Similar values of IE
- D. All of the above

Answer: D



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79. Diborane is prepared on large scale by

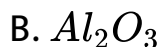
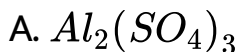


Answer: D



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80. Which one is covalent compound



D. AlF_3

Answer: C

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81. Borax bead test is not given by

A. Copper salts

B. Cobalt salts

C. Nickel salts

D. Aluminium salts

Answer: D

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82. The borax bead test can be used to detect the presence of

A. Al

B. Mg

C. Na

D. Fe

Answer: D



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83. alums are used for :

- A. Purification of water and styptic to arrest bleeding
- B. Mordant in dyeing and in calico printing
- C. In tanning of leather, for sizing of paper and in fire extinguishers
- D. All of the above

Answer: D



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84. Which one of following is not an electron deficient compound

A. BCl_3

B. $AlCl_3$

C. B_2H_6

D. Al_2Cl_6

Answer: D



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85. Borax bead test is based upon the formation of

A. Metaborates

B. B_2O_3

C. H_3BO_3

D. B

Answer: A



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86. *Al* salts on heating with Na_2CO_3 in charcoal cavity gives a white infusible residue. On moistening the same with a drop of cobalt nitrate, it changes to ___ due to the formation of cobalt meta-aluminate (Thenard's blue)

A. Brown

B. Yellow

C. Blue

D. Lemon

Answer: C



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Exercise Assertion Reasoning

1. Boron always forms covalent compound.

The small size of B^{3+} favours formation of covalent compound.

A. If both (A) are correct and (R) is the correct explanation of (A).

B. If both (A) and (R) are correct but (R) is not the correct explanation of (A).

C. If (A) is correct, but (R) is incorrect.

D. If (A) is incorrect, but (R) is correct.

Answer: A

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2. In B_2H_6 , there is no $B - B$ bond.

The $B_2H_6 \cdot 2NH_3$ adduct on heating gives borazine.

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3. $TlCl_3$ is more stable than $TlCl$.

+1 oxidation state of thallium is more stable than +3.



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4. Boric acid is weak monobasic acid and acts as Lewis acid

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5. The Lewis acid character of boron trihalides decreases as: $BBr_3 > BCl_3 > BF_3$. Explain ?

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6. Aluminium acts as an oxidising agent.

Aluminium gas a strong affinity for oxygen.



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7. $B(OH)_3$ is acidic while $In(OH)_3$ is basic.

$B_{OH} - (3)$ has highly H-bonded network structure.



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8. Borax bead test is not suitable of for $Al(III)$

Al_2O_3 is insoluble in H_2O .



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9. Thallium exhibits +1 and +3 oxidation states.

Thallium exhibits inert pair effect.



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10. Boric acid is tribasic acid.

Boric acid contains three hydroxyl groups.



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11. Borazole is aromatic in nature.

Nitrogen contributes π - electrons to the system.



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12. Many metals produce coloured beads with borax.

Borax forms a glassy structure on heating, which is optically

influences light in a way that is characteristic of the metal involved.

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13. $AlCl_3$ forms dimer Al_2Cl_6 but dissolves in water forming $[Al(H_2O)_6]^{3+}$ and Cl^\ominus ions.

Aqueous solution of $AlCl_3$ is acidic due to hydrolysis.

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Exercise Integer

1. What is the value of x in the silicate mineral, $Be_3Al_2Si_xO_{18}$?

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2. What is the value of x in colemanite, $Ca_2B_xO_{11} \cdot 6H_2O$?

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3. How much nitrogen is evolved when one gram of ammonium chloride is heated with borax strongly ?

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4. How many orbitals of boron are involved in the hybridisation in B_2H_6 ?

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5. Borax is correctly represented as $Na_2[B_4O_5(OH)_4] \cdot 8H_2O$. How many tetrahedral boron atoms are present in the structure of borax ?

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6. The number of isomers possible for disubstituted borazine, $B_3N_3H_4X_2$ is

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7. How many water molecules of crystallisation are present in crystalline aluminium chloride ?

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8. How many water molecules of crystallisation are present in borax, $Na_2B_4O_7 \cdot 10H_2O$?

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9. How many moles of NO_2 are produced when mole of B reacts with HNO_3 ?

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Exercise Fill In The Blanks

1. Corundum is an ore of aluminium.

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2. Gallium is _____ block element.

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3. The electrolysis of pure alumina is not feasible because of its _____ nature.



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4. The common impurities present in bauxite are _____ and _____.



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5. The number of OH units directly linked to boron atom in $Na_2B_4O_7 \cdot 10H_2O$ is _____.



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6. Silicon resembles B due to



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7. *BN* is known as inorganic benzene.

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8. $AlCl_3$ on hydrolysis gives _____.

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9. *BN* is known as inorganic benzene.

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10. Boron cannot expand its covalency beyond three due to ____.

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11. Borax bead test is responded by :

 [Watch Video Solution](#)

12. Alumina is.

 [Watch Video Solution](#)

13. Boric acid is weak monobasic acid and acts as Lewis acid

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14. Boric acid is polymeric due to :

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15. Borazine is isoelectronic with _____.

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16. Thallium shows different oxidation states due to :

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17. Corundum is an ore of aluminium.

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Exercise True False

1. BI_3 is an ionic compound.

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2. BCl_3 is an electron-deficient compound.

 [Watch Video Solution](#)

3. BN is known as inorganic benzene.

 [Watch Video Solution](#)

4. German silver is an alloy of aluminium.

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5. When orthoboric acid is heated to red heat the residue is



[Watch Video Solution](#)

6. Corundum is an ore of aluminium.



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7. The trihalides of group 13 are hydrolysed by water and they fume in moist air due to the



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8. The members of B_nH_{n+4} series are less stable than B_nH_{n+6} series.



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9. Borax is used as a cleaning agent because on dissolving in water, it gives

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10. Borax is used as a cleaning agent because on dissolving in water, it gives

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11. Boron with hydrogen forms a number of hydrides which are known as boranes. These hydrides are

classified into closoboranes and nido-boranes. The simplest hydride of boron is diborane. Boron apart from having $(2c, 2e)$ bonds also contains $(3c, 2e)$ bonds.

Boron in diborane is ___ hybridised.

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12. Boric acid is a weak monobasic acid and acts as a Lewis acid

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13. Chlorides of both beryllium and aluminium have bridged chloride structures in the solid phase.

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14. $Tl(III)$ salt undergoes disproportionation.

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15. The hydroxide of boron is basic, while that of aluminium is amphoteric.

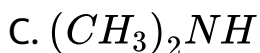
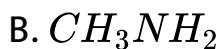
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Exercise Archives Multiple Correct

1. In the following reaction.



The amine (s) x is /are.



Answer: A::B::C



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2. The correct statement (s) for orthoboric acid is/are

- A. It behaves as a weak acid in water due to self-ionization
- B. Acidity of its aqueous solution increases upon addition of ethylene glycol
- C. It has a three-dimensional structure due to hydrogen bonding
- D. It is a weak electrolyte in water.

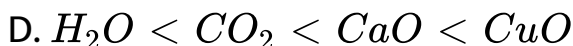
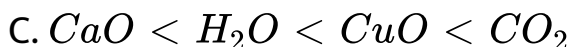
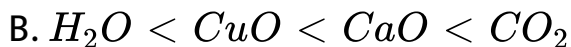
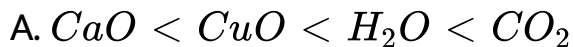
Answer: B::D



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Exercise Archives Singlecorrect

1. Identify the correct order of acidic strengths of CO_2 , CuO , CaO and H_2O



Answer: A



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2. H_3BO_3 is.

A. a monobasic acid and weak Lewis acid.

B. a monobasic and weak Bronsted acid.

C. a monobasic and strong Lewis acid.

D. a tribasic and weak Bronsted acid.

Answer: A



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3. $(Me)_2SiCl_2$ on hydrolysis will produce.

A. $(Me)_2Si(OH)_2$

B. $(Me)_2Si = O$

C. $\text{c. } \text{---} \text{O---Si(Me)}_2\text{---O---}$

D. $Me_2SiCl(OH)$

Answer: C



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4. The name of the structure of silicates in which three oxygen atoms of $[SiO_4]^{4-}$ are shared is

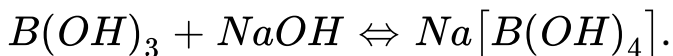
- A. pyrosilicate
- B. sheet silicate
- C. linear-chain silicate
- D. three-dimensional silicate

Answer: B



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5. How can the following reaction be made to proceed in forward direction ?



- A. By the addition of *cis* – 1, 2 – *diol*.
- B. By the addition of borax.
- C. By the addition of *trans* – 1, 2 – *diol*
- D. By the addition of Na_2HPO_4 .

Answer: A



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6. In the correct of the Hall-Heroult process for the extraction of Al , which of the following statements is false ?

A. CO and CO_2 are produced in this process

B. Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivity

C. Al^{3+} is reduced at the cathode to form Al .

D. Na_3AlF_6 serves as the electrolyte.

Answer: D

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1. $Al(OH)_3$ is amphoteric in nature.

$Al - O$ and $O - H$ bonds can be broken with equal ease in $Al(OH)_3$.

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2. Between $SiCl_4$ and CCl_4 , only $SiCl_4$ reacts with water.

$SiCl_4$ is ionic and CCl_4 is covalent.

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3. Boric acid is weak monobasic acid and acts as Lewis acid

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4. Boron always forms covalent compound.

The small size of B^{3+} favours formation of covalent compound.

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[Exercise Archives Integer](#)

1. The coordination number of Al in the crystalline state of $AlCl_3$ is _____.

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2. Three moles of B_2H_6 are completely reacted with methanol. The number of moles of boron containing product formed is.

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Exercise Archives Fill In The Blanks

1. The two types of bonds present in B_2H_6 are covalent and _____.

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Exercise Archives True False

1. All the $Al - Cl$ bonds in Al_2Cl_6 are equivalent.

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2. The basic nature of the hydroxides of group 13 decreases progressively down the group.

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Exercise Archives Subjective

1. State with balanced equations, what happens when aluminium is reacted with hot concentrated caustic soda solution.

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2. State the conditions under which the preparation of aluminium is carried out. Give the necessary equations which need not be balanced.

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3. Anhydrous $AlCl_3$ is covalent. From the data given below, predict whether it would remain covalent or become ionic in aqueous solution. (Ionisation energy for Al is $1537kJmol^{-1}$)

$$\Delta_{\text{hydration}} f \text{ or } Al^{3+} = -4665kJmol^{-1}$$

$$\Delta_{\text{hydration}} f \text{ or } Cl^{\ominus} = -381kJmol^{-1}.$$

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4. Aluminium sulphide gives a foul odour when it becomes damp. Write a balanced chemical equation for the reaction.

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5. Write the chemical reactions associated with the 'borax' test of cobalt (II) oxide.

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6. Compound (X) on reduction with $LiAlH_4$ gives a hydride (Y) containing 21.72% hydrogen along with other products. The compound (Y) reacts with air explosively resulting in formation of boron trioxide. Identify (X) and (Y).

Give balanced reactions involved in the formation of (Y) and its reaction with air. Give the structure of (Y).

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7. How is boron obtained from borax ? Give the chemical reactions involved. Draw the structure of B_2H_6 and give its reaction with HCl .

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8. Write the balanced equations for the reaction of the following compounds with water :

(a) Al_4C_3

(b) BF_3

(c) $CaNCN$.

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9. AlF_3 is insoluble in anhydrous HF but dissolves on addition of NaF . AlF_3 precipitates out of the resulting solution when gaseous BF_3 is bubbled through. Give reasons.



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