



NCERT Solutions for 11th Class Chemistry: Chapter 11-The p- Block Elements



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NCERT Solutions for 11th Class Chemistry: Chapter 11-The p-Block Elements

Class 11: Chemistry Chapter 11 solutions. Complete Class 11 Chemistry Chapter 11 Notes.

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Question 1. Discuss the pattern of variation in the oxidation states of

(i) B to Tl (ii) C to Pb.

Answer: (i) B to Tl

Common oxidation states are +1 and +3. The stability of +3 oxidation state decreases from B to Tl. +1 oxidation state increases from B to Tl.

(ii) C to Pb

The common oxidation states are +4 and +2. Stability of +4 oxidation state decreases from C to Pb.

Details can be seen from the text part.

Question 2. How can you explain higher stability of BCl_3 as compared to TlCl_3 ?

Answer: BCl_3 is quite stable. Because there is absence of d- and f-electrons in boron three valence electrons ($2s^2 2p_{x1}$) are there for bonding with chlorine atom. In Tl the valence s-electron ($6s^2$) are experiencing maximum inert pair effect. Thus, only $6p^1$ electron is available for bonding. Therefore, BCl_3 is stable but TlCl_3 is comparatively unstable.

Question 3. Why does borontrifluoride behave as a Lewis acid?

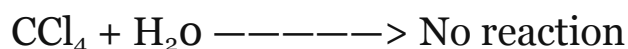
Answer: In BF_3 , central atom has only six electrons after sharing with the electrons of the F

atoms. It is an electron-deficient compound and thus behaves as a Lewis acid.

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Question 4. Consider the compounds, BCl_3 , and CCl_4 . How will they behave with water justify?

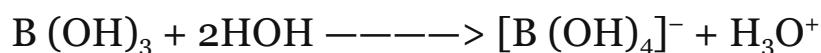
Answer: In BCl_3 , there is only six electrons in the valence shell of B atom. Thus, the octet is incomplete and it can accept a pair of electrons from water and hence BCl_3 undergoes hydrolysis. Whereas, in CCl_4 , C atom has 8 electrons and its octet is complete. That's why it has no tendency to react with water.



Question 5. Is boric acid a protonic acid? Explain.

Answer: Boric acid is a Lewis acid, it is not a protonic acid.

Boric acid accepts electrons from hydroxyl ion of H_2O molecule.



Question 6. Explain what happens when boric acid is heated.

Answer: On heating boric acid above 370 K, it forms metaboric acid, HBO_2 which on further heating yields boric oxide B_2O_3 .



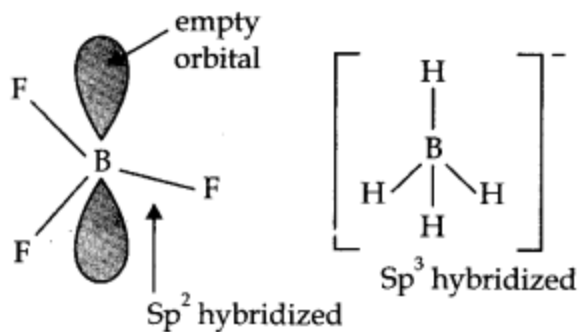
Question 7. Describe the shapes of BF_3 and BH_4^- . Assign the hybridisation of boron in these species.

Answer: In BF_3 , boron is sp^2 hybridized.

$\therefore$ shape of BF_3 = planar.

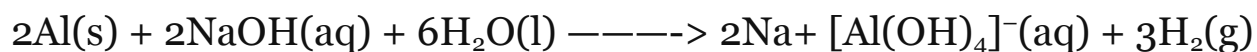
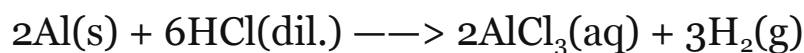
In $[\text{BH}_4]^-$, boron is sp^3 hybridized, thus the shape is tetrahedral.

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Question 8. Write reactions to justify amphoteric nature of aluminium.

Answer: Aluminium reacts with acid as well as base. This shows amphoteric nature of aluminium.



Question 9. What are electron deficient compounds? Are BCl_3 and SiCl_4 electron deficient species? Explain.

Answer: Electron deficient species are those in which the central atom in their molecule has the tendency to accept one or more electron pairs. They are also known as Lewis acid. BCl_3 and SiCl_4 both are electron deficient species.

Since, in BCl_3 , B atom has only six electrons. Therefore, it is an electron deficient compound.

In SiCl_4 the central atom has 8 electrons but it can expand its covalency beyond 4 due to the presence of d-orbitals.

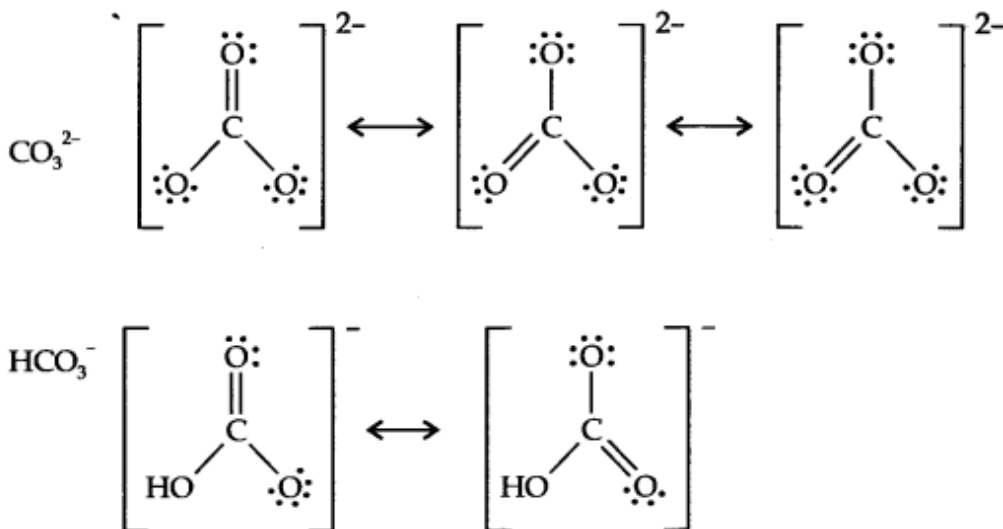
Thus, SiCl_4 should also be considered as electron-deficient species.

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Question 10. Write the resonance structure of CO_3^{2-} and HCO_3^- .

Answer:



Question 11. What is the state of hybridisation of carbon in

(a) CO_3^{2-} (b) diamond (c) graphite?

Answer: (a) CO_3^{2-} (sp^2) (b) Diamond (sp^3) (c) Graphite (sp^2)

Question 12. Explain the difference in properties of diamond and graphite on the basis of their structures.

Answer:

- Since diamond exists as a three dimensional network solid, it is the hardest substance known with high density and high melting point.

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Whereas in graphite, any two successive layers are held together by weak forces of attraction. This makes graphite soft.

- In graphite, carbon atom is sp^2 hybridized whereas in diamond, carbon atom is sp^3 hybridized.
- Unlike diamond, graphite is good conductor of heat and electricity.

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Question 13.

- **Rationalise the given statements and give chemical reactions:**
- **Lead (II) chloride reacts with Cl_2 to give $PbCl_4$.**
- **Lead (IV) chloride is highly unstable towards heat.**
- **Lead is known not to form an iodide PbI_4 .**

Answer:

- $PbCl_2 + Cl_2 \longrightarrow PbCl_4$.

This is because Pb can show +2 oxidation state more easily than +4 due to inert pair effect.
heat

- $PbCl_4 \longrightarrow PbCl_2 + Cl_2$

Because Pb^{2+} is more stable than Pb^{4+} due to inert pair effect.

- PbI_4 does not exist because I^- ion being a powerful reducing agent reduces Pb^{4+} ion to Pb^{2+} ion in solution.
- $Pb^{4+} + 2I^- \longrightarrow Pb^{2+} + I_2$
Pb(IV) Pb(II)

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Question 14. Suggest reason why the B-F bond lengths in BF_3 (130 pm) and BF_4^- (143 pm) differ.

Answer: In BF_3 'B' is sp^2 hybridised and in BF_4^- 'B' is sp^3 hybridised. Thus, the difference in bond length is due to the state of hybridisation.

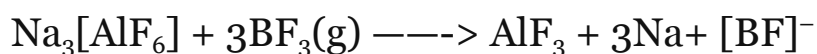
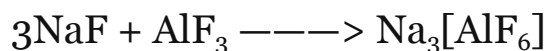
Question 15. If B-Cl bond has a dipole moment, explain why BCl_3 molecule has zero dipole moment.

Answer: B-Cl bond has dipole moment because of polarity. In BCl_3 since the molecule is symmetrical (planar). Thus the polarities cancel out.

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

Answer: Since, anhydrous HF is covalent compound and weak acid due to high bond dissociation energy. AlF_3 does not dissolve in HF.

Whereas NaF is ionic compound.



Question 17. Suggest a reason as to why CO is poisonous.

Answer: CO reacts with haemoglobin to form carboxyhaemoglobin which can destroy the oxygen carrying capacity of haemoglobin and the man dies of suffocation.

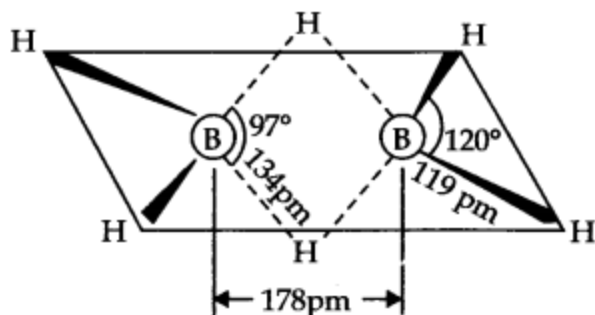
Question 18. How is excessive content of CO_2 responsible for global warming?

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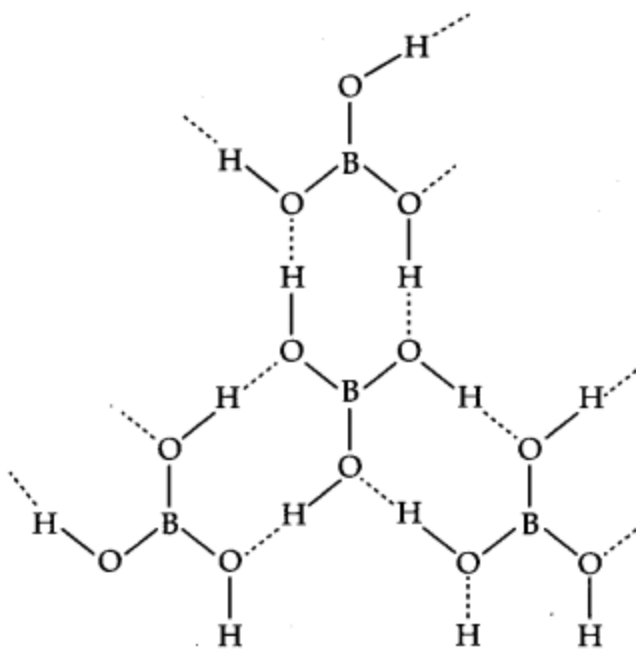
Answer: Excess of CO_2 absorbs heat radiated by the earth. Some of it is dissipated into the atmosphere while the remaining part is radiated back to the earth. As a result, temperature of the earth increases. This is the cause of global warming.

Question 19. Explain structures of diborane and boric acid.

Answer: Boric acid contains planar BO_3^{3-} ions which are linked together through hydrogen bonding shown in the fig.



Structure of Diborane (B_2H_6) molecule



Structure of boric acid

Question 20. What happens when

(a) Borax is heated strongly

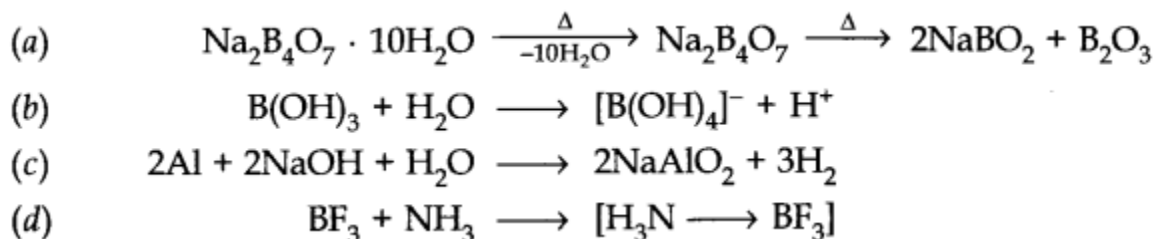
(b) Boric acid is added to water

(c) Aluminium is treated with dilute NaOH

(d) BF_3 is reacted with ammonia?

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Answer:



Question 21. Explain the following reactions.

(a) Silicon is heated with methyl chloride at high temperature in the presence of copper.

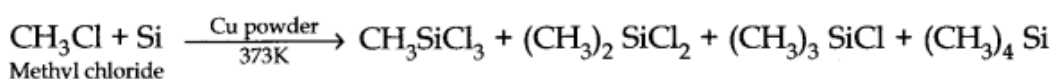
(b) Silicon dioxide is treated with hydrogen fluoride.

(c) CO is heated with ZnO.

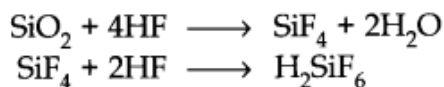
(d) Hydrated alumina is treated with aqueous NaOH solution.

Answer:

(a) A mixture of mono-, di- and trimethyl chlorosilanes along with a small amount of tetramethyl silane is formed.



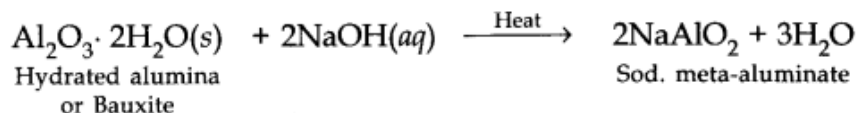
(b) The initially formed silicon tetrafluoride dissolves in HF to form hydrofluorosilicic acid.



(c) ZnO is reduced to zinc metal



(d) Alumina dissolves to form sodium meta-aluminate



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Question 22. Give reasons:

(i) Cone. HNO_3 can be transported in aluminium container.

(ii) A mixture of dilute NaOH and aluminium pieces is used to open drain.

(iii) Graphite is used as lubricant.

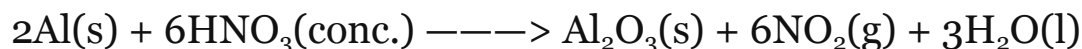
(iv) Diamond is used as an abrasive.

(v) Aluminium alloys are used to make aircraft body.

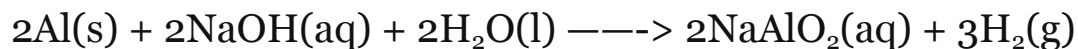
(vi) Aluminium utensils should not be kept in water overnight.

(vii) Aluminium wire is used to make transmission cables.

Answer: (i) Al reacts with cone. HNO_3 to form a very thin film of aluminium oxide on its surface which protects it from further reaction.



(ii) NaOH reacts with Al to evolve H_2 gas. Thus the pressure of the gas produced can be used for clogged drains.



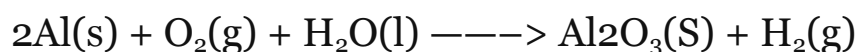
(iii) Graphite has layered structure which are held by weak van der Waals forces. Thus, graphite cleaves easily between the layers, therefore it is very soft and slippery. That's why it is used as lubricant.

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(iv) Diamond is used as an-abrasive because it is an extremely hard substance.

(v) Alloys of aluminium, like duralumin, is used to make aircraft body due to some of its property like toughness, lightness and resistant to corrosion.

(vi) Generally, aluminium metal does not react with water quickly but, when it is kept overnight, it reacts slowly with water in presence of air.



a very small amount of (in ppm) Al^{3+} produced in the solution is injurious to health if the water is used for drinking purposes.

(vii) Aluminium is generally unaffected by air and moisture and it is also good conductor of electricity. That's why it is used in transmission cables.

Question 23. Explain why is there a phenomenal decrease in ionization enthalpy from carbon to silicon.

Answer: Because there is increase in atomic size on moving from carbon to silicon, the screening effect increases. Thus the force of attraction of nucleus for the valence electron decreases as compared to carbon. Thus the ionization enthalpy decreases from carbon to silicon.

Question 24. How would you explain the lower atomic radius of Ga as compared to Al?

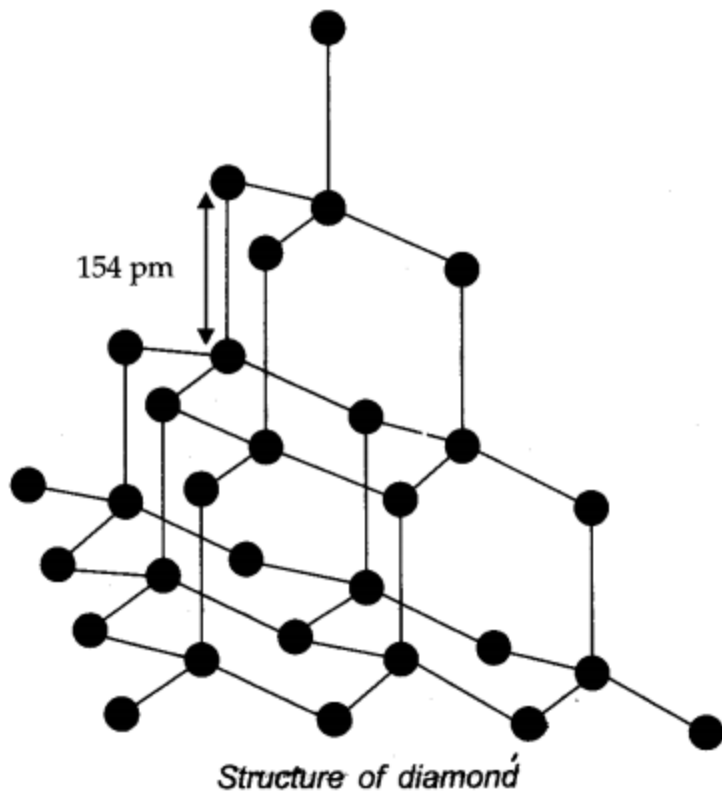
Answer: Due to poor shielding effect of d-electrons in Ga, the electrons in gallium experience great force of attraction by nucleus as compared to Al.

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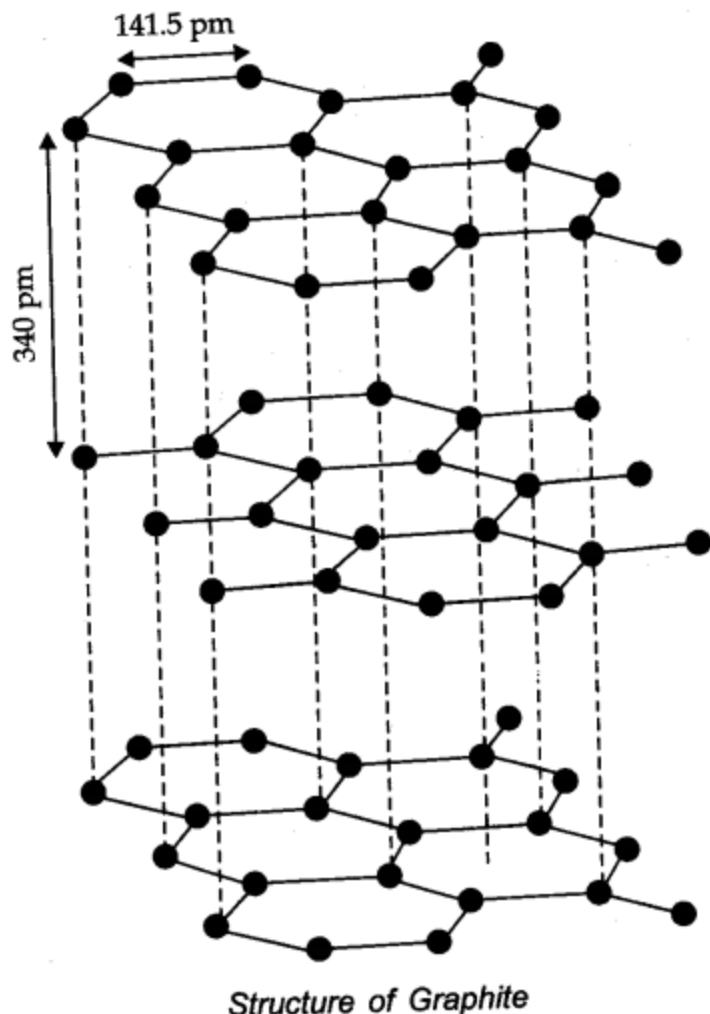
Question 25. What are allotropes? Sketch the structure of two allotropes of carbon namely diamond and graphite. What is the impact of structure on physical properties of two allotropes?

Answer: Allotropes: Allotropes are the different forms of an element which are having same chemical properties but different physical properties due to their structures.

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In diamond, carbon is sp^3 -hybridized. Since, diamond is three dimensional network solid, it is hardest substance with high density whereas graphite has a layered structure. The various layers are formed by van der Waals forces of attraction that's why graphite is soft and slippery.

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Question 26. (a) Classify the following oxides as neutral, acidic, basic or amphoteric

CO, B₂O₃, SiO₂, Co₂, Al₂O₃, PbO₂, Tl₂O₃

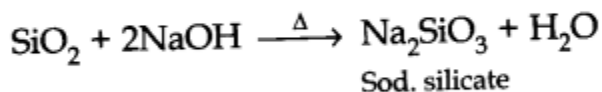
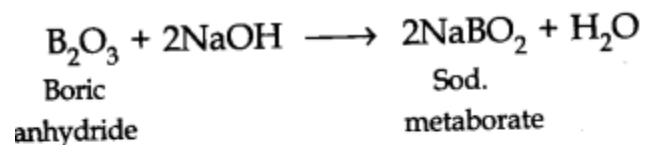
(b) Write suitable equations to show their nature.

Answer: (a) Neutral — CO

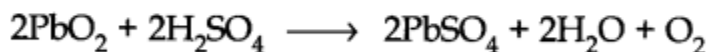
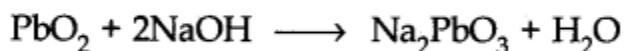
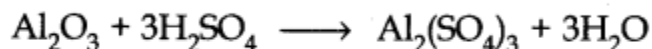
Acidic — B₂O₃, SiO₂, Co₂ Basic — Tl₂O₃ Amphoteric — Tl₂O₃, PbO₂

(b)-CO does not react with acid as well as base at room temperature.

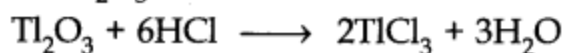
Being acidic B₂O₃, SiO₂ and Co₂ reacts with alkalis to form salts.



Being amphoteric, Al₂O₃ and PbO₂ react with acids and bases.



Being Basic Tl₂O₃ dissolves in acids.

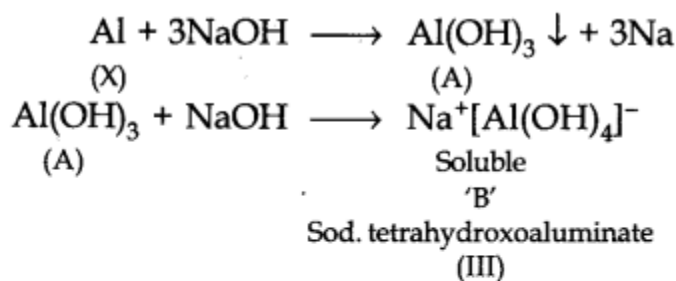


Question 27. In some of the reactions thallium resembles aluminium, whereas in others it resembles with group 1 metals. Support this statement by giving some evidences.

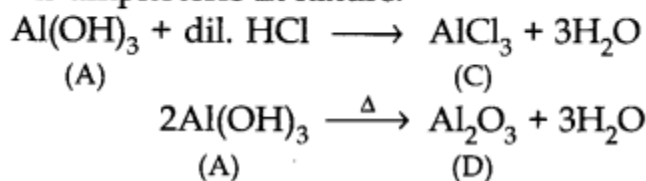
Answer: Tl shows both the oxidation state +1 and +3 due to inert pair effect. Tl forms basic oxide like group I elements. TlO_2 is strongly basic.

Question 28. When metal X is treated with sodium hydroxide, a white precipitate (A) is obtained, which is soluble in excess of NaOH to give soluble complex (B). Compound (A) is soluble in dilute HCl to form compound (C). The compound (A) when heated strongly gives (D), which is used to extract metal. Identify (X), (A), (B), (C) and (D). Write suitable equations to support their identities.

Answer:



Since A is amphoteric in nature.



Question 29. What do you understand by (a) inert pair effect (b) allotropy and (c) catenation?

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Answer: (a) Inert pair effect: The pair of electron in the valence shell does not take part in bond formation is called inert pair effect.

(b) Allotropy: It is the property of the element by which an element can exist in two or more forms which have same chemical properties but different physical properties due to their structures.

(c) Catenation: The property to form chains or rings not only with single bonds but also with multiple bonds with itself is called catenation.

For example, carbon forms chains with (C-C) single bonds and also with multiple bonds (C = C or C ≡ C).

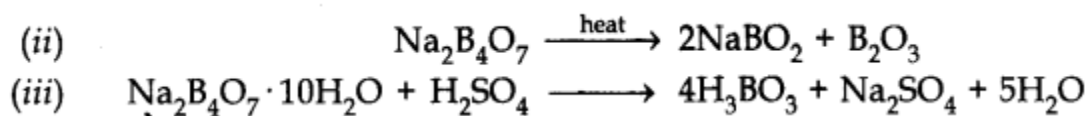
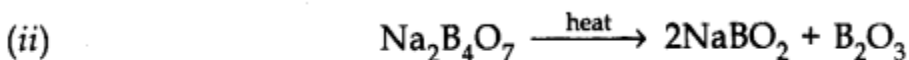
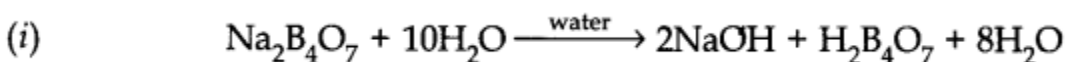
Question 30. A certain salt X, gives the following results.

(i) Its aqueous solution is alkaline to litmus.

(ii) It swells up to a glassy material Y on strong heating.

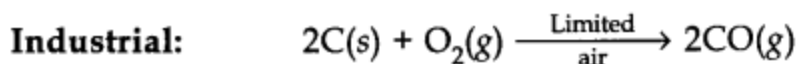
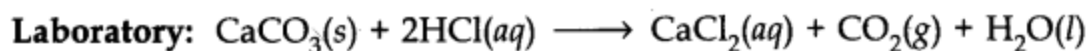
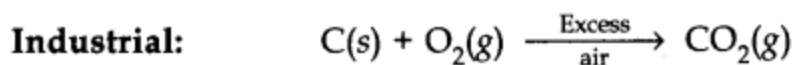
(iii) When cone. H_2SO_4 is added to a hot solution of X, white crystal of an acid Z separates out.

Answer:



Question 31. Write balanced equations for:

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Carbon monoxide**Carbon dioxide**

Question 33. An aqueous solution of borax is

(a) neutral (b) amphoteric (c) basic (d) acidic

Answer: Borax is a salt of a strong base (NaOH) and a weak acid (H_3BO_3), therefore, it is basic in nature, i.e., option (c) is correct.

Question 34. Boric acid is polymeric due to

(a) its acidic nature (b) the presence of hydrogen bonds

(c) its monobasic nature (d) its geometry

Answer: Boric acid is polymeric due to the presence of H-bonds. Therefore, option (b) is correct.

Question 35. The type of hybridisation of boron in diborane is

(a) sp (b) sp^2 (c) sp^3 (d) dsp^2

Answer: In B_2H_6 , B is sp^3 -hybridized. Therefore, option (c) is correct.

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Question 36. Thermodynamically the most stable form of carbon is

(a) diamond (b) graphite (c) fullerenes (d) coal

Answer: Thermodynamically the most stable form of carbon is graphite, i.e., option (b) is correct.

Question 37. Elements of group 14

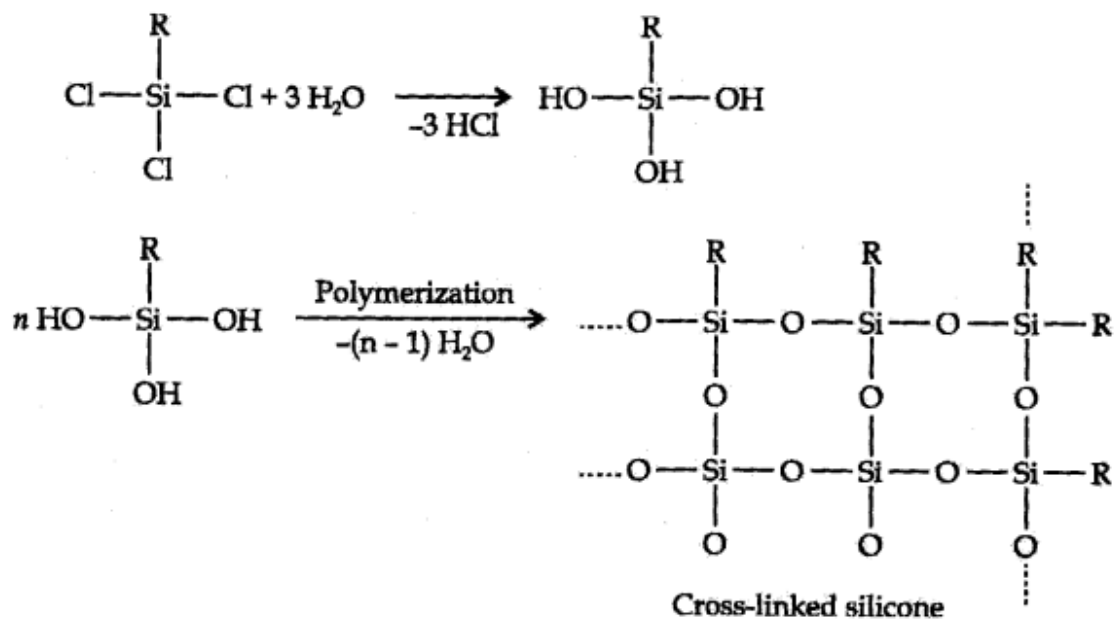
(a) exhibit oxidation state of +4 only (b) exhibit oxidation state of +2 and +4

(c) form M^{2-} and M^{4+} ion (d) form M^{2+} and M^{4+} ions.

Answer: Due to inert pair effect, elements of group 14 exhibit oxidation states of +2 and +4. Thus, option (b) is correct.

Question 38. If the starting material for the manufacture of silicon is $RSiCl_3$, write the structure of the product formed.

Answer: Hydrolysis of alkyltrichlorosilanes gives cross-linked silicones.



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Chapterwise NCERT Solutions for Class 11 Chemistry:

- Chapter 1-Some Basic Concepts
- Chapter 2-Structure of Atom
- Chapter 3-Classification of Elements and Periodicity in Properties
- Chapter 4-Chemical Bonding and Molecular Structure
- Chapter 5-States of Matter
- Chapter 6-Thermodynamics
- Chapter 7-Equilibrium
- Chapter 8-Redox Reactions
- Chapter 9-Hydrogen
- Chapter 10-The s-Block Elements
- Chapter 11-The p-Block Elements
- Chapter 12-Organic Chemistry Some Basic Principles and Techniques
- Chapter 13-Hydrocarbons
- Chapter 14-Environmental Chemistry

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