

The p block elements

SUBJECTIVE PROBLEMS:

Q 1.

Account for the following. Limit your answer to two sentences.

(i) Hydrogen bromide cannot be prepared by action of concentration sulphuric acid or sodium bromide.

(i) When a blue litmus paper is dipped into a solution of hypochlorous acid, it first turns red and then later gets decolorized. **(IIT JEE 1979 – 2 Marks)**

Q 2.

Write balanced equation involved in the preparation of

(i) Anhydrous aluminum chloride from alumina.

(ii) Bleaching powder from slaked lime.

(iii) Tin metal from cassiterite

(iv) Chlorine from sodium chloride.

(v) Nitric oxide from nitric acid. **(IIT JEE 1979 – 4 Marks)**

Q 3.

State with balanced equations, what happens when :

(i) Tin is treated with moderately concentration nitric acid.

(ii) Aluminum is reacted with hot concentrated caustic soda solution **(IIT JEE 1979 – 1 Marks)**

Q 4.

Explain the following in not more than two sentences-

(i) Conc HNO_3 turns yellow in sunlight **(IIT JEE 1980 – 3 Marks)**

(ii) CO_2 does not burn in air and does not support combustion but a burning Mg wire continues to burn.

(iii) Bleaching powder loses its bleaching property when it is kept in an open bottle for a long time.

Q 5.

Give structural formula for the following :

(i) Phosphorous acid, H_3PO_3 **(IIT JEE 1981 – 1 Marks)**

(ii) Pyro phosphoric acid, $\text{H}_4\text{P}_2\text{O}_7$ **(IIT JEE 1981 – 1 Marks)**

Q 6.

Complete the following equations (no balancing is needed)

(i) $\text{HCO}_3^- + \text{Al}^{3+} \rightarrow \text{Al}(\text{OH})_3 + \dots$ **(IIT JEE 1981 – 1 Marks)**

(ii) $\text{AlBr}_3 + \text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_3\text{PO}_4 \rightarrow \text{K}_3\text{PO}_4 + \text{AlPO}_4 + \text{H}_2\text{O} + \dots + \dots$ **(IIT JEE 1981 – 1 Marks)**

Q 7.

Give reason for the following :

- (i) Carbon acts as an abrasive and also as a lubricant. **(IIT JEE 1981 – 1 Marks)**
- (ii) Sulphur melts to a clear mobile liquid at 119°C , but on further heating above 160°C , it become viscous. **(IIT JEE 1981 – 1 Marks)**
- (iii) In the preparation of hydrogen iodide for alkali iodides, phosphoric acid is preferred to sulphuric acid **(IIT JEE 1982 – 1 Marks)**
- (iv) Orthophosphoric acid, H_3PO_4 , is tribasic, but phosphorous acid, H_3PO_3 , is dibasic. **(IIT JEE 1982 – 1 Marks)**
- (v) A bottle of liquor ammonia should be cooled before opening the stopper. **(IIT JEE 1983 – 1 Marks)**
- (vi) Solid carbon dioxide is known as dry ice. **(IIT JEE 1983 – 1 Marks)**
- (vii) Anhydrous HCl is a bad conductor of electricity but aqueous HCl is a good conductor; **(IIT JEE 1985 – 1 Marks)**
- (viii) Graphite is used as a solid lubricant; **(IIT JEE 1985 – 1 Marks)**
- (ix) Fluorine cannot be prepared from fluorides by chemical oxidation. **(IIT JEE 1985 – 1 Marks)**
- (x) The mixture of hydrazine and hydrogen peroxide with a copper (II) catalyst is used as a rocket propellant. **(IIT JEE 1987 – 1 Marks)**
- (xi) Orthophosphorus acid is not tribasic acid. **(IIT JEE 1987 – 1 Marks)**
- (xii) The molecule of magnesium chloride is linear whereas that of stannous chloride is angular. **(IIT JEE 1987 – 1 Marks)**
- (xiii) Valency of oxygen is generally two whereas sulphur shows valency of two, four and six. **(IIT JEE 1988 – 1 Marks)**
- (xiv) H_3PO_3 is a dibasic acid. **(IIT JEE 1989 – 1 Marks)**
- (xv) Phosphine has lower boiling point than ammonia. **(IIT JEE 1989 – 1 Marks)**
- (xvi) Ammonium chloride is acidic in liquid ammonia solvent. **(IIT JEE 1991 – 1 Marks)**
- (xvii) The hydroxides of aluminum and iron are insoluble in water. However, NaOH is used to separate one from the other. **(IIT JEE 1991 – 1 Marks)**
- (xviii) Bond dissociation energy of F_2 is less than that of Cl_2 . **(IIT JEE 1992 – 1 Marks)**
- (xix) Sulphur dioxide is a more powerful reducing agent in an alkaline medium than in acidic medium. **(IIT JEE 1992 – 1 Marks)**
- (xx) The experimentally determined N – F bond length in NF_3 is greater than the sum of the single covalent bond radii of N and F. **(IIT JEE 1995 – 2 Marks)**
- (xxi) Mg_2N_2 when reacted with water gives off NH_3 but HCl is not obtained from MgCl_2 on reaction with water at room temperature. **(IIT JEE 1995 – 2 Marks)**
- (xxii) $(\text{SiH}_3)_3\text{N}$ is a weaker base than $(\text{CH}_3)_3\text{N}$. **(IIT JEE 1995 – 2 Marks)**

Q 8.

State with balanced equations what happens when :

- (i) White phosphorus (P_4) is boiled with a strong solution of sodium hydroxide in an inert atmosphere. **(IIT JEE 1982 – 1 Marks)**
- (ii) Sodium iodate is treated with sodium bisulphite solution. **(IIT JEE 1982 – 1 Marks)**
- (iii) Dilute nitric acid is slowly reacted with metallic tin. **(IIT JEE 1987 – 1 Marks)**
- (iv) Potassium permanganate is reacted with warm solution of oxalic acid in the presence of sulphuric acid. **(IIT JEE 1987 – 1 Marks)**
- (v) Iodate ion reacts with bisulphite ion to liberate iodine. **(IIT JEE 1988 – 1 Marks)**
- (vi) Phosphorus reacts with nitric acid to give equimolar ratio of nitric oxide and nitrogen dioxide. **(IIT JEE 1988 – 1 Marks)**
- (vii) Hypo phosphorous acid is heated. **(IIT JEE 1989 – 1 Marks)**
- (viii) Sodium bromate reacts with fluorine in presence of alkali. **(IIT JEE 1989 – 1 Marks)**
- (ix) Sodium chlorate reacts with sulphur dioxide in dilute sulphuric acid medium **(IIT JEE 1989 – 1 Marks)**
- (X) Write balanced equations for the preparation of crystalline silicon from $SiCl_4$. **(IIT JEE 1990 – 1 Marks)**
- (xi) Write balanced equations for the preparation of phosphine from CaO and white phosphorus. **(IIT JEE 1990 – 2 Marks)**
- (xii) Write balanced equations of the preparation of ammonium sulphate from gypsum, ammonia and carbon dioxide. **(IIT JEE 1990 – 1 Marks)**
- (xii) Aqueous solution of sodium nitrate is heated with zinc dust and caustic soda solution **(IIT JEE 1990 – 1 Marks)**
- (xiv) Sodium iodate is added to a solution of sodium bisulphate. **(IIT JEE 1990 – 1 Marks)**
- (xv) Sodium nitrite is produced by absorbing the oxides of nitrogen in aqueous solution of washing soda. **(IIT JEE 1991 – 1 Marks)**
- (xvi) Nitrogen is obtained in the reaction of aqueous ammonia with potassium permanganate. **(IIT JEE 1991 – 1 Marks)**
- (xvii) Elemental phosphorus reacts with conc. HNO_3 to give phosphoric acid. **(IIT JEE 1991 – 1 Marks)**
- (xviii) Sulphur is precipitated in the reaction of hydrogen sulphide with sodium bisulphate solution
- (xix) Phosphorus is treated with concentrated nitric acid. **(IIT JEE 1997 – 1 Marks)**

OR

Manufacture of phosphoric acid from phosphorus. **(IIT JEE 1997 – 1 Marks)**

(xx) Reaction of aluminum with aqueous sodium hydroxide. (IIT JEE 1997 – 1 Marks)

(xxi) Aluminum sulphide gives a foul odour when it becomes damp. Write a balanced chemical equation for the reaction. (IIT JEE 1997 – 2 Marks)

(xxii) $P_4O_{10} + PCl_5 \rightarrow$ (IIT JEE 1998 – 1 Marks)

(xxiii) $SnCl_4 + C_2H_5Cl + Na \rightarrow$ (IIT JEE 1998 – 1 Marks)

Q 9.

Show with equations how the following compound is prepared (equations need not be balanced) sodium thiosulphate from sodium sulphite. (IIT JEE 1982 – 1 Marks)

Q 10.

Give balanced equations for the extraction of aluminum from bauxite by electrolysis. (IIT JEE 1982 – 2 Marks)

Q 11.

State the conditions under which the following preparation is carried out. Give the necessary equations which need not be balanced : Alumina from aluminum. (IIT JEE 1983 – 1 Marks)

Q 12.

Write down the resonance structures of nitrous oxide. (IIT JEE 1985 – 2 Marks)

OR

Write the two resonance structures of N_2O that satisfy the octet rule. (IIT JEE 1990 – 1 Marks)

Q 13.

Write down the balanced equations for the reactions when:

(i) a mixture of potassium chlorate, oxalic acid and sulphuric acid is heated; (IIT JEE 1985 – 1 Marks)

(ii) ammonium sulphate is heated with a mixture of nitric oxide and nitrogen dioxide. (IIT JEE 1985 – 1 Marks)

Q 14.

What happens when : (i) hydrogen sulphide is bubbled through an aqueous solution of sulphur dioxide. (IIT JEE 1985-1 Marks)

(ii) tin is treated with concentrated nitric acid. (IIT JEE 1985 – 1 Marks)

(iii) Pb_3O_4 is treated with nitric acid. (IIT JEE 1985 – 1 Marks)

Q 15.

Arrange the following in :

(i) increasing bond strength (IIT JEE 1986 – 1 Marks)
HCl, HBr, HF, HI

(ii) HOCl, HOClO₂, HOClO₃, HOClO in increasing order of thermal stability. (IIT JEE 1988- 1Marks)

(iii) CO₂, N₂O₅, SiO₂, SO₃ in the order of increasing acidic character. (IIT JEE 1988 – 1 Marks)

(iv) Increasing order of extent of hydrolysis : (IIT JEE 1991 – 1 Marks)
CCl₄, MgCl₂, AlCl₃, PCl₅, SiCl₄

Q 16.

Mention the products formed in the following :

(i) Chlorine gas is bubbled through a solution of ferrous bromide. (IIT JEE 1986 – 1 Marks)

(ii) Iodine is added to a solution of stannous chloride. (IIT JEE 1986 – 1 Marks)

(iii) Sulphur dioxide gas, water vapour and air are passed over heated sodium chloride. (IIT JEE 1986 – 1 Marks)

Q 17.

Write the two resonance structures of ozone which satisfy the octet rule.

(IIT JEE 1991 – 1 Marks)

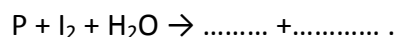
Q 18.

$\text{PbS} \xrightarrow[\text{air}]{\text{heat in}} \text{A} + \text{PbS} \xrightarrow{\text{B}} \text{Pb} + \text{SO}_2$: identify A and B. (IIT JEE 1991 – 2 Marks)

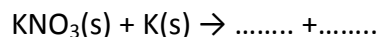
Q 19.

Complete and balance the following chemical reaction :

(i) Red phosphorus is reacted with iodine in presence of water (IIT JEE 1992 – 1 Marks)



(ii) Anhydrous potassium nitrate is heated with excess of metallic potassium. (IIT JEE 1992 – 1 Marks)



(iii) $\text{NH}_3 + \text{NaOCl} \rightarrow \dots + \dots$ (IIT JEE 1993 – 1 Marks)

(iv) $\text{Sn} + 2\text{KOH} + 4\text{H}_2\text{O} \rightarrow \dots + \dots$ (IIT JEE 1994 – 1 Marks)

Q 20.

Draw the structure of P_4O_{10} and identify the number of single and double P-O bonds.

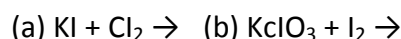
(IIT JEE 1996 – 3 Marks)

Q 21.

Gradual addition of KI solution to $\text{Bi}(\text{NO}_3)_3$ solution initially produces a dark brown precipitate which dissolves in excess of KI to give a clear yellow solution. Write chemical equations for the above reaction (IIT JEE 1996 – 2 Marks)

Q 22.

Complete the following chemical equations :



Justify the formation of the products in the above reactions. (IIT JEE 1996 – 2 Marks)

Q 23.

A soluble compound of a poisonous element M, when heated with $\text{Zn}/\text{H}_2\text{SO}_4$ gives a colourless and extremely poisonous gaseous compound N, which on passing through a heated tube give a silvery mirror of element M. identify M and N. (IIT JEE 1997 – 2 Marks)

Q 24.

Draw the structure of a cyclic silicate, $(\text{Si}_3\text{O}_9)^{6-}$ with proper labeling. (IIT JEE 1998 – 4 Marks)

Q 25.

Thionyl chloride can be synthesized by chlorinating SO_2 using PCl_5 . Thionyl chloride is used to prepare anhydrous ferric chloride starting from its hex hydrated salt. Alternatively, the anhydrous ferric chloride can also be prepared from its hex hydrated salt by treating with 2, 2 – dimethoxypropane. Discuss all this using balanced chemical equations.

(IIT JEE 1998 – 6 Marks)

Q 26.

Reaction of phosphoric acid with $\text{Ca}_5(\text{PO}_4)_3\text{F}$ yields a fertilizer “triple superphosphate”.

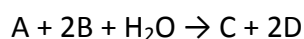
Represent the same through balanced chemical equation.

(IIT JEE 1998 – 2 Marks)

Q 27.

In the following equation,

(IIT JEE 1999 – 6 Marks)



(A = HNO_2 , B = H_2SO_3 , C = NH_2OH). Identify D. Draw the structures of A, B, C and D.

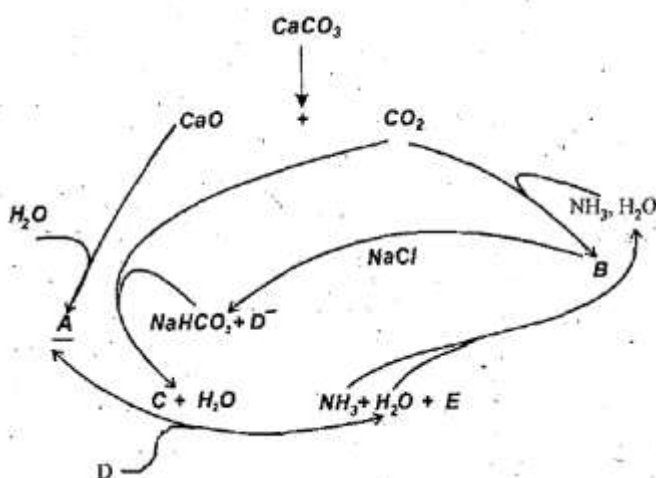
Q 28.

In the contact process for industrial manufacture of sulphuric acid some amount of sulphuric acid is used as a starting material. Explain briefly. What is the catalyst used in the oxidation of SO_2 ?

(IIT JEE 1994 – 4 Marks)

Q 29.

The Haber process can be represented by the following scheme;



Identify A, B, C, D and E

(IIT JEE 1999 – 5 Marks)

Q 30.

Give an example of oxidation of one halide by another halogen. Explain the feasibility of the reaction

(IIT JEE 2000 – 2 Marks)

Q 31.

Draw the molecular structures of XeF_2 , XeF_4 and XeO_2F_2 indicating the location of lone pair(s) of electrons. (IIT JEE 2000 – 3 Marks)

Q 32.

Give reason(s) why elemental nitrogen exists as a diatomic molecular whereas elemental phosphorus as a tetraatomic molecule. (IIT JEE 2000 – 2 Marks)

Q 33.

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 boron trioxide. Identify (X) and (Y). Give balanced reactions involved in the formation of (Y) and its reaction with air. Draw the structure of (Y). (IIT JEE 2001 – 5 Marks)

Q 34.

Starting from SiCl_4 , prepare the following in steps not exceeding the number given in parentheses (give reactions only):

(i) Silicon (1)

(ii) Linear silicone containing methyl groups only (4)

(iii) Na_2SiO_3 (3) (IIT JEE 2001 – 5 Marks)

Q 35.

Write balanced equations for the reactions of the following compounds with water : (IIT JEE 2002 – 5 Marks)

(i) Al_4C_3

(ii) CaNCN

(iii) BF_3

(iv) NCl_3

(v) XeF_4

Q 36.

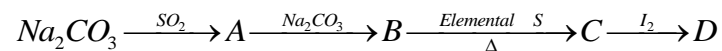
How is boron obtained from borax? Give chemical equations with reaction conditions. Write the structure of B_2H_6 and its reaction with HCl . (IIT JEE 2002 – 5 Marks)

Q 37.

Write down reactions involved in the extraction of Pb. What is the oxidation number of lead in litharge? (IIT JEE 2003 – 2 Marks)

Q 38.

Identify the following: (IIT JEE 2003 – 4 Marks)



Also mention the oxidation state of S in all the compounds.

Q 39.

AlF_3 is insoluble in anhydrous HF but it becomes soluble in presence of little amount of KF. Addition of boron trifluoride to the resulting solution causes reprecipitation of AlF_3 . Explain with balanced chemical equations.

(IIT JEE 2004 – 2 Marks)

Q 40.

How many grams of CaO are required to neutralize 852 gm of P_4O_{10} ? Draw structure of P_4O_{10} molecule.

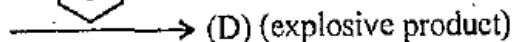
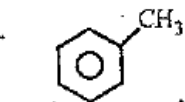
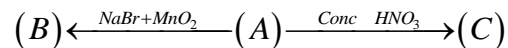
(IIT JEE 2005 – 2 Marks)

Q 41.

Write the structures of $(\text{CH}_3)_3\text{N}$ and $(\text{Me}_3\text{Si})_3\text{N}$. Are they is structural? Justify your answer.

(IIT JEE 2005 – 2 Marks)

Q 42.



Identify the missing compounds. Give the equation from A to B and A to C.

(IIT JEE 2005 – 4 Marks)