CHAPTER

16 The p-Block Elements

Section-A JEE Advanced/ IIT-JEE

A Fill in the Blanks

1. The lowest possible oxidation state of nitrogen is *(1980)*
2. Iodine reacts with hot NaOH solution. The products are NaI and ..... *(1980)*
3. ..... is a weak acid. (HF, HCl, HI) *(1981 - 1 Mark)*
4. The increase in the solubility of iodine in an aqueous solution of potassium iodide is due to the formation of ..... . *(1982 - 1 Mark)*
5. Hydrogen gas is liberated by the action of aluminium with concentrated solution of ..... . *(1987 - 1 Mark)*
6. ..... phosphorus is reactive because of its highly strained tetrahedral structure. *(1987 - 1 Mark)*
7. ..... acid gives hypo ..... ion. *(1988 - 1 Mark)* (hydrobromic, hypobromous, perbromic, bromide, bromite, perbromate)
8. Sulphur acts as ..... agent in vulcanization of rubber. *(1989 - 1 Mark)*
9. The basicity of phosphorous acid (H_3PO_3) is ..... . *(1990 - 1 Mark)*
10. The hydrolysis of alkyl substituted chlorosilanes gives ..... . *(1991 - 1 Mark)*
11. In P_4O_{10}, the number of oxygen atoms bonded to each phosphorus atom is ..... . *(1992 - 1 Mark)*
12. The lead chamber process involves oxidation of SO_2 by atomic oxygen under the influence of ..... as catalyst. *(1992 - 1 Mark)*
13. The hydrolysis of trialkylchlorosilane R_3SiCl, yields ..... *(1994 - 1 Mark)*
14. One recently discovered allotrope of carbon (e.g., C_{60}) is commonly known as..... *(1994 - 1 Mark)*
15. Solubility of iodine in water is greatly increased by the addition of iodide ions because of the formation of ..... *(1994 - 1 Mark)*
16. A liquid which is permanently supercooled is frequently called a ..... . *(1997 - 1 Mark)*
17. Compounds that formally contain Pb^{4+} are easily reduced to Pb^{2+}. The stability of the lower oxidation state is due to ..... . *(1997 - 1 Mark)*

B True / False

1. Red phosphorus is less volatile than white phosphorus because the former has a tetrahedral structure. *(1982 - 1 Mark)*
2. When PbO_2 reacts with a dilute acid, it gives hydrogen peroxide. *(1982 - 1 Mark)*
3. Carbon tetrachloride burns in air when lighted to give phosgene. *(1983 - 1 Mark)*
4. Dil. HCl oxidizes metallic Fe to Fe^{2+}. *(1983 - 1 Mark)*
5. In aqueous solution chlorine is a stronger oxidizing agent than fluorine. *(1984 - 1 Mark)*
6. The H-N-H bond angle in NH_3 is greater than the H-As-H bond angle is AsH_3. *(1984 - 1 Mark)*
7. Carbon tetrachloride is inflammable. *(1985 - ½ Mark)*
8. Graphite is better lubricant on the moon than on the earth. *(1987 - 1 Mark)*
9. All the Al–Cl bonds in Al_2Cl_6 are equivalent. *(1989 - 1 Mark)*
10. Nitric oxide, though an odd electron molecule, is diamagnetic in liquid state. *(1991 - 1 Mark)*
11. Diamond is harder than graphite. *(1993 - 1 Mark)*
12. The tendency for catenation is much higher for C than for Si. *(1993 - 1 Mark)*
13. HBr is a stronger acid than HI because of hydrogen bonding. *(1993 - 1 Mark)*

C MCQs with One Correct Answer

1. The reddish brown coloured gas formed when nitric oxide is oxidised by air is *(1979)*
   (a) N_2O_5 (b) N_2O_4
   (c) NO_2 (d) N_2O_3
2. The temporary hardness of water due to calcium carbonate can be removed by adding – *(1979)*
   (a) $CaCO_3$ (b) $Ca(OH)_2$
   (c) $CaCl_2$ (d) HCl
3. Which of the following is most stable to heat *(1980)*
   (a) HCl (b) HOCl
   (c) HBr (d) HI

4. White P reacts with caustic soda. The products are PH_3 and NaH_2PO_2. This reaction is an example of *(1980)*
(a) Oxidation (b) Reduction
(c) oxidation and reduction (d) Neutralisation

5. A solution of KBr is treated with each of the following. Which one would liberate bromine *(1980)*
(a) Cl_2 (b) HI
(c) I_2 (d) SO_2

6. Which of the following is coloured *(1980)*
(a) NO (b) N_2O
(c) SO_3 (d) None

7. Lead pencil contains *(1980)*
(a) Pb (b) FeS
(c) Graphite (d) PbS

8. Ammonia can be dried by *(1980)*
(a) Conc. H_2SO_4 (b) P_2O_5
(c) Anhydrous $CuSO_4$ (d) none

9. HBr and HI reduce sulphuric acid, HCl can reduce $KMnO_4$ and HF can reduce *(1981 - 1 Mark)*
(a) H_2SO_4 (b) $KMnO_4$
(c) $K_2Cr_2O_7$ (d) none of the above

10. Which of the following statements about anhydrous aluminium chloride is correct? *(1981 - 1 Mark)*
(a) it exists as $AlCl_3$ molecules
(b) it is not easily hydrolysed
(c) it sublimes at 100°C under vacuum
(d) it is a strong Lewis base

11. Moderate electrical conductivity is shown by *(1982 - 1 Mark)*
(a) silica (b) graphite
(c) diamond (d) carborundum

12. Chlorine acts as a bleaching agent only in presence of *(1983 - 1 Mark)*
(a) dry air (b) moisture
(c) sunlight (d) pure oxygen

13. Nitrogen dioxide cannot be obtained by heating : *(1985 - 1 Mark)*
(a) KNO_3 (b) $Pb(NO_3)_2$
(c) $Cu(NO_3)_2$ (d) $AgNO_3$

14. A gas that cannot be collected over water is : *(1985 - 1 Mark)*
(a) N_2 (b) O_2
(c) SO_2 (d) PH_3

15. The compound which gives off oxygen on moderate heating is : *(1986 - 1 Mark)*
(a) cupric oxide (b) mercuric oxide
(c) zinc oxide (d) aluminium oxide

16. The bonds present in N_2O_5 are : *(1986 - 1 Mark)*
(a) only ionic (b) covalent and coordinate
(c) only covalent (d) covalent and ionic

17. Which of the following oxides of nitrogen is a coloured gas? *(1987 - 1 Mark)*
(a) N_2O (b) NO
(c) N_2O_5 (d) NO_2

18. Amongst the trihalides of nitrogen which one is least basic? *(1987 - 1 Mark)*
(a) NF_3 (b) NCl_3
(c) NBr_3 (d) NI_3

19. Bromine can be liberated from potassium bromide solution by the action of *(1987 - 1 Mark)*
(a) Iodine solution (b) Chlorine water
(c) Sodium chloride (d) Potassium iodide

20. There is no S–S bond in : *(1991 - 1 Mark)*
(a) $S_2O_4^{2-}$ (b) $S_2O_5^{2-}$
(c) $S_2O_3^{2-}$ (d) $S_2O_7^{2-}$

21. In P_4O_{10} each P atom is linked with ..... O atoms
(a) 2 (b) 3 *(1995S)*
(c) 4 (d) 5

22. H_2SO_4 cannot be used to prepare HBr from NaBr as it : *(1995S)*
(a) reacts slowly with NaBr (b) oxidises HBr
(c) reduces HBr (d) disproportionates HBr

23. Hydrolysis of one mole of peroxodisulphuric acid produces *(1996 - 1 Mark)*
(a) two moles of sulphuric acid
(b) two moles of peroxomonosulphuric acid
(c) one mole of sulphuric acid and one mole of peroxomonosulphuric acid
(d) one mole of sulphuric acid, one mole of peroxomonosulphuric acid and one mole of hydrogen peroxide.

24. Which of the following statements is correct for $CsBr_3$? *(1996 - 1 Mark)*
(a) It is a covalent compound.
(b) It contains Cs^{3+} and Br^- ions.
(c) It contains Cs^+ and Br_3^- ions
(d) It contains Cs^+, and Br^- and lattice Br_2 molecule

25. KF combines with HF to form KHF_2. The compound contains the species. *(1996 - 1 Mark)*
(a) K^+, F^- and H^+ (b) K^+, F^- and HF
(c) K^+ and $[HF_2]^-$ (d) $[KHF]^+$ and F^-

26. Sodium thiosulphate is prepared by *(1996 - 1 Mark)*
(a) reducing Na_2SO_4 solution with H_2S
(b) boiling Na_2SO_3 solution with S in alkaline medium
(c) neutralising $H_2S_2O_3$ solution with NaOH
(d) boiling Na_2SO_3 solution with S in acidic medium

27. Which of the following halides is least stable and has doubtful existence? *(1996 - 1 Mark)*
(a) CI_4 (b) GeI_4
(c) SnI_4 (d) PbI_4

28. Which one of the following oxides is neutral? *(1996 - 1 Mark)*
(a) CO (b) SnO_2
(c) ZnO (d) SiO_2

29. Which one of the following species is not a pseudohalide? *(1997 - 1 Mark)*
(a) CNO^- (b) $RCOO^-$
(c) OCN^- (d) NNN^-

30. One mole of calcium phosphide on reaction with excess water gives *(1999 - 2 Marks)*
(a) one mole of phosphine
(b) two moles of phosphoric acid
(c) two moles of phosphine
(d) one mole of phosphorus pentoxide

31. On heating ammonium dichromate, the gas evolved is *(1999 - 2 Marks)*
(a) oxygen (b) ammonia
(c) nitrous oxide (d) nitrogen

32. In the commercial electrochemical process for aluminium extraction the electrolyte used is *(1999 - 2 Marks)*
(a) $Al(OH)_3$ in NaOH solution
(b) an aqueous solution of $Al_2(SO_4)_3$.
(c) a molten mixture of Al_2O_3 and Na_3AlF_6
(d) a molten mixture of AlO(OH) and $Al(OH)_3$

33. In compounds of type ECl_3, where E = B, P, As or Bi, the angles Cl – E– Cl for different E are in the order *(1999 - 2 Marks)*.
(a) B > P = As = Bi (b) B > P > As > Bi
(c) B < P = As = Bi (d) B < P < As < Bi

34. Electrolytic reduction of alumina to aluminium by Hall-Heroult process is carried out *(2000S)*
(a) in the presence of NaCl
(b) in the presence of fluorite
(c) in the presence of cryolite which forms a melt with lower melting temperature
(d) in the presence of cryolite which forms a melt with higher melting temperature

35. The number of P – O – P bonds in cyclic metaphosphoric acid is *(2000S)*
(a) zero (b) two
(c) three (d) four

36. Ammonia can be dried by *(2000S)*
(a) conc. H_2SO_4 (b) P_4O_{10}
(c) CaO (d) anhydrous $CaCl_2$

37. The number of S – S bonds in sulphur trioxide trimer (S_3O_9) is *(2001S)*
(a) three (b) two
(c) one (d) zero

38. Polyphosphates are used as water softening agents because they *(2002S)*
(a) form soluble complexes with anionic species
(b) precipitate anionic species
(c) form soluble complexes with cationic species
(d) precipitate cationic species

39. For H_3PO_3 and H_3PO_4 the correct choice is: *(2003S)*
(a) H_3PO_3 is dibasic and reducing
(b) H_3PO_3 is dibasic and non-reducing
(c) H_3PO_4 is tribasic and reducing
(d) H_3PO_3 is tribasic and non-reducing

40. H_3BO_3 is: *(2003S)*
(a) Monobasic and weak Lewis acid
(b) Monobasic and weak Bronsted acid
(c) Monobasic and strong Lewis acid
(d) Tribasic and weak Bronsted acid

41. $(Me)_2SiCl_2$ on hydrolysis will produce *(2003S)*
(a) $(Me)_2Si(OH)_2$ (b) $(Me)_2Si=O$
(c) $-[-O-(Me)_2Si-O-]_n-$ (d) $Me_2SiCl(OH)$

42. Total number of lone pair of electrons in $XeOF_4$ is *(2004S)*
(a) 0 (b) 1
(c) 2 (d) 3

43. The acid having O – O bond is *(2004S)*
(a) $H_2S_2O_3$ (b) $H_2S_2O_6$
(c) $H_2S_2O_8$ (d) $H_2S_4O_6$

44. Pb and Sn are extracted from their chief ores by *(2004S)*
(a) carbon reduction and self reduction respectively
(b) self reduction and carbon reduction respectively
(c) electrolysis and self reduction respectively
(d) self reduction and electrolysis respectively

45. Name of the structure of silicates in which three oxygen atoms of $[SiO_4]^{4-}$ are shared. *(2005S)*
(a) Pyrosilicate
(b) Sheet silicate
(c) Linear chain silicate
(d) Three dimensional silicate

46. Which is the most thermodynamically stable allotropic form of phosphorus? *(2005S)*
(a) red (b) white
(c) black (d) yellow

47. Which of the following is not oxidized by O_3 ? *(2005S)*
(a) KI (b) $FeSO_4$
(c) $KMnO_4$ (d) K_2MnO_4

48. Blue liquid which is obtained on reacting equimolar amounts of two gases at –30°C is? *(2005S)*
(a) N_2O (b) N_2O_3
(c) N_2O_4 (d) N_2O_5

49. When PbO_2 reacts with conc. HNO_3 the gas evolved is *(2005S)*
(a) NO_2 (b) O_2
(c) N_2 (d) N_2O

50. How can the following reaction be made to proceed in forward direction? *(2006 - 3M, –1)*
$B(OH)_3 + NaOH \rightleftharpoons NaBO_2 + Na[B(OH)_4] + H_2O$
(a) addition of borax
(b) addition of *cis* -1,2-diol
(c) addition of Na_2HPO_4
(d) addition of *trans* -1,2-diol

51. The percentage of π-character in the orbitals forming P – P bonds in P_4 is *(2007)*
(a) 25 (b) 33
(c) 50 (d) 75

52. Aqueous solution of $Na_2S_2O_3$ on reaction with Cl_2 gives – *(2008)*
(a) $Na_2S_4O_6$ (b) $NaHSO_4$
(c) NaCl (d) NaOH

53. The reaction of P_4 with **X** leads selectively to P_4O_6. The **X** is *(2009)*
(a) Dry O_2
(b) A mixture of O_2 and N_2
(c) Moist O_2
(d) O_2 in the presence of aqueous NaOH

54. Extra pure N_2 can be obtained by heating *(2011)*
(a) NH_3 with CuO
(b) NH_4NO_3
(c) $(NH_4)_2Cr_2O_7$
(d) $Ba(N_3)_2$

55. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen? *(2012)*
(a) HNO_3, NO, NH_4Cl, N_2
(b) HNO_3, NO, N_2, NH_4Cl
(c) HNO_3, NH_4Cl, NO, N_2
(d) NO, HNO_3, NH_4Cl, N_2

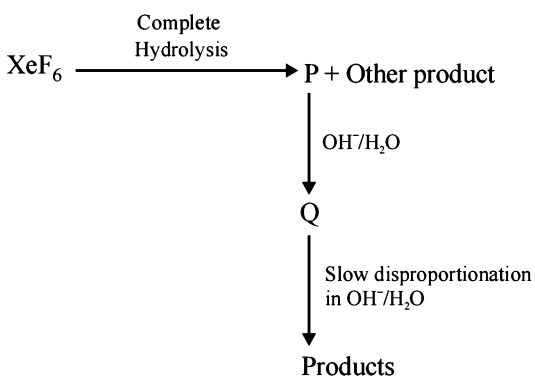
56. The reaction of white phosphorus with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type; the oxidation states of phosphorus in phosphine and the other product are respectively *(2012)*
(a) redox reaction; – 3 and – 5
(b) redox reaction; + 3 and + 5
(c) disproportionation reaction; – 3 and + 5
(d) disproportionation reaction; – 3 and + 3

57. The shape of XeO_2F_2 molecule is *(2012)*
(a) trigonal bipyramidal
(b) square planar
(c) tetrahedral
(d) see-saw

58. Concentrated nitric acid, upon long standing, turns yellow brown due to the formation of *(JEE Advanced 2013)*
(a) NO (b) NO_2
(c) N_2O (d) N_2O_4

59. The product formed in the reaction of $SOCl_2$ with white phosphorous is *(JEE Adv. 2014)*
(a) PCl_3 (b) SO_2Cl_2
(c) SCl_2 (d) $POCl_3$

60. Under ambient conditions, the total number of gases released as products in the final step of the reaction scheme shown below is *(JEE Adv. 2014)*



(a) 0 (b) 1
(c) 2 (d) 3

61. The increasing order of atomic radii of the following Group 13 elements is
(a) $A\ell < Ga < In < T\ell$ (b) $Ga < A\ell < In < T\ell$
(c) $A\ell < In < Ga < T\ell$ (d) $A\ell < Ga < T\ell < In$
(JEE Adv. 2016)

62. In the following reaction sequence in aqueous solution, the species X, Y and Z, respectively, are *(JEE Adv. 2016)*

$$S_2O_3^{2-} \xrightarrow{Ag^+} \underset{\text{clear solution}}{X} \xrightarrow{Ag^+} \underset{\text{white precipitate}}{Y}$$
$$\xrightarrow{\text{with time}} \underset{\text{black precipitate}}{Z}$$

(a) $[Ag(S_2O_3)_2]^{3-}, Ag_2S_2O_3, Ag_2S$
(b) $[Ag(S_2O_3)_3]^{5-}, Ag_2SO_3, Ag_2S$
(c) $[Ag(SO_3)_2]^{3-}, Ag_2S_2O_3, Ag$
(d) $[Ag(SO_3)_3]^{3-}, Ag_2SO_4, Ag$

D MCQs with One or More Than One Correct

1. In the electrolysis of alumina, cryolite is added to : *(1986 - 1 Mark)*
(a) lower the melting point of alumina
(b) increase the electrical conductivity
(c) minimise the anode effect
(d) remove impurities from alumina

2. Nitrogen(I) oxide is produced by : *(1989 - 1 Mark)*
(a) thermal decomposition of ammonium nitrate
(b) disproportionation of N_2O_4
(c) thermal decomposition of ammonium nitrite
(d) interaction of hydroxylamine and nitrous acid.

3. The compounds used as refrigerant are *(1990 - 1 Mark)*
(a) NH_3
(b) CCl_4
(c) CF_4
(d) CF_2Cl_2
(e) CH_2F_2

4. The major role of fluorspar (CaF_2), which is added in small quantities in the electrolytic reduction of alumina dissolved in fused cryolite (Na_3AlF_6), is *(1993 - 1 Mark)*
(a) as a catalyst
(b) to make the fused mixture very conducting
(c) to lower the temperature of the melt
(d) to decrease the rate of oxidation of carbon at the anode.

5. The material used in the solar cells contains *(1993 - 1 Mark)*
(a) Cs
(b) Si
(c) Sn (d) Ti

6. Sodium nitrate decomposes above 800° C to give *(1998 - 2 Marks)*
(a) N_2 (b) O_2
(c) NO_2 (d) Na_2O

7. White phosphorus (P_4) has *(1998 - 2 Marks)*
   (a) six P-P single bonds
   (b) four P-P single bonds
   (c) four lone pairs of electrons
   (d) PPP angle of 60°
8. Ammonia, on reaction with hypochlorite anion, can form *(1999 - 3 Marks)*
   (a) NO (b) NH_4Cl
   (c) N_2H_4 (d) HNO_2
9. A solution of colourless salt H on boiling with excess NaOH produces a non-flammable gas. The gas evolution ceases after sometime. Upon addition of Zn dust to the same solution, the gas evolution restarts. The colourless salt (s) H is (are) *(2008)*
   (a) NH_4NO_3 (b) NH_4NO_2
   (c) NH_4Cl (d) $(NH_4)_2SO_4$
10. The nitrogen oxide(s) that contain(s) N-N bond(s) is(are)
    (a) N_2O (b) N_2O_3 *(2009)*
    (c) N_2O_4 (d) N_2O_5
11. Which of the following halides react(s) with $AgNO_3$(aq) to give a precipitate that dissolves in $Na_2S_2O_3$(aq)?
    (a) HCl (b) HF *(2012)*
    (c) HBr (d) HI
12. With respect to graphite and diamond, which of the statement(s) given below is (are) correct ? *(2012)*
    (a) Graphite is harder than diamond.
    (b) Graphite has higher electrical conductivity than diamond.
    (c) Graphite has higher thermal conductivity than diamond.
    (d) Graphite has higher C–C bond order than diamond.
13. The correct statement(s) about O_3 is(are)
    (a) O—O bond lengths are equal *(JEE Adv. 2013-II)*
    (b) Thermal decomposition of O_3 is endothermic
    (c) O_3 is diamagnetic in nature
    (d) O_3 has a bent structure
14. For the reaction *(JEE Adv. 2014)*

$$I^- + ClO_3^- + H_2SO_4 \rightarrow Cl^- + HSO_4^- + I_2$$

The correct statement(s) in the balanced equation is/are
    (a) Stoichiometric coefficient of HSO_4^- is 6
    (b) Iodide is oxidized
    (c) Sulphur is reduced
    (d) H_2O is one of the products
15. The correct statement(s) for orthoboric acid is/are *(JEE Adv. 2014)*
    (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
16. The correct statement(s) regarding, (i) HClO, (ii) $HClO_2$, (iii) $HClO_3$ and (iv) $HClO_4$, is(are) *(JEE Adv. 2015)*
    (a) The number of Cl=O bonds in (ii) and (iii) together is two
    (b) The number of lone pairs of electrons on Cl in (ii) and (iii) together is three
    (c) The hybridization of Cl in (iv) is sp^3
    (d) Amongst (i) to (iv), the strongest acid is (i)
17. Under hydrolytic conditions, the compounds used for preparation of linear polymer and for chain termination, respectively, are *(JEE Adv. 2015)*
    (a) CH_3SiCl_3 and $Si(CH_3)_4$
    (b) $(CH_3)_2SiCl_2$ and $(CH_3)_3SiCl$
    (c) $(CH_3)_2SiCl_2$ and CH_3SiCl_3
    (d) $SiCl_4$ and $(CH_3)_3SiCl$
18. The crystalline form of borax has *(JEE Adv. 2016)*
    (a) tetranuclear $[B_4O_5(OH)_4]^{2-}$ unit
    (b) all boron atoms in the same plane
    (c) equal number of sp^2 and sp^3 hybridized boron atoms
    (d) one terminal hydroxide per boron atom
19. The nitrogen containing compound produced in the reaction of HNO_3 with P_4O_{10} *(JEE Adv. 2016)*
    (a) can also be prepared by reaction of P_4 and HNO_3
    (b) is diamagnetic
    (c) contains one N-N bond
    (d) reacts with Na metal producing a brown gas

E Subjective Problems

1. Account for the following. Limit your answer to two sentences
   (i) Hydrogen bromide cannot be prepared by action of concentrated 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 decolourised. *(1979)*
2. Write balanced equation involved in the preparation of
   (i) Anhydrous aluminium 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. *(1979)*
3. State with balanced equations, what happens when :
   (i) Tin is treated with moderately concentrated nitric acid.
   (ii) Aluminium is reacted with hot concentrated caustic soda solution *(1979)*
4. Give structural formula for the following :
   (*i*) Phosphorous acid, H_3PO_3 *(1981 - 1 Mark)*
   (*ii*) Pyrophosphoric acid, $H_4P_2O_7$ *(1981 - 1 Mark)*

5. Complete the following equations (no balancing is needed)

(*i*) $HCO_3^- + Al^{3+} \longrightarrow Al(OH)_3 + ...$ ***(1981 - 1 Mark)***

(*ii*) $AlBr_3 + K_2Cr_2O_7 + H_3PO_4 \longrightarrow K_3PO_4 + AlPO_4 + H_2O + ... + ...$ ***(1981 - 1 Mark)***

6. Give reasons for the following :

(*i*) Carbon acts as an abrasive and also as a lubricant. ***(1981 - 1 Mark)***

(*ii*) Sulphur melts to a clear mobile liquid at 119°C, but on further heating above 160°C, it becomes viscous. ***(1981 - 1 Mark)***

(*iii*) In the preparation of hydrogen iodide from alkali iodides, phosphoric acid is preferred to sulphuric acid ***(1982 - 1 Mark)***

(*iv*) Orthophosphoric acid, H_3PO_4, is tribasic, but phosphorous acid, H_3PO_3, is dibasic. ***(1982 - 1 Mark)***

(*v*) A bottle of liquor ammonia should be cooled before opening the stopper. ***(1983 - 1 Mark)***

(*vi*) Solid carbon dioxide is known as dry ice. ***(1983 - 1 Mark)***

(*vii*) Anhydrous HCl is a bad conductor of electricity but aqueous HCl is a good conductor; ***(1985 - 1 Mark)***

(*viii*) Graphite is used as a solid lubricant; ***(1985 - 1 Mark)***

(*ix*) Fluorine cannot be prepared from fluorides by chemical oxidation. ***(1985 - 1 Mark)***

(*x*) The mixture of hydrazine and hydrogen peroxide with a copper(II) catalyst is used as a rocket propellant. ***(1987 - 1 Mark)***

(*xi*) Orthophosphorus acid is not tribasic acid. ***(1987 - 1 Mark)***

(*xii*) The molecule of magnesium chloride is linear whereas that of stannous chloride is angular. ***(1987 - 1 Mark)***

(*xiii*) Valency of oxygen is generally two whereas sulphur shows valency of two, four and six. ***(1988 - 1 Mark)***

(*xiv*) H_3PO_3 is a dibasic acid. ***(1989 - 1 Mark)***

(*xv*) Phosphine has lower boiling point than ammonia. ***(1989 - 1 Mark)***

(*xvi*) Ammonium chloride is acidic in liquid ammonia solvent. ***(1991 - 1 Mark)***

(*xvii*) The hydroxides of aluminium and iron are insoluble in water. However, NaOH is used to separate one from the other. ***(1991 - 1 Mark)***

(*xviii*) Bond dissociation energy of F_2 is less than that of Cl_2. ***(1992 - 1 Mark)***

(*xix*) Sulphur dioxide is a more powerful reducing agent in an alkaline medium than in acidic medium. ***(1992 - 1 Mark)***

(*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. ***(1995 - 2 Marks)***

(*xxi*) Mg_3N_2 when reacted with water gives off NH_3 but HCl is not obtained from $MgCl_2$ on reaction with water at room temperature. ***(1995 - 2 Marks)***

(*xxii*) $(SiH_3)_3N$ is a weaker base than $(CH_3)_3N$. ***(1995 - 2 Marks)***

7. State with balanced equations what happens when :

(*i*) White phosphorous (P_4) is boiled with a strong solution of sodium hydroxide in an inert atmosphere. ***(1982/87 - 1 Mark)***

(*ii*) Sodium iodate is treated with sodium bisulphite solution. ***(1982 - 1 Mark)***

(*iii*) Dilute nitric acid is slowly reacted with metallic tin. ***(1987 - 1 Mark)***

(*iv*) Potassium permanganate is reacted with warm solution of oxalic acid in the presence of sulphuric acid. ***(1987 - 1 Mark)***

(*v*) Iodate ion reacts with bisulphite ion to liberate iodine. ***(1988 - 1 Mark)***

(*vi*) Phosphorus reacts with nitric acid to give equimolar ratio of nitric oxide and nitrogen dioxide. ***(1988 - 1 Mark)***

(*vii*) Hypophosphorous acid is heated. ***(1989 - 1 Mark)***

(*viii*) Sodium bromate reacts with fluorine in presence of alkali. ***(1989 - 1 Mark)***

(*ix*) Sodium chlorate reacts with sulphur dioxide in dilute sulphuric acid medium. ***(1989 - 1 Mark)***

(*x*) Write balanced equations for the preparation of crystalline silicon from $SiCl_4$. ***(1990 - 1 Mark)***

(*xi*) Write balanced equations for the preparation of phosphine from CaO and white phosphorus. ***(1990 - 2 Marks)***

(*xii*) Write balanced equations for the preparation of ammonium sulphate from gypsum, ammonia and carbon dioxide. ***(1990 - 1 Mark)***

(*xiii*) Aqueous solution of sodium nitrate is heated with zinc dust and caustic soda solution. ***(1990 - 1 Mark)***

(*xiv*) Sodium iodate is added to a solution of sodium bisulphite. ***(1990 - 1 Marks)***

(*xv*) Sodium nitrite is produced by absorbing the oxides of nitrogen in aqueous solution of washing soda. ***(1991 - 1 Mark)***

(*xvi*) Nitrogen is obtained in the reaction of aqueous ammonia with potassium permanganate. ***(1991 - 1 Mark)***

(*xvii*) Elemental phosphorus reacts with conc. HNO_3 to give phosphoric acid. ***(1991 - 1 Mark)***

(*xviii*) Sulphur is precipitated in the reaction of hydrogen sulphide with sodium bisulphite solution. ***(1991 - 1 Mark)***

(*xix*) Phosphorus is treated with concentrated nitric acid. ***(1997 - 1 Mark)***

OR

Manufacture of phosphoric acid from phosphorus. ***(1997 - 1 Mark)***

(*xx*) Reaction of aluminium with aqueous sodium hydroxide. ***(1997 - 1 Mark)***

(*xxi*) Aluminium sulphide gives a foul odour when it becomes damp. Write a balanced chemical equation for the reaction. ***(1997 - 2 Marks)***

(*xxii*) $P_4O_{10} + PCl_5 \rightarrow$ ***(1998 - 1 Mark)***

(*xxiii*) $SnCl_4 + C_2H_5Cl + Na \rightarrow$ ***(1998 - 1 Mark)***

8. Show with equations how the following compound is prepared (equations need not be balanced) sodium thiosulphate from sodium sulphite. ***(1982 - 1 Mark)***

9. Give balanced equations for the extraction of aluminium from bauxite by electrolysis. ***(1982 - 2 Marks)***

10. State the conditions under which the following preparation is carried out. Give the necessary equations which need not be balanced : Alumina from aluminium. ***(1983 - 1 Mark)***

11. Write down the resonance structures of nitrous oxide. ***(1985 - 2 Marks)***

OR

Write the two resonance structures of N_2O that satisfy the octet rule. ***(1990 - 1 Mark)***

12. Write down the balanced equations for the reactions when:

(*i*) a mixture of potassium chlorate, oxalic acid and sulphuric acid is heated; ***(1985 - 1 Mark)***

(*ii*) ammonium sulphate is heated with a mixture of nitric oxide and nitrogen dioxide. ***(1985 - 1 Mark)***

13. What happens when :

(*i*) hydrogen sulphide is bubled through an aqueous solution of sulphur dioxide. ***(1985 - 1 Mark)***

(*ii*) tin is treated with concentrated nitric acid. ***(1985 - 1 Mark)***

(*iii*) Pb_3O_4 is treated with nitric acid. ***(1985 - 1 Mark)***

14. Arrange the following in :

(*i*) increasing bond strength ***(1986 - 1 Mark)***
HCl, HBr, HF, HI

(*ii*) $HOCl$, $HOClO_2$, $HOClO_3$, $HOClO$ in increasing order of thermal stability. ***(1988 - 1 Mark)***

(*iii*) CO_2, N_2O_5, SiO_2, SO_3 in the order of increasing acidic character. ***(1988 - 1 Mark)***

(*iv*) Increasing order of extent of hydrolysis :
$CCl_4, MgCl_2, AlCl_3, PCl_5, SiCl_4$ ***(1991 - 1 Mark)***

15. Mention the products formed in the following :

(*i*) Chlorine gas is bubbled through a solution of ferrous bromide. ***(1986 - 1 Mark)***

(*ii*) Iodine is added to a solution of stannous chloride. ***(1986 - 1 Mark)***

(*iii*) Sulphur dioxide gas, water vapour and air are passed over heated sodium chloride. ***(1986 - 1 Mark)***

16. Write the two resonance structures of ozone which satisfy the octet rule. ***(1991 - 1 Mark)***

17. $PbS \xrightarrow[\text{air}]{\text{heat in}} A + PbS \xrightarrow{B} Pb + SO_2$; Identify A and B. ***(1991 - 2 Marks)***

18. Complete and balance the following chemical reactions :

(i) Red phosphorus is reacted with iodine in presence of water. ***(1992 - 1 Mark)***
$P + I_2 + H_2O \rightarrow$ ..... + ...

(ii) Anhydrous potassium nitrate is heated with excess of metallic potassium. ***(1992 - 1 Mark)***
$KNO_3(s) + K(s) \rightarrow$ ..... + ...

(iii) $NH_3 + NaOCl \rightarrow$ ..... + ... ***(1993 - 1 Mark)***

(iv) $Sn + 2KOH + 4H_2O \longrightarrow$ ..... + ... ***(1994 - 1 Mark)***

19. Draw the structure of P_4O_{10} and identify the number of single and double P—O bonds. ***(1996 - 3 Marks)***

20. Gradual addition of KI solution to $Bi(NO_3)_3$ 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 reactions. ***(1996 - 2 Marks)***

21. Complete the following chemical equations :

(a) $KI + Cl_2 \rightarrow$ (b) $KClO_3 + I_2 \rightarrow$

Justify the formation of the products in the above reactions. ***(1996 - 2 Marks)***

22. A soluble compound of a poisonous element M, when heated with Zn/H_2SO_4 gives a colourless and extremely poisonous gaseous compound N, which on passing through a heated tube gives a silvery mirror of element M. Identify M and N. ***(1997 - 2 Marks)***

23. Draw the structure of a cyclic silicate, $(Si_3O_9)^{6-}$ with proper labelling. ***(1998 - 4 Marks)***

24. Thionyl chloride can be synthesized by chlorinating SO_2 using PCl_5. Thionyl chloride is used to prepare anhydrous ferric chloride starting from its hexahydrated salt. Alternatively, the anhydrous ferric chloride can also be prepared from its hexahydrated salt by treating with 2, 2 – dimethoxypropane. Discuss all this using balanced chemical equations. ***(1998 - 6 Marks)***

25. Reaction of phosphoric acid with $Ca_5(PO_4)_3F$ yields a fertilizer "triple superphosphate". Represent the same through balanced chemical equation. ***(1998 - 2 Marks)***

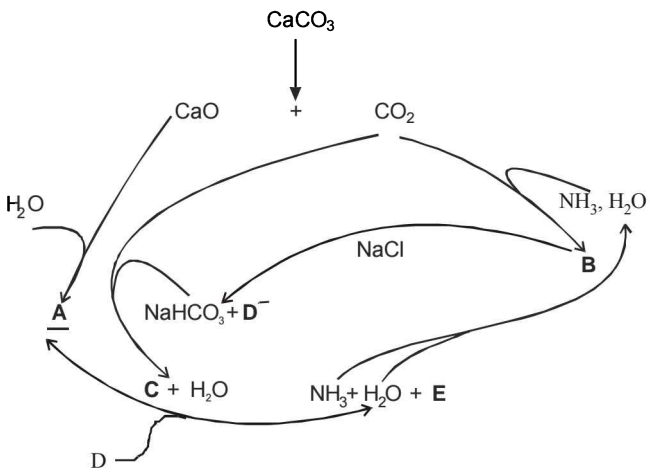
26. In the following equation, ***(1999 - 6 Marks)***

$A + 2B + H_2O \rightarrow C + 2D$

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

27. 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? ***(1999 - 4 Marks)***

28. The Haber process can be represented by the following scheme;



Identify A, B, C, D and E. ***(1999 - 5 Marks)***

29. Give an example of oxidation of one halide by another halogen. Explain the feasibility of the reaction ***(2000 - 2 Marks)***.

30. Draw the molecular structures of XeF_2, XeF_4 and XeO_2F_2 indicating the location of lone pair(s) of electrons. ***(2000 - 3 Marks)***

31. Give reason(s) why elemental nitrogen exists as a diatomic molecule whereas elemental phosphorus as a tetraatomic molecule. ***(2000 - 2 Marks)***

32. 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). ***(2001 - 5 Marks)***

33. 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) ***(2001 - 5 Marks)***

34. Write balanced equations for the reactions of the following compounds with water : ***(2002 - 5 Marks)***

(i) Al_4C_3

(ii) CaNCN

(iii) BF_3

(iv) NCl_3

(v) XeF_4

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

36. Write down reactions involved in the extraction of Pb. What is the oxidation number of lead in litharge? ***(2003 - 2 Marks)***

37. Identify the following: ***(2003 - 4 Marks)***

$$Na_2CO_3 \xrightarrow{SO_2} A \xrightarrow{Na_2CO_3} B \xrightarrow[\Delta]{\text{Elemental S}} C \xrightarrow{I_2} D$$

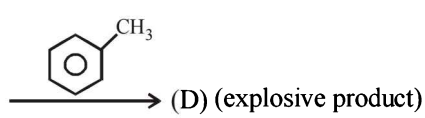
Also mention the oxidation state of S in all the compounds.

38. 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. ***(2004 - 2 Marks)***

39. How many grams of CaO are required to neutralize 852 gm of P_4O_{10} ? Draw structure of P_4O_{10} molecule. ***(2005 - 2 Marks)***

40. Write the structures of $(CH_3)_3N$ and $(Me_3Si)_3N$. Are they isostructural? Justify your answer. ***(2005 - 2 Marks)***

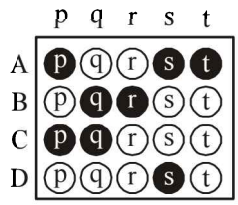
41. $(B) \xleftarrow{NaBr + MnO_2} (A) \xrightarrow{Conc.HNO_3} (C)$



Identify the missing compounds. Give the equation from A to B and A to C. ***(2005 - 4 Marks)***

F Match the Following

DIRECTIONS (Q. 1 to 3) : *Each question contains statements given in two columns, which have to be matched. The statements in Column-I are labelled A, B, C and D, while the statements in Column-II are labelled p, q, r, s and t. Any given statement in Column-I can have correct matching with ONE OR MORE statement(s) in Column-II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example :*
If the correct matches are A-p, s and t; B-q and r; C-p and q; and D-s then the correct darkening of bubbles will look like the given.



1. Match gases under specified conditions listed in **Column I** with their properties/laws in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS. *(1995S)*

Column I	**Column II**
(A) Explosive	(p) NaN_3
(B) Artificial gem	(q) Fe_3O_4
(C) Self reduction	(r) Cu
(D) Magnetic material	(s) Al_2O_3
	(t) $Pb(N_3)_2$
	(u) Fe_2O_3
	(v) Cu
	(w) SiC

2. Match the following : *(2006 - 6M)*

Column I	**Column II**
(A) $Bi^{3+} \longrightarrow (BiO)^+$	(p) Heat
(B) $[AlO_2]^- \longrightarrow Al(OH)_3$	(q) Hydrolysis
(C) $[SiO_4]^{4-} \longrightarrow [Si_2O_7]^{6-}$	(r) Acidification
(D) $[B_4O_7]^{2-} \longrightarrow [B(OH)_3]$	(s) Dilution by water

3. Match each of the diatomic molecules in **Column I** with its property/properties in **Column II**. *(2009)*

Column I	**Column II**
(A) B_2	(p) Paramagnetic
(B) N_2	(q) Undergoes oxidation
(C) O_2^-	(r) Undergoes reduction
(D) O_2	(s) Bond order ≥ 2
	(t) Mixing of 's' and 'p' orbital

DIRECTIONS (for Q. 4) : *Following question has matching lists. The codes for the lists have choices (a), (b), (c) and (d) out of which ONLY ONE is correct.*

4. The unbalanced chemical reactions given in List I show missing reagent or condition (?) which are provided in List II. Match List I with List II and select the correct answer using the code given below the lists *(JEE Adv. 2013-II)*

List I	**List II**
P. $PbO_2 + H_2SO_4 \xrightarrow{?} PbSO_4 + O_2 +$ other product	1. NO
Q. $Na_2S_2O_3 + H_2O \xrightarrow{?} NaHSO_4 +$ other product	2. I_2
R. $N_2H_4 \xrightarrow{?} N_2 +$ other product	3. Warm
S. $XeF_2 \xrightarrow{?} Xe +$ other product	4. Cl_2

Codes :

	P	Q	R	S
(a)	4	2	3	1
(b)	3	2	1	4
(c)	1	4	2	3
(d)	3	4	2	1

G Comprehension Based Questions

PASSAGE - 1

The noble gases have closed-shell electronic configuration and are monoatomic gases under normal conditions. The low boiling points of the lighter noble gases are due to weak dispersion forces between the atoms and the absence of other interatomic interactions.

The direct reaction of xenon with fluorine leads to a series of compounds with oxidation numbers +2, +4 and +6. XeF_4 reacts violently with water to given XeO_3. The compounds of xenon exhibit rich stereochemistry and their geometries can be deduced considering the total number of electron pairs in the valence shell.

1. Argon is used in arc welding because of its *(2007)*
- (a) low reactivity with metal
- (b) ability to lower the melting point of metal
- (c) flammability
- (d) high calorific value

2. The structure of XeO_3 is *(2007)*
- (a) linear (b) planar
- (c) pyramidal (d) T-shaped

3. XeF_4 and XeF_6 are expected to be *(2007)*
- (a) oxidizing
- (b) reducing
- (c) unreactive
- (d) strongly basic

PASSAGE - 2

There are some deposits of nitrates and phosphates in earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under the laboratory conditions but microbes do it easily. Ammonia forms large number of complexes with transition metal ions. Hybridization easily explains the ease of sigma donation capability of NH_3 and PH_3. Phosphine is a flammable gas and is prepared from white phosphorous.

4. Among the following, the correct statement is *(2008)*
- (a) Phosphates have no biological significance in humans
- (b) Between nitrates and phosphates, phosphates are less abundant in earth's crust
- (c) Between nitrates and phosphates, nitrates are less abundant in earth's crust
- (d) Oxidation of nitrates is possible in soil

5. Among the following, the correct statement is
- (a) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies spherical s-orbital and is less directional
- (b) Between NH_3 and PH_3 , PH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional
- (c) Between NH_3 and PH_3 , NH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional
- (d) Between NH_3 and PH_3 , PH_3 is a better electron donor because the lone pair of electrons occupies spherical s-orbital and is less directional

6. White phosphorus on reaction with NaOH gives PH_3 as one of the products. This is a
- (a) dimerization reaction
- (b) disporportionation reaction
- (c) condensation reaction
- (d) precipitation reaction

PASSAGE - 3

Bleaching powder and bleach solution are produced on a large scale and used in several household products. The effectiveness of bleach solution is often measured by iodometry. *(2012 - II)*

7. Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is
- (a) Cl_2O
- (b) Cl_2O_7
- (c) ClO_2
- (d) Cl_2O_6

8. 25 mL of household solution was mixed with 30 mL of 0.50 M KI and 10 mL of 4N acetic acid. In the titration of the liberated iodine, 48 mL of 0.25 N $Na_2S_2O_3$ was used to reach the end point. The molarity of the household bleach solution is
- (a) 0.48 M
- (b) 0.96 M
- (c) 0.24 M
- (d) 0.024 M

PASSAGE - 4

The reactions of Cl_2 gas with cold-dilute and hot-concentrated NaOH in water give sodium salts of two (different) oxoacids of chlorine, P and Q, respectively. The Cl_2 gas reacts with SO_2 gas, in presence of charcoal, to give a product R. R reacts with white phosphorus to give a compound S. On hydrolysis, S gives an oxoacid of phosphorus, T. *(JEE Adv. 2013)*

9. P and Q, respectively, are the sodium salts of
- (a) Hypochlorus and chloric acids
- (b) Hypochlorus and chlorus acids
- (c) Chloric and perchloric acids
- (d) Chloric and hypochlorus acids

10. R, S and T respectively, are
- (a) SO_2Cl_2, PCl_5 and H_3PO_4
- (b) SO_2Cl_2, PCl_3 and H_3PO_3
- (c) $SOCl_2$, PCl_3 and H_3PO_2
- (d) $SOCl_2$, PCl_5 and H_3PO_4

H Assertion & Reason Type Questions

This question contains STATEMENT-1 (Assertion/ Statement) and STATEMENT-2 (Reason/Explanation) and has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

(a) Statement-1 is True, Statement-2 isTrue; Statement-2 is a correct explanation for Statement-1

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(c) Statement-1 is True, Statement-2 is False

(d) Statement-1 is False, Statement-2 is True.

1. **Statement-1 :** Although PF_5, PCl_5 and PBr_5 are known,the pentahalides of nitrogen have not been observed
Statement-2 : Phosphorus has lower electronegativity than nitrogen. ***(1994 - 2 Marks)***
2. **Statement-1 :** F atom has less electron affinity than Cl atom.
Statement-2 : Additional electrons are repelled more effectively by 3*p* electrons in Cl atom than by 2*p* electrons in F atom. ***(1998 - 2 Marks)***
3. **Statement-1 :** $Al(OH)_3$ is amphoteric in nature
Statement-2 : Al–O and O–H bonds can be broken with equal ease in $Al(OH)_3$. ***(1998 - 2 Marks)***
4. **Statement-1 :** Between $SiCl_4$ and CCl_4, only $SiCl_4$ reacts with water.
Statement-2 : $SiCl_4$ is ionic and CCl_4 is covalent. ***(2001S)***
5. **Statement-1 :** In water, orthoboric acid behaves as a weak monobasic acid.
because
Statement-2 : In water, orthoboric acid acts as a proton donor. ***(2007)***
6. **Statement-1 :** Boron always forms covalent bond.
because
Statement-2 : The small size of B^{3+} favours formation of covalent bond. ***(2007)***
7. **Statement-1 :** Pb^{+4} compounds are stronger oxidising agents than Sn^{4+} compounds ***(2008)***
Statement-2 : The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'.

I Integer Value Correct Type

1. The coordination number of Al in the crystalline state of $AlCl_3$ is ***(2009)***
2. The value of *n* in the molecular formula $Be_nAl_2Si_6O_{18}$ is ***(2010)***
3. Reaction of Br_2 with Na_2CO_3in aqueous solution gives sodium bromide and sodium bromate with evolution of CO_2 gas. The number of sodium bromide molecules involved in the balanced chemical equation is ***(2011)***
4. Among the following, the number of compounds than can react with PCl_5 to give $POCl_3$ is ***(2011)***
O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}
5. The total number of lone pairs of electrons in N_2O_3 is ***(JEE Adv. 2015)***
6. Three moles of B_2H_6 are completely reacted with methanol. The number of moles of boron containing product formed is ***(JEE Adv. 2015)***

Section-B JEE Main / AIEEE

1. Alum helps in purifying water by [2002]
   (a) forming Si complex with clay partiles
   (b) sulphate part which combines with the dirt and removes it
   (c) coagulaing the mud particles
   (d) making mud water soluble.
2. In XeF_2, XeF_4, XeF_6 the number of lone pairs on Xe are respectively [2002]
   (a) 2, 3, 1
   (b) 1, 2, 3
   (c) 4, 1, 2
   (d) 3, 2, 1.
3. In case of nitrogen, NCl_3 is possible but not NCl_5 while in case of phosphorous, PCl_3 as well as PCl_5 are possible. It is due to [2002]
   (a) availability of vacant *d* orbitals in P but not in N
   (b) lower electronegativity of P than N
   (c) lower tendency of H-bond formation in P than N
   (d) occurrence of P in solid while N in gaseous state at room temperature.
4. Which of the following statements is true? [2002]
   (a) HF is less polar than HBr
   (b) absolutely pure water does not contain any ions
   (c) chemical bond formation take place when forces of attraction overcome the forces of repulsion
   (d) in covalency transference of electron takes place.
5. Number of sigma bonds in P_4O_{10} is [2002]
   (a) 6
   (b) 7
   (c) 17
   (d) 16.
6. Oxidation number of Cl in $CaOCl_2$ (bleaching power) is:
   (a) zero, since it contains Cl_2 [2002]
   (b) – 1, since it contains Cl^-
   (c) + 1, since it contains ClO^-
   (d) + 1 and – 1 since it contains ClO^- and Cl^-
7. What may be expected to happen when phosphine gas is mixed with chlorine gas ? [2003]
   (a) PCl_3 and HCl are formed and the mixture warms up
   (b) PCl_5 and HCl are formed and the mixture cools down
   (c) PH_3 . Cl_2 is formed with warming up
   (d) The mixture only cools down
8. Concentrated hydrochloric acid when kept in open air sometimes produces a cloud of white fumes. The explanation for it is that [2003]
   (a) oxygen in air reacts with the emitted HCl gas to form a cloud of chlorine gas
   (b) strong affinity of HCl gas for moisture in air results in forming of droplets of liquid solution which appears like a cloudy smoke.
   (c) due to strong affinity for water, concentrated hydrochloric acid pulls moisture of air towards itself. This moisture forms droplets of water and hence the cloud.
   (d) concentrated hydrochloric acid emits strongly smelling HCl gas all the time.
9. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite
   (a) is an allotropic form of diamond [2003]
   (b) has molecules of variable molecular masses like polymers
   (c) has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds
   (d) is a non-crystalline substance
10. Glass is a [2003]
   (a) super-cooled liquid
   (b) gel
   (c) polymeric mixture
   (d) micro-crystalline solid
11. Which one of the following substances has the highest proton affinity ? [2003]
   (a) H_2S
   (b) NH_3
   (c) PH_3
   (d) H_2O
12. For making good quality mirrors, plates of float glass are used. These are obtained by floating molten glass over a liquid metal which does not solidify before glass. The metal used can be [2003]
   (a) tin
   (b) sodium
   (c) magnesium
   (d) mercury

13. Which among the following factors is the most important in making fluorine the strongest oxidizing halogen ? [2004]
(a) Hydration enthalpy
(b) Ionization enthalpy
(c) Electron affinity
(d) Bond dissociation energy

14. Which one of the following statement regarding helium is **incorrect**? [2004]
(a) It is used to produce and sustain powerful superconducting magnets
(b) It is used as a cryogenic agent for carrying out experiments at low temperatures
(c) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable
(d) It is used in gas-cooled nuclear reactors

15. Beyllium and aluminium exhibit many properties which are similar. But, the two elements differ in [2004]
(a) forming covalent halides
(b) forming polymeric hydrides
(c) exhibiting maximum covalency in compounds
(d) exhibiting amphoteric nature in their oxides

16. Aluminium chloride exists as 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 [2004]
(a) $[Al(OH)_6]^{3-} + 3HCl$
(b) $[Al(H_2O)_6]^{3+} + 3Cl^-$
(c) $Al^{3+} + 3Cl^-$
(d) $Al_2O_3 + 6HCl$

17. Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is **incorrect** for this reaction ? [2004]
(a) $Na_2S_2O_3$ is oxidised
(b) CuI_2 is formed
(c) Cu_2I_2 is formed
(d) Evolved I_2 is reduced

18. The number of hydrogen atom(s) attached to phosphorus atom in hypophosphorous acid is [2005]
(a) three (b) one
(c) two (d) zero

19. The correct order of the thermal stability of hydrogen halides (H – X) is [2005]
(a) HI > HCI < HF > HBr
(b) HCI< HF > HBr < HI
(c) HF > HCI < HBr > HI
(d) HI < HBr > HCI < HF

20. Heating an aqueous solution of aluminium chloride to dryness will give [2005]
(a) $Al(OH)Cl_2$
(b) Al_2O_3
(c) Al_2Cl_6
(d) $AlCl_3$

21. In silicon dioxide [2005]
(a) there are double bonds between silicon and oxygen atoms
(b) silicon atom is bonded to two oxygen atoms
(c) each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms
(d) each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms.

22. The structure of diborane (B_2H_6) contains [2005]
(a) four 2c-2e bonds and four 3c-2e bonds
(b) two 2c-2e bonds and two 3c-3e bonds
(c) two 2c-2e bonds and four 3c-2e bonds
(d) four 2c-2e bonds and two 3c-2e bonds

23. Which of the following statements is true? [2006]
(a) $HClO_4$ is a weaker acid than $HClO_3$
(b) HNO_3 is a stronger acid than HNO_2
(c) H_3PO_3 is a stronger acid than H_2SO_3
(d) In aqueous medium HF is a stronger acid than HCl

24. The increasing order of the first ionization enthalpies of the elements B, P, S and F (Lowest first) is [2006]
(a) B < P < S < F
(b) B < S < P < F
(c) F < S < P < B
(d) P < S < B < F

25. What products are expected from the disproportionation reaction of hypochlorous acid? [2006]
(a) HCl and Cl_2O
(b) HCl and $HClO_3$
(c) $HClO_3$ and Cl_2O
(d) $HClO_2$ and $HClO_4$

26. Identify the incorrect statement among the following. [2007]
(a) Br_2 reacts with hot and strong NaOH solution to give NaBr and H_2O.
(b) Ozone reacts with SO_2 to give SO_3.
(c) Silicon reacts with $NaOH_{(aq)}$ in the presence of air to give Na_2SiO_3 and H_2O.
(d) Cl_2 reacts with excess of NH_3 to give N_2 and HCl.

27. Regular use of the following fertilizers increases the acidity of soil? [2007]
(a) Ammonium sulphate
(b) Potassium nitrate
(c) Urea
(d) Superphosphate of lime.

28. Which one of the following is the correct statement?
(a) Boric acid is a protonic acid [2008]
(b) Beryllium exhibits coordination number of six
(c) Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase
(d) $B_2H_6.2NH_3$ is known as 'inorganic benzene'

29. Which one of the following reactions of xenon compounds is not feasible? [2009]
(a) $3XeF_4 + 6H_2O \longrightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$
(b) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$
(c) $XeF_6 + RbF \longrightarrow Rb[XeF_7]$
(d) $XeO_3 + 6HF \longrightarrow XeF_6 + 3H_2O$

30. Which of the following statement is wrong? [2011]
(a) The stability of hydride increases from NH_3 to BiH_3 in group 15 of the periodic table.
(b) Nitrogen cannot form $d\pi - p\pi$ bond.
(c) Single N – N bond is weaker than the single P – P bond.
(d) N_2O_4 has two resonance structures.

31. Which of the following statements regarding sulphur is incorrect? [2011]
(a) S_2 molecule is paramagnetic.
(b) The vapour at 200°C consists mostly of S_8 rings.
(c) At 600°C the gas mainly consists of S_2 molecules.
(d) The oxidation state of sulphur is never less than +4 in its compounds.

32. Boron cannot form which one of the following anions? [2011]
(a) BF_6^{3-} (b) BH_4^-
(c) $B(OH)^-_4$ (d) BO_2^-

33. The molecule having smallest bond angle is : [2012]
(a) NCl_3 (b) $AsCl_3$
(c) $SbCl_3$ (d) PCl_3

34. Among the following oxoacids, the correct decreasing order of acid strength is: [JEE M 2014]
(a) $HOCl > HClO_2 > HClO_3 > HClO_4$
(b) $HClO_4 > HOCl > HClO_2 > HClO_3$
(c) $HClO_4 > HClO_3 > HClO_2 > HOCl$
(d) $HClO_2 > HClO_4 > HClO_3 > HOCl$

35. Which one of the following properties is **not** shown by NO? [JEE M 2014]
(a) It is diamagnetic in gaseous state
(b) It is neutral oxide
(c) It combines with oxygen to form nitrogen dioxide
(d) It's bond order is 2.5

36. The correct statement for the molecule, CsI_3 is: [JEE M 2014]
(a) It is a covalent molecule.
(b) It contains Cs^+ and I_3^- ions.
(c) It contains Cs^{3+} and I^- ions.
(d) It contains Cs^+, I^- and lattice I_2 molecule.

37. Which among the following is the most reactive ? [JEE M 2015]
(a) I_2
(b) ICl
(c) Cl_2
(d) Br_2

38. **Assertion:** Nitrogen and oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.
Reason: The reaction between nitrogen and oxygen requires high temperature. [JEE M 2015]
(a) The assertion is incorrect, but the reason is correct
(b) Both the assertion and reason are incorrect
(c) Both assertion and reason are correct, and the reason is the correct explanation for the assertion
(d) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion

39. Which one has the highest boiling point ? [JEE M 2015]
(a) Kr
(b) Xe
(c) He
(d) Ne

40. The pair in which phosphorous atoms have a formal oxidation state of + 3 is : [JEE M 2016]
(a) Orthophosphorous and hypophosphoric acids
(b) Pyrophosphorous and pyrophosphoric acids
(c) Orthophosphorous and pyrophosphorous acids
(d) Pyrophosphorous and hypophosphoric acids

41. The reaction of zinc with dilute and concentrated nitric acid, respectively, produces: [JEE M 2016]
(a) NO and N_2O
(b) NO_2 and N_2O
(c) N_2O and NO_2
(d) NO_2 and NO