Chapter 22

THE p-BLOCK ELEMENTS

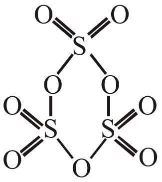
A SINGLE CORRECT CHOICE TYPE

Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

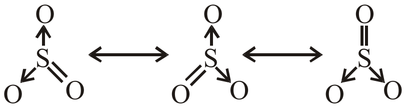
1. When KOH reacts with Cl_2, the product is
(a) KClO (b) $KClO_4$
(c) $KClO_3$ (d) none of these

2. In the solid state, SO_3 may have structure

(a)



(b)



(c) a & b both
(d) None of these

3. CO_2 is isostructural with
(a) $HgCl_2$ (b) $SnCl_2$
(c) C_2H_4 (d) NO_2

4. Which of the following is an organometallic compound?
(a) Sodium ethoxide (b) Potassium acetate
(c) Methyl lithium (d) Lithium dimethylamide

5. Most reactive form of phosphorus is
(a) white (b) red
(c) black (d) yellow

6. Which acid will you use to dissolve lead (II) oxide?
(a) HNO_3 (b) H_2SO_4
(c) HCl (d) None of these

7. Sulphur dioxide bleaches colouring matter by
(a) oxidation (b) reduction
(c) dehydrogenation (d) dehydration

8. Which of the following is not hydrolysed?
(a) PF_3 (b) NF_3
(c) SbF_3 (d) AsF_3

9. $$PbS \xrightarrow[\text{in air}]{\text{Heat}} A + PbS \xrightarrow[\text{No air}]{\text{High temp.}} Pb + SO_2$$
Identify A
(a) PbO (b) $PbSO_4$
(c) None (d) (a) or (b)

10. When Sn is treated with conc. HNO_3
(a) it is converted into stannous nitrate
(b) it is converted into stannic nitrate
(c) it is converted into metastannic acid
(d) it becomes passive

11. Which of the following compounds is converted into the dimer form?
(a) BF_3 (b) BH_3
(c) BCl_3 (d) BBr_3

12. Which of following is called 'Inorganic Benzene?
(a) Boron nitride (b) Graphite
(c) Borazine (d) none of these

13. Which of the following is a correct statement ?
(a) S_α and S_β are monotropic allotropes
(b) O_2 & O_3 are enantiotropic allotropes
(c) Both a & b
(d) O_2 & O_3 are monotropic allotropes

14. The number of P–O–P bonds in P_4O_{10} is
(a) 4 (b) 5
(c) 6 (d) none

15. Which of the following represents the decreasing order of vander waal's forces in halogens?
(a) $F_2 > Cl_2 > Br_2 > I_2$ (b) $I_2 > Br_2 > Cl_2 > F_2$
(c) $Br_2 > Cl_2 > F_2 > I_2$ (d) $Cl_2 > F_2 > I_2 > Br_2$

MARK YOUR RESPONSE					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ

16. Which of the following species is not pseudohalide?

(a) CN^- (b) $RCOO^-$

(c) OCN^- (d) NNN^-

17. Which of the following is highly acidic than others?

(a) H_3PO_2 (b) H_3PO_4

(c) H_3PO_2 (d) none

18. Which of the following halogen has highest bond dissociation energy?

(a) Cl–Cl (b) F–F

(c) Br–Br (d) I–I

19. Which of the following hydride is the most reducing?

(a) NH_3 (b) PH_3

(c) SbH_3 (d) BiH_3

20. Which of the following has the highest bond length?

(a) O_2^- (b) O_2

(c) O_2^+ (d) O_2^{++}

21. Which of the following has correct increasing order of hydrolysis ?

(a) $CCl_4 < MgCl_2 < AlCl_3 < SiCl_4 < PCl_5$

(b) $PCl_5 < MgCl_2 < AlCl_3 < SiCl_4 < CCl_4$

(c) $PCl_5 < SiCl_2 < MgCl_2 < AlCl_3 < CCl_4$

(d) none of these

22. $B(OH)_3$ is a/ an

(a) acid (b) base

(c) both (d) none of these

23. Pyrophosphoric acid is a

(a) monobasic (b) Tribasic

(c) Tetrabasic (d) none

24. Peroxodisulphuric acid is a

(a) Monobasic (b) Dibasic

(c) Tribasic (d) Tetrabasic

25. Which of the following oxides is most acidic?

(a) Ag_2O (b) V_2O_5

(c) CO (d) N_2O_5

26. Predict the relative basicity of the following ions F^-, Cl^-, Br^-, I^-

(a) $F^- > I^- > Br^- > Cl^-$ (b) $Cl^- > F^- > Br^- > I^-$

(c) $F^- > Cl^- > Br^- > I^-$ (d) none of these

27. Predict the relative acidic strength among the following H_2O, H_2S, H_2Se, H_2Te

(a) $H_2O < H_2S < H_2Se < H_2Te$

(b) $H_2Te < H_2Se < H_2S < H_2O$

(c) $H_2O < H_2Se < H_2S < H_2Te$

(d) none of these

28. $Pb(NO_3)_2$ on heating gives

(a) NO (b) N_2O_3

(c) a residue of PbO (d) none of these

29. Addition of acetic acid and potassium dichromate to the aqueous solution of $Pb(NO_3)_2$ gives a yellow precipitate of

(a) $Pb(CH_3COO)_2$ (b) $PbCr_2O_7$

(c) $PbCrO_4$ (d) none of these

30. The gas produced when ammonium bisulphide is added to an aqueous solution of aluminium sulfate is

(a) SO_2 (b) SO_3

(c) O_2 (d) H_2S

31. $NaNO_2$ gives coloured fumes on treatment with dilute acids. The colour of fumes is

(a) reddish (b) brown

(c) reddish-brown (d) none of these

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

(i) Its aqueous solution is alkaline to litmus.

(ii) On strongly heating it swells to give a glassy bead

(iii) When concentrated sulphuric acid is added to a hot concentrated solution of (X), crystals of H_3BO_3 separate out. Identify the colour of these crystals.

(a) White (b) Blue

(c) Brown (d) Violet

33. When $NaNO_3$ is heated with $(NH_4)_2SO_4$ a colourless gas & a residue is obtained. The colour of residue is

(a) black (b) brown

(c) red (d) white

34. The strongest reducing agent amongst the following is

(a) $P_2O_7^{-4}$ (b) $P_2O_6^{-4}$

(c) H_3PO_4 (d) $H_2PO_2^-$

35. Which of the following is correct order of bond strength?

(a) $N_2^+ > N_2 > N_2^-$ (b) $N_2^- > N_2 > N_2^+$

(c) $N_2 > N_2^+ > N_2^-$ (d) $N_2^- > N_2^+ > N_2$

MARK YOUR RESPONSE	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ
	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ
	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ

36. Red phosphorus is .... volatile than white phosphorus.

(a) less (b) more
(c) equally (d) can't say

37. Of the following acids of sulphur which one has more than one oxidation state of sulphur atom ?

(a) $H_2S_2O_4$ (b) $H_2S_2O_3$
(c) $H_2S_2O_7$ (d) $H_2S_2O_6$

38. Of the following which compound is most unstable?

(a) IF (b) IF_3
(c) IF_5 (d) IF_7

39. Passing H_2S gas through nitric acid produces

(a) rhombic sulfur (b) monoclinic sulfur
(c) amorphous sulfur (d) plastic sulfur

40. Which of the following is true?

(a) Coke is found in nature
(b) Producer gas is a mixture of CO & H_2
(c) CO is used in the extraction of Ni by Mond's process
(d) CO_2 can be prepared by dehydration of formic acid.

41. Mn^{++} can be converted into Mn^{+7} by reacting with

(a) SO_2 (b) Cl_2
(c) PbO_2 (d) $SnCl_2$

42. Oxidation state exhibited by sulphur is

(a) +6 (b) +4
(c) 0 (d) all of the above

43. How many bonding electron pairs are there in white phosphorus?

(a) 6 (b) 12
(c) 4 (d) 8

44. Solid iodine is

(a) covalent crystal (b) molecular crystal
(c) metallic crystal (d) ionic crystal

45. Conc. HNO_3 reacts with I_2 to form

(a) $HOIO_3$ (b) HI
(c) HIO_3 (d) HOI

46. From which of the following, SO_2 is formed?

(a) Hydrolysis of dil H_2SO_4
(b) Reaction of dil H_2SO_4 with oxygen
(c) Reaction of Na_2SO_3 with conc. H_2SO_4
(d) None of these

47. Chlorine cannot displace

(a) iodine from NaI (b) bromine from NaBr
(c) fluorine from NaF (d) none of these

48. Sulphuric acid reacts with PCl_5 to give

(a) sulphur tetrachloride
(b) sulphuryl chloide
(c) sulphur monochloride
(d) thionyl chloride

49. The following acids have been arranged in order of decreasing acid strength. Identify the correct order. ClOH (I), BrOH (II), IOH (III)

(a) II > I > III (b) III > II > I
(c) I > II > III (d) I > III > II

50. Which of the following oxides is neutral?

(a) SnO_2 (b) CO
(c) ZnO (d) SiO_2

51. Which of the following halides is least stable and has doubtful existence?

(a) CrI_4 (b) SnI_4
(c) PbI_4 (d) Cl_4

52. An aqueous solution of a gas shows following reactions :

(i) It turns red litmus blue
(ii) When added in excess to a copper sulphate solution a deep blue colour is obtained.
(iii) On addition to ferric chloride solution a brownish precipitate soluble in HNO_3 is obtained.

Identify the gas.

(a) SO_2 (b) SO_3
(c) NH_3 (d) CO_2

53. Ammonium dichromate on heating gives

(a) chromic acid & ammonia
(b) chromium sesquioxide & nitrogen
(c) chromium sesquioxide & ammonia
(d) chromic acid and N_2

54. One gas bleaches the colour of flowers by reduction while the other by oxidation, the two respective gases are

(a) CO and Cl_2 (b) H_2S and Br_2
(c) NH_3 and SO_3 (d) SO_2 & Cl_2

55. Bromine (molecular mass, 160 amu) boils at 59ºC, whereas iodine monochloride (molecular mass, 162 amu) boils at 92º. The best explantion for this difference in b.p. is

(a) the I–Cl bond is stronger than Br–Br bond
(b) Br_2 is a non-polar molecule, ICl is polar
(c) the vander Waal's forces in ICl are stronger than in Br_2
(d) the difference in molecular masses

MARK YOUR RESPONSE	36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ
	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ
	46. ⓐⓑⓒⓓ	47. ⓐⓑⓒⓓ	48. ⓐⓑⓒⓓ	49. ⓐⓑⓒⓓ	50. ⓐⓑⓒⓓ
	51. ⓐⓑⓒⓓ	52. ⓐⓑⓒⓓ	53. ⓐⓑⓒⓓ	54. ⓐⓑⓒⓓ	55. ⓐⓑⓒⓓ

56. White silver surface turns black when O_3 is passed over it. This is due to the formation of

(a) silver hydroxide
(b) freshly reduced silver which is black in colour
(c) silver oxide
(d) a complex compound of silver and ozone

57. Reaction that involves atomspheric oxygen are never promoted by

(a) bacterical activity (b) low temperatures
(c) moisture (d) carbonic acid

58. The yellow colour often shown by nitric acid may be removed by

(a) adding a little tin
(b) boiling the acid
(c) passing ammonia through the acid in cold
(d) bubbling the air through the warm acid

59. What is the name of the compound containing N, H and O, which on heating gives laughing gas?

(a) Hydroxylamine (b) Ammonium Nitrate
(c) Ammonium Nitrite (d) None of these

60. Silicon carbide is used as a/ an

(a) abrasive (b) dehydrating agent
(c) solvent (d) catalyst

61. Which one of the following is best oxidising agent ?

(a) Br^- (b) I^-
(c) Cl_2 (d) Cl^-

62. Which one of the following is pseudohalide?

(a) I_3^- (b) ICl^-
(c) IF_5 (d) CN^-

63. Which one is not an acid?

(a) NaH_2PO_2 (b) NaH_2PO_3
(c) NaH_2PO_4 (d) none

64. Minimum flocculation value is of

(a) Na^+ (b) Pb^{+4}
(c) Pb^{+2} (d) Sr^{+2}

65. The species that does not contain peroxide ion is

(a) PbO_2 (b) SrO_2
(c) BaO_2 (d) none of these

66. Maximum pπ-pπ back bonding exists in

(a) BCl_3 (b) BF_3
(c) BBr_3 (d) BI_3

67. Bromine can be liberated from KI solution by the action of

(a) iodine solution
(b) chlorine solution
(c) sodium chloride
(d) potassium iodide

68. Fluorine does not show highest oxidation state opposite to other halogens, because

(a) it is most electronegative
(b) it has no *d*-orbital
(c) its atomic radius is very small
(d) F^- ion is stable and isoelectronic with neon

69. Aluminium vessels should not be washed with materials containing washing soda since

(a) washing soda is expensive
(b) washing soda is easily decomposed
(c) washing soda reacts with Al to form soluble aluminate
(d) washing soda reacts with Al to form insoluble aluminium oxide

70. Of the following types of glass, the one with the smallest coefficient of thermal expansion is

(a) safety glass (b) pyrex glass
(c) soft glass (d) soda lime glass

71. The element with the highest first ionisation potential is

(a) boron (b) carbon
(c) nitrogen (d) oxygen

72. All the three atoms of ozone are used up when it reacts with

(a) H_2O_2 (b) PbS
(c) KI (d) SO_2

73. Conc. H_2SO_4 displaces hydrogen chloride from chlorides because

(a) it is a stronger acid
(b) sulphates are less soluble than chlorides
(c) sulphates are more soluble than chlorides
(d) HCl is a gas while H_2SO_4 is a liquid

74. Bad conductor of electricity is

(a) H_2F_2 (b) HCl
(c) HBr (d) HI

75. Xenon forms compounds only with

(a) oxygen & chlorine (b) oxygen and fluorine
(c) oxygen & bromine (d) oxygen and ozone

MARK YOUR RESPONSE	56. ⓐⓑⓒⓓ	57. ⓐⓑⓒⓓ	58. ⓐⓑⓒⓓ	59. ⓐⓑⓒⓓ	60. ⓐⓑⓒⓓ
	61. ⓐⓑⓒⓓ	62. ⓐⓑⓒⓓ	63. ⓐⓑⓒⓓ	64. ⓐⓑⓒⓓ	65. ⓐⓑⓒⓓ
	66. ⓐⓑⓒⓓ	67. ⓐⓑⓒⓓ	68. ⓐⓑⓒⓓ	69. ⓐⓑⓒⓓ	70. ⓐⓑⓒⓓ
	71. ⓐⓑⓒⓓ	72. ⓐⓑⓒⓓ	73. ⓐⓑⓒⓓ	74. ⓐⓑⓒⓓ	75. ⓐⓑⓒⓓ

76. It is recommended that liquor ammonia bottles should be opened after cooling them in ice for sometime. This is because liquor ammonia

(a) brings tears to eyes
(b) has a high vapour pressure
(c) a corrosive liquid
(d) is a mild explosive

77. In the manufacture of safety matches we use

(a) white P (b) red P
(c) black P (d) selenium

78. Bromine can be liberated from potassium bromide solution by the action of

(a) iodine solution (b) chlorine water
(c) sodium chloride (d) potassium iodide

79. Phosphine is producd by adding water to

(a) CaC_2 (b) HPO_3
(c) Ca_3P_2 (d) P_4O_{10}

80. Which of the following show maximum number of allotropic forms ?

(a) Oxygen (b) Sulphur
(c) Selenium (d) Polonium

81. Iron when treated with conc. nitric acid

(a) readily reacts (b) slowly reacts
(c) becomes passive (d) gives ferrous nitrate

82. H_3PO_3 is

(a) neutral (b) basic
(c) a tribasic acid (d) a dibasic acid

83. Oxide which can not be a reducing agent is

(a) NO_2 (b) ClO_2
(c) CO_2 (d) SO_2

84. Which of the following sulphates has highest solubility in water?

(a) $CaSO_4$ (b) $BeSO_4$
(c) $MgSO_4$ (d) $BaSO_4$

85. Strongest reducing agent is

(a) Cl^- (b) I^-
(c) F^- (d) Br^-

86. When alumina is heated with carbon in the atmosphere of nitrogen then products formed are

(a) Al + CO (b) Al + CO + N_2
(c) Al + CO_2 (d) AlN + CO

87. Which compound does not form alum?

(a) Cu (b) Li
(c) K (d) Al

88. When concentrated HNO_3 decomposes slowly in sun light, it gives

(a) blue colour (b) yellow colour
(c) green colour (d) brown colour

89. Which of the following molecule is theoretically not possible?

(a) OF_4 (b) O_2F_2
(c) OF_2 (d) SF_4

90. Electrolytic reduction of alumina to aluminium by Hall-Heroult process is carried out

(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

91. The number of P–O–P bonds in cyclic metaphosphoric acid is

(a) 0 (b) 2
(c) 3 (d) 4

92. Ammonia can be dried by

(a) conc. H_2SO_4 (b) P_4O_{10}
(c) CaO (d) anhydrous $CaCl_2$

93. The set with correct order of acidity is

(a) $HClO < HCO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO_3 < HClO_2 < HClO$
(c) $HClO < HClO_4 < HClO_3 < HClO_2$
(d) $HClO_4 < HClO_2 < HClO_3 < HClO$

94. The number of S–S bonds in sulphur trioxide trimer (S_3O_9) is

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

95. Identify the correct order of solubility of Na_2S, CuS and ZnS in aqueous medium

(a) CuS > ZnS > Na_2S (b) ZnS > Na_2S > CuS
(c) Na_2S > CuS > ZnS (d) Na_2S > ZnS > CuS

MARK YOUR RESPONSE	76. ⓐⓑⓒⓓ	77. ⓐⓑⓒⓓ	78. ⓐⓑⓒⓓ	79. ⓐⓑⓒⓓ	80. ⓐⓑⓒⓓ
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	86. ⓐⓑⓒⓓ	87. ⓐⓑⓒⓓ	88. ⓐⓑⓒⓓ	89. ⓐⓑⓒⓓ	90. ⓐⓑⓒⓓ
	91. ⓐⓑⓒⓓ	92. ⓐⓑⓒⓓ	93. ⓐⓑⓒⓓ	94. ⓐⓑⓒⓓ	95. ⓐⓑⓒⓓ

96. Polyphosphates are used as water softening agent because they
(a) form soluble complexes with anionic species
(b) precipitate anionic species
(c) form soluble complexes with cationic species
(d) precipitate cationic species

97. Identify the correct order of acidic strength of CO_2, CuO, CaO, H_2O
(a) $CaO < CuO < H_2O < CO_2$
(b) $H_2O < CuO < CaO < CO_2$
(c) $CaO < H_2O < CuO < CO_2$
(d) $H_2O < CO_2 < CaO < CuO$

98. For H_3PO_3 and H_3PO_4, the correct choice is
(a) H_3PO_3 is dibasic and reducing
(b) H_3PO_4 is diabasic and non-reducing
(c) H_3PO_4 is tribasic and reducing
(d) H_3PO_4 is tribasic and non reducing

99. H_3BO_2 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

100. Nitrolium is a mixture of
(a) $CaCN_2$ and graphite (b) CaC_2 and graphite
(c) $Ca(CN)_2$ and graphite (d) $CaCN_2$ & nitrogen

101. Identify B in the following sequence of reactions

$$A + \text{dil. } H_2SO_4 + K_2Cr_2O_7 \longrightarrow (B) \text{ green colour};$$

$$A + O_2 \xrightarrow{H_2O} Na_2SO_4$$

(a) Na_2SO_3 (b) K_2SO_4
(c) CrO_5 (d) $Cr_2(SO_4)_3$

102. A is a binary compound of a univalent metal. 1.422 g. of A reacts completely with 0.321 g of sulphur in an evacuated and sealed tube to give 1.734 g of a white crystalline solid, B, which is a sulphate of a univalent metal. Identify A.
(a) Na_2SO_4 (b) K_2SO_4
(c) Li_2SO_4 (d) None of these

103. A salt '*R*' shows the following characteristics
(i) It is soluble in water.
(ii) To aqueous solution of salt '*R*' if we add aqueous NaOH, it forms a white precipitate.
(iii) The white precipitate formed in (ii) is soluble in excess of aqueous NaOH.
(iv) '*R*' when treated with aqueous ammonia gives a white ppt. that is not soluble in excess of aqueous ammonia.
The salt '*R*' is
(a) $ZnSO_4$ (b) $CaSO_4$
(c) $Al_2(SO_4)_3$ (d) $BaCl_2$

104. An aqueous solution of hydrated aluminium chloride contains the following set of ions
(a) Al^{3+} and Cl^-
(b) $AlCl_3$ and H_2O
(c) $[Al(H_2O)_6]^{3+}$ and Cl^-
(d) $[AlCl_3(H_2O)_4]^+$ and $[AlCl_4(H_2O)_2]^-$

105. In solid state the colour of oxygen has been observed as **pale blue**. This pale colour of oxygen(s) is due to electronic transitions from
(a) the triplet ground state to the excited singlet state
(b) the triplet ground state to antibonding $\sigma 2p_z$ molecular orbital
(c) the antibonding π-molecular orbitals to the bonding $\sigma 2p_z$ molecular orbital
(d) the singlet ground state to the excited triplet state

106. Select the one which on shaking with iodine solution will discharge the colour of iodine solution.
(a) Na_2S (b) Na_2SO_4
(c) aqueous SO_2 (d) NaBr

107. Select the pair which on treatment with excess of dil HCl gets partly dissolved with evolution of a colourless gas.
(a) $CaCO_3$ and $MgSO_4$ (b) $MgCO_3$ and CaO
(c) $CaCO_3$ and $BaSO_4$ (d) $Ba(NO_3)_2$ and CaO

MARK YOUR RESPONSE	96. ⓐⓑⓒⓓ	97. ⓐⓑⓒⓓ	98. ⓐⓑⓒⓓ	99. ⓐⓑⓒⓓ	100. ⓐⓑⓒⓓ
	101. ⓐⓑⓒⓓ	102. ⓐⓑⓒⓓ	103. ⓐⓑⓒⓓ	104. ⓐⓑⓒⓓ	105. ⓐⓑⓒⓓ
	106. ⓐⓑⓒⓓ	107. ⓐⓑⓒⓓ			

108. A yellow metallic powder when burnt in a stream of fluorine produced a colourless, thermally stable and chemically inert gas 'X'. A gas 'Y', which is colourless and consists of the same elements as are present in gas 'X', is obtained by heating together sulphur dichloride and sodium fluoride. Gases 'X' and 'Y' respectively are

(a) SF_4 and SF_6 (b) SF_4 and S_2F_2

(c) SF_6 and SF_4 (d) none of these

109. The reason for **not** storing XeF_6 in a glass or a quartz vessel is that

(a) it forms an explosive having the formula XeO_2F_2

(b) it forms an explosive having the formula $XeOF_4$

(c) it forms XeO_2 which is explosive substance

(d) it forms XeO_6^{4-} which is explosive in nature

110. Due to which one of the following processes is "vortex rings" formed ?

"Vortex rings" is formed due to oxidation of

(a) PH_3 (b) P_2H_4

(c) NO_2 (d) N_2O

111. P_2H_4 can be removed from phosphine containing traces of it :

(a) by passing impure PH_3 gas through a freezing mixture

(b) by passing the impure PH_3 gas through HI and then its treatment with KOH (aq)

(c) by both (a) and (b)

(d) by none of these

112. We know that farmers use CaO to reduce the acidity of soil and they use ammonium sulphate [$(NH_4)_2SO_4$] as a nitrogenous fertilizer. Why is it not possible to use a mixture of CaO and ammonium sulphate ?

(a) The dry mixture is quite explosive in nature

(b) $CaSO_4$ formed on mixing may cause hardness in water

(c) NH_3(g) may be given out when the mixture is dampened

(d) the constituents of mixture may react to form H_2SO_4

113. Which one is **correct** :

(a) White phosphorus glows in dark because of its slow combustion in air

(b) The energy of oxidation of white phosphorus (i.e., slow combustion in air) is emitted as light

(c) Red phosphorus glows in dark because of its slow combustion in air.

(d) **Cold fire** can be produced by combustion of white phosphorus

114. "**Holme's signals**" are used for ships to know about position of rocks in the sea. For this purpose a mixture of which of the following substances is taken in a ship ?

(a) CaC_2 and Ca_3P_2 (b) CaC_2 and $Ca_3(PO_4)_2$

(c) NaN_3 and Ca_3P_2 (d) none of these

115. One of the important uses of phosphine is to prepare smoke screens in warfare. The smoke screen is formed due to

(a) action of phosphine with moisture in air

(b) action of phosphine with oxygen in air

(c) action of phosphine with CO_2 in air

(d) action of phosphine with N_2 in air

116. Select the incorrect statement about NO (nitric oxide)

(a) It is an odd electron molecule

(b) It is blue coloured in liquid state

(c) It is a colourless gas

(d) It has red colour in solid state

117. Select the incorrect statement.

(a) HNO_3 is called aqua fortis

(b) As_4O_6 is called white arsenic

(c) As_4O_6 is poisonous in nature

(d) HNO_4 (per nitric acid) is not explosive in nature

118. **Amatol** that is used as an explosive has the composition

(a) 80% of NH_4NO_3 + 20% TNT

(b) 20% of NH_4NO_3 + 80% TNT

(c) 30% of NH_4NO_2 + 20% TNT

(d) 20% of NH_4NO_2 +80% TNT

119. Which of the following is used in photoelectric cells ?

(a) Oxygen (b) Sulphur

(c) Selenium (d) Tellurium

120. Which of the following is obtained by the reaction of sulphur(S) with CoF_3 ?

(a) SF_4 (b) SF_6

(c) S_2F_2 (d) none of these

MARK YOUR RESPONSE					
	108. ⓐⓑⓒⓓ	109. ⓐⓑⓒⓓ	110. ⓐⓑⓒⓓ	111. ⓐⓑⓒⓓ	112. ⓐⓑⓒⓓ
	113. ⓐⓑⓒⓓ	114. ⓐⓑⓒⓓ	115. ⓐⓑⓒⓓ	116. ⓐⓑⓒⓓ	117. ⓐⓑⓒⓓ
	118. ⓐⓑⓒⓓ	119. ⓐⓑⓒⓓ	120. ⓐⓑⓒⓓ		

121. Which of the following is true ?

(a) minute quantities of boron are used in hardening of steel

(b) boron is also a trace element in plants and serves as significant nutrient factor

(c) boron occupies the top rank of all elements as neutron absorber

(d) All of the above are true

122. Corrundum is

(a) α-Al_2O_3 (b) γ-Al_2O_3

(c) both the above (d) none of these

123. The form of BN which is as hard as diamond is

(a) hexagonal form

(b) Cubic form with ZnS structure

(c) both of these

(d) none of these

124. Carbon sub-oxide (C_3O_2)

(a) is a foul smelling gas

(b) is obtained by dehydrating malonic acid with P_2O_5

(c) is a linear molecule

(d) all the above are correct

Animals die when they inhale nitrous oxide in excess because

(a) it is poisonous

(b) it cause laughing hysteria

(c) it deactivates haemoglobin

(d) it reacts with organic tissues

126. NH_4Cl is used to clear metal surfaces because

(a) it dissociates in ammonia and HCl

(b) ammonia forms a soluble complex with metal

(c) HCl forms a volatile chloride

(d) none of the above

127. When conc. HNO_3 acts on our skin, the skin becomes yellow, because

(a) HNO_3 acts as an oxidising agent

(b) HNO_3 acts as a dehydrating agent

(c) Nitro-cellulose is formed

(d) The proteins are converted into xanthoproteins

128. Of the interhalogen AX_3 compounds, ClF_3 is most reactive but BrF_3 has higher conductance in liquid state. This is because

(a) BrF_3 has higher molecular mass

(b) ClF_3 is more volatile

(c) BrF_3 dissociates into BrF_2^+ and BrF_4^- most easily

(d) Electrical conductance does not depend on concentration

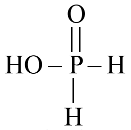
MARK YOUR RESPONSE					
	121.ⓐⓑⓒⓓ	122.ⓐⓑⓒⓓ	123. ⓐⓑⓒⓓ	124. ⓐⓑⓒⓓ	125. ⓐⓑⓒⓓ
	126.ⓐⓑⓒⓓ	127.ⓐⓑⓒⓓ	128. ⓐⓑⓒⓓ		

B COMPREHENSION TYPE

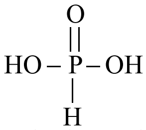
This section contains groups of questions. Each group is followed by some multiple choice questions based on a paragraph. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

PASSAGE-1

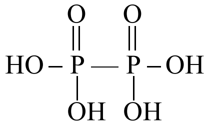
In all the oxyacids of phosphorus, each phosphorus atom is in sp^3 hybrid state, i.e., it is tetrahedrally bonded to neighbouring four atoms. All these acids contain P – OH bonds, the hydrogen atom of which are ionisable imparting acidic nature to the compound. The *ous acids* (oxidation state of P = +1 or +3) also have P – H bonds in which hydrogens are not ionisable (P and hydrogen have nearly same electronegativity). The presence of P – H group in these acids imparts reducing properties. The structure of the various acids are drawn below (note that the tetrahedral shape of phosphorus is not shown only for convenience of representation).


$HO-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle H}{|}}{P}}-H$

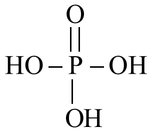
(A) Hypophosphorous acid


$HO-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle H}{|}}{P}}-OH$

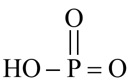
(B) Phosphorous acid


$HO-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle OH}{|}}{P}}-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle OH}{|}}{P}}-OH$

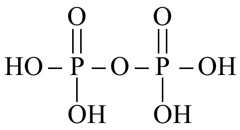
(C) Hypophosphoric acid


$HO-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle OH}{|}}{P}}-OH$

(D) Phosphoric (Orthphosphoric) acid


$HO-\overset{\overset{\displaystyle O}{||}}{P}=O$

(E) Metaphosphoric acid


$HO-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle OH}{|}}{P}}-O-\overset{\overset{\displaystyle O}{||}}{\underset{\underset{\displaystyle OH}{|}}{P}}-OH$

(F) Pyrophosphoric acid

1. In which of the above structures, the oxidation state of P is +5.

(a) D & E (b) F & E

(c) C, D & E (d) D, E & F

2. Among the above acids, the acids having basicity 4 are :

(a) A & E (b) C & D

(c) C & F (d) D & F

3. There is very little difference in acid strength in the series H_3PO_4, H_3PO_3 and H_3PO_2 because

(a) phosphorus in these acids exists in different oxidation states

(b) the hydrogen in these acids are not all bonded to phosphorus

(c) phosphorus is not a highly electronegative element

(d) phosphorus oxides are less basic

4. Which of the acids show reducing properties?

(a) A & C (b) A& B

(c) A, B & E (d) A only

5. Although metaphosphoric acid is written as a monomer, it exists as a polymer, $(HPO_3)_n$. The number of P – O – P bonds in cyclic tri-metaphosphoric acid is

(a) zero (b) two

(c) three (d) four

6. Metaphosphoric acid (E) can be prepared by heating

(a) D & F (b) C & F

(c) C & D (d) B, C & F

PASSAGE-2

It is well known that there are two major forms of carbon, that is, carbon has two main allotropes; graphite and diamond. These differ greatly from each other with respect to their physical properties as shown in Table-1. The physical properties of silicon are also shown in Table-1 for comparison as carbon and silicon belong to the same group in the periodic table.

Table 1

Physical properties	Graphite	Diamond	Silicon
Density (g cm^{-3})	2.26	3.51	2.33
Enthalpy of combustion to yields oxide (ΔH) kJ mol^{-1}	–393.3	–395.1	–910
Melting point °C	2820	3730	1410
Boiling point °C		4830	2680
Conductivity (electrical)	Fairly good	Non - conductor	Good
Conductivity (thermal)	Fairly good	Non - conductivity	Good

Graphite possesses what is commonly known as a layer structure: carbon atoms form three covalent bonds with each other to yield layers of carbon assemblies parallel with each other. Theses layers are held together via weak Vander Waal's forces which permit some movement of the layers relative to one another.

The most common compound of carbon is carbon dioxide which makes up 0.03% of the atmosphere. The triple point of carbon dioxide occurs at 217 K and 515 kPa.

One of the unique properties of carbon is that it can form multiple bonds between itself and other atoms, including other carbon atoms. Thus, large polymers involving carbon atoms are possible.

7. The properties of the layer-like structure of solid graphite stated in the passage would lend to it which of the following industrial uses?

(a) Insulator (b) Structural

(c) Corrosive (d) Lubricant

8. Using the information in the table, calculate the enthalpy change for the following process :

$$C_{graphite} = C_{diamond}$$

(a) $+1.8\ kJ\ mol^{-1}$ (b) $-1.8\ kJ\ mol^{-1}$

(c) $+1.0\ kJ\ mol^{-1}$ (d) $-1.0\ kJ\ mol^{-1}$

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ		

9. It is possible to convert graphite into diamond via various chemical processes. Based on the information in the passage, which of the following would facilitate increased amounts of diamond assuming that the system is in equilibrium?

(a) High pressures (b) High temperature

(c) A catalyst (d) None of the above

10. Diamond consists of tetrahedral arrangements of carbon atoms, with each atom covalently bound to four others to yield a giant molecular structure. What is the hybridization state of carbon in diamond?

(a) It is not hybridized (b) sp

(c) sp^2 (d) sp^3

11. C – C bond length is .... than (to) C – C bond length in diamond.

(a) greater (b) shorter

(c) equal (d) can't say

12. Diamond is a bad conductor of current whereas graphite is a good conductor. Why?

(a) Diamond has a very high Boiling Point

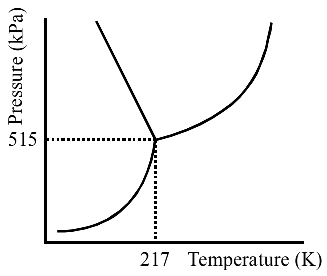
(b) Diamond has a higher density

(c) In diamond each C has its octet completely filled and hence no mobile electrons

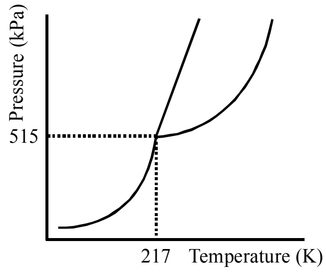
(d) Graphite uses sp^2 hybridisation and has free π-electrons

13. Which of the following is a correct representation of the phase diagram for carbon dioxide?

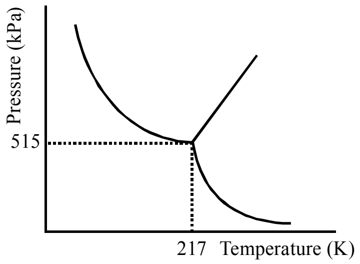
(a)



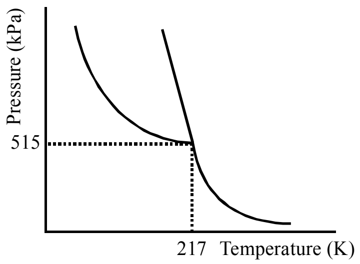
(b)



(c)



(d)



PASSAGE-3

Several features of sulfuric acid are given below :

Preparation of Sulfuric Acid : Sulfuric acid is commonly prepared by the combustion of elemental sulfur to sulfur dioxide, followed by the catalytic oxidation of sulfur dioxide to sulfur trioxide. Sulfur trioxide is then absorbed into a 98% aqueous solution of H_2SO_4, and water is added to maintain a 98% concentration. SO_3 reacts with the water in the aqueous solution according to Reaction-1.

$$SO_3(g) + H_2O(\ell) \longrightarrow H_2SO_4(\ell)\ ; \quad \textbf{Reaction - 1}$$

Properties : Concentrated sulfuric acid is 98% H_2SO_4 and 2% water by mass. It has a density of 1.84 g/mL and a boiling point of 338°C.

Preparation of other Acids : HCl (g) and $HNO_3(\ell)$ may be prepared by the reaction between sulfuric acid and the sodium salt of the corresponding conjugate base (Cl^- or NO_3^-, respectively).

Formation of SO_2 : Sulfuric acid forms SO_2 gas when it reacts with several compounds. For example, I_2 and SO_2 are formed when I^- reacts with concentrated H_2SO_4; Br_2 and SO_2 are formed when Br^- reacts with concentrated H_2SO_4. Cu^+ and SO_2 are formed in hot solutions of Cu(s) in H_2SO_4. This last reaction is unusual, because most metals react with solution of H_2SO_4 to form hydrogen gas and a metal sulfate.

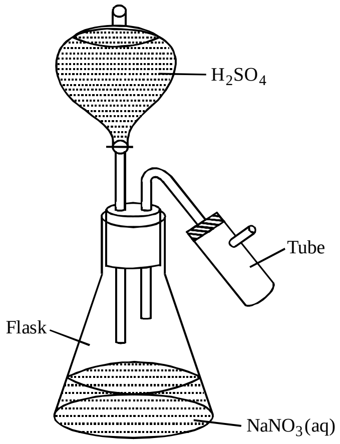
MARK YOUR RESPONSE	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ

14. When sulfuric acid reacts with copper, how does the oxidation number of the sulfur change?

(a) From + 4 to + 6 (b) From + 6 to + 4

(c) From + 6 to + 8 (d) From + 8 to + 6

15. The apparatus shown below can be used to prepare HNO_3 (boiling point = 86°C).



The yield of HNO_3 collected in the tube can be maximized by maintaining the temperatures of the flask and tube, respectively, at :

(a) 0°C and 100°C (b) 100°C and 0°C

(c) 350°C and 150°C (d) 350°C and 100°C

16. Which of the following is the balanced equation describing the combustion of elemental sulfur?

(a) $2H_2S \quad 3O_2 \longrightarrow 2SO_2 \quad 2H_2O$

(b) $H_2S \quad 2O_2 \longrightarrow SO_3 \quad H_2O$

(c) $2SO_3 \longrightarrow 2S \quad 3O_2$

(d) $S \quad O_2 \longrightarrow SO_2$

17. In the second step of preparing H_2SO_4 from elemental sulfur (the catalytic oxidation of SO_2), which strategy is most likely to increase the yield of SO_3 formed?

(a) Reducing the reaction temperature

(b) Reducing the reaction pressure

(c) Removing SO_3 from the reaction mixture

(d) Removing O_2 from the reaction mixture

18. Which of the following expressions can be used to determine the number of moles of water in 1 mL of concentrated H_2SO_4?

(a) $\frac{(1.84)(0.98)}{98} \quad \frac{(1.84)(0.02)}{18}$

(b) $\frac{(1.84)(0.2)}{18}$ (c) $\frac{(1.84)(0.98)}{18}$

(d) $\frac{(1.84)(0.98)(18.0)}{98.0}$

19. If $H_2(g)$ is formed from the reaction of Fe(s) with dilute H_2SO_4 (aq), which species acts as the reducing agent?

(a) Fe (b) $FeSO_4$

(c) SO_4^{2-} (d) H_3O

20. Which of the following species has the smallest concentration in 98% H_2SO_4 ?

(a) SO_4^{2-} (b) H_2SO_4

(c) H_3O (d) HSO_4^-

PASSAGE-4

The pronounced change from non-metallic behaviour as also the increase in basicity of oxides form N, P, As, Sb to Bi is principally due to the increasing size of the atoms. The ionization potential indicate that it is much more difficult to pull electrons of small nitrogen atom than the larger bismuth atom. It is interesting to note that nitrogen obtained from the decomposition of compounds such as NH_4NO_2 is of lower density than the residual gas obtained from the atmosphere by removal of oxygen, carbon dioxide and water.

21. Which of the following oxides is most acidic ?

(a) As_2O_3 (b) Bi_2O_3

(c) Sb_2O_3 (d) P_2O_3

22. Which of the following hydrides would be most basic ?

(a) PH_3 (b) AsH_3

(c) NH_3 (d) SbH_3

MARK YOUR RESPONSE	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	

23. The residual nitrogen obtained from air after removal of oxygen, carbon dioxide and water vapour has a greater density than that obtained from chemical compounds because

(a) it is an allotrophic modification of nitrogen

(b) it is mixed with some heavier gas

(c) it is rich in heavier isotopes of nitrogen

(d) Nitrogen obtained from chemical sources contains some light gas.

PASSAGE-5

Aluminium is so reactive and its oxide is so stable that the preparation of metal by reduction of Al_2O_3 or by carbon or by carbon monoxide is not feasible. Electro-depositon of the melt from an aqueous solution of its salts will not work because it reacts with water. Molten aluminium chloride is a poor conductor of electricity and Al_2O_3 melts at a prohibitively high temperature. The method universally used for obtaining aluminium is by electrolysis of a solution of Al_2O_3 in molten cryolite which is a low melting compound. Al_2O_3 has a high heat of formation. A finely divided mixture of Al and Fe_2O_3. When ignited, the following reaction will proceed with evolution of heat

$$Fe_2O_3 + 2Al \longrightarrow 2Fe + Al_2O_3$$

The heat evolved in the above reaction is so much that the temperature rises to 2500°C, which turns the whole product into molten state. Similar reaction occur with MnO_2 and Cr_2O_3 but in their case the amount of heat evolved is less than that in case of Fe_2O_3.

24. In the extraction of aluminium by electrolysis, the solvent is

(a) Molten Al_2O_3 (b) water

(c) $Fe_2O_3 + Al$ (d) Molten cryolite

25. Which one of the following metals has the greatest affinity for oxygen ?

(a) Mn (b) Al

(c) Cr (d) Fe

26. The melting point of Al_2O_3 is

(a) about 300°C (b) about 1200°C

(c) about 2100°C (d) same as that of cryolite

MARK YOUR RESPONSE	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	

C

REASONING TYPE

In the following questions two Statement-1 (Assertion) and Statement-2 (Reason) are provided. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct. Mark your responses from the following options:

(a) Both Statement-1 and Statement-2 are true and Statement-2 is the correct explanation of Statement-1.

(b) Both Statement-1 and Statement-2 are true and Statement-2 is not the correct explanation of Statement-1.

(c) Statement-1 is true but Statement-2 is false.

(d) Statement-1 is false but Statement-2 is true.

1. **Statement-1** : Although PF_5, PCl_5 and PBr_6 are known, the pentahalides of nitrogen have not been observed.

Statement-2 : Phosphorus has lower electronegativity than nitrogen.

2. **Statement-1** : F atom has a less negative electron affinity than Cl atom.

Statement-2 : Additional electrons are repelled more effectively by 3p electrons in Cl atom than by 2p electrons in F-atom.

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 $Al(OH)_3$.

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.

5. **Statement-1** : Boric acid behaves as a weak monobasic acid.

Statement-2 : Boric acid contains hydrogen bonds in its structure.

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

6. **Statement-1** : Hydrazine functions as a monodentate ligand.

Statement-2 : There are lone pairs of electrons on N atoms in hydrazine.

7. **Statement-1** : Ozone in the upper atmosphere (stratosphere) is beneficial but it is harmful in the lower atmosphere.

Statement-2 : Ozone absorbs UV light and is a strong oxidising agent.

8. **Statement-1** : On cooling, the brown colour of nitrogen dioxide disappears.

Statement-2 : On cooling, N_2 undergoes dimerisation resulting in the pairing of odd electrons in NO_2.

9. **Statement-1** : Tl^{3+} acts as an oxidising agent.

Statement-2 : Due to inert pair effect, Tl^{+} is more stable than Tl^{3+}.

10. **Statement-1** : Alums are isomorophous crystalline double salts which are soluble in water.

Statement-2 : Due to hydrolysis, the aqueous solutions of alums have acidic character.

11. **Statement-1** : Pb^{2+} is more stable than Pb^{4+}.

Statement-2 : Inert pair effect is more prominent in Pb.

12. **Statement-1** : CO_2 is gas and SiO_2 is solid at room temperature.

Statement-2 : CO_2 contains C = O bonds but SiO_2 does not contain Si = O bonds.

13. **Statement-1** : White phosphorus is more reactive than red phosphorus.

Statement-2 : Red phosphorus consists of P_4 tetrahedral units linked to one another to form linear chains.

14. **Statement-1** : SO_2 acts as a Lewis base.

Statement-2 : S atom in SO_2 contains one lone pair of electrons.

15. **Statement-1** : SO_3 has a planar structure.

Statement-2 : S atom in SO_3 is sp^2-hybridized and O–S–O bond angle is 120º.

16. **Statement-1** : Salts of ClO_3^- and ClO_4^- are well known but those of FO_3^- and FO_4^- are non-existent.

Statement-2 : F is more electronegative than O while Cl is less electronegative than O.

17. **Statement-1** : HClO is stronger acid than HBrO.

Statement-2 : Greater is the electronegativity of the halogen, greater will be attraction of electron pair towards it and hence more easily the H^+ ion will be released.

18. **Statement-1** : Solubility of noble gases in water decreases with increasing size of the gas.

Statement-2 : Solubility in water is due to dipole induced dipole interaction.

19. **Statement-1** : Xenon fluorides are well known and stable but the corresponding chlorides have not been reported.

Statement-2 : Xe–F bond is more strong than Xe–Cl bond and F_2 molecule has low bond dissociation energy than that of Cl_2 molecule.

20. **Statement-1** : An aqueous solution of orthoboric acid behaves as a weak monobasic acid.

Statement-2 : As its aqueous solution orthoboric acid acts as a proton donor.

21. **Statement-1** : When a metal is treated with conc. HNO_3 it generally yields a nitrate, NO_2 and H_2O.

Statement-2 : Conc. HNO_3 reacts with metal and first produces a metal nitrate and nascent hydrogen. The nascent hydrogen then further reduces HNO_3 to NO_2.

22. **Statement-1** : A solution of aluminium chloride is acidic.

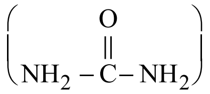
Statement-2 : H^+ and Cl^- ions are present in a solution of aluminium chloride.

23. **Statement-1** : We can prepare anhydrous aluminium chloride by heating hydrated aluminium chloride ($AlCl_3.6H_2O$)

Statement-2 : When heated hydrated aluminium chloride cause hydrolysis.

24. **Statement-1** : When urea is added to a reaction mixture, where HNO_3 is acting as an oxidising agent, the oxidising action of HNO_3 reduces.

Statement-2 : The NO_2 formed in the reaction is consumed by urea



$\left(NH_2-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2\right)$

MARK YOUR RESPONSE					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	

25. **Statement-1** : Si – Si bonds are much weaker as compared to Si – O bonds.

Statement-2 : Silicon forms double bonds with itself.

26. **Statement-1** : H_3PO_3 is a dibasic acid. It also shows reducing character.

Statement-2 : H_3PO_3 contains two OH^- groups and in it one H-atoms is directly linked to P-atom.

27. **Statement-1** : Hydrolysis of XeF_6 is an example of a redox reaction.

Statement-2 : XeF_6 when hydrolysed yields $XeOF_4$ and XeO_2F_2.

28. **Statement-1** : Both ClF_3 and SF_4 show same hybridization but ClF_3 is T-shaped.

Statement-2 : In ClF_3, there are five pairs of electrons and out of these five pairs, two pairs are lone pairs and three are bond pairs.

MARK YOUR RESPONSE	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	

D MULTIPLE CORRECT CHOICE TYPE

Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONE OR MORE is/are correct.

1. Which of the following is/are false ?
(a) $AlCl_3$ exists as Al_2Cl_6 in vapour state
(b) All the Al–Cl bonds in Al_2Cl_6 are equivalent
(c) Borax when heated with ammonium chloride forms ammonium tetraborate
(d) AlF_3 is a high m.pt. solid while $AlCl_3$ is a low m.pt. volatile solid.

2. Of the following statements regarding N_2O_3 which are correct?
(a) It is an anhydride of nitrous acid
(b) In liquid form, it has intense blue colour
(c) The stable form has a strong N – N bond
(d) It readily dissociates to give NO and NO_2

3. Which of the following is/ are green house gas(es) ?
(a) N_2 (b) CCl_4
(c) CO_2 (d) CF_2Cl_2

4. In which of the following oxides, 'P-atom' has two different oxidation states?
(a) P_4O_6 (b) P_4O_7
(c) P_4O_{10} (d) P_4O_8

5. Which of the following statements is/are correct ?
(a) Lead is a metal which can show +2 valency
(b) Lead reacts with conc. HCl to form $PbCl_2$
(c) Lead forms a powerful oxidising agent $PbCl_4$
(d) Lead reacts with NaOH to form $Pb(OH)_4$

6. There is no S–S bond in
(a) $S_2O_4^{2-}$ (b) $S_2O_5^{-}$
(c) $S_2O_3^{2-}$ (d) $S_2O_7^{2-}$

7. Which of the following is/are produced when lead dioxide is added to a boiling solution of manganous sulphate containing nitric acid?
(a) $Pb(NO_3)_2$ (b) $HMnO_4$
(c) $PbSO_4$ (d) none of these

8. Which of the following statements regarding silicon are correct ?
(a) silicones have good thermal stability
(b) liquid silicones are lubricants
(c) silicones are chemically inert substances
(d) silicon rubbers are made up of straight chain polymers of 100–500 silicon units

9. Of the following compounds, which one is not observed.
(a) $SiCl_4$ (b) $GeCl_4$
(c) SnI_4 (d) PbI_4

10. Which of the following statements are correct ?
(a) I^- is a weaker base than F^-
(b) $HONH_2$ is a weaker base than NH_3
(c) OH^- is a stronger base than NH_2^-
(d) F_3C^- is a stronger base than Cl_3C^-

11. Which of the following cannot be used as dehydrating agents for ammonia?
(a) Conc. H_2SO_4 (b) anhydrous $CaCl_2$
(c) P_4O_{10} (d) None of these

12. An aqueous solution of $FeSO_4$, $Al_2(SO_4)_3$ and chrome alum is heated with excess of Na_2O_2 and filtered. The materials obtained are
(a) a green residue (b) a yellow filtrate
(c) a brown residue (d) a colourless filtrate

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ			

13. HF is not preserved in glass bottles because
(a) it reacts with the aluminium oxide of the glass
(b) it reacts with SiO_2 of the glass
(c) it reacts with the visible part of the light
(d) it reacts with sodium oxide of the glass

14. A colourless solution contains a metal nitrate. A little solution of sodium chloride is added to it when a cloudy white precipitate appears. Identify the precipitate.
(a) $PbCl_2$
(b) AgCl
(c) Hg_2Cl_2
(d) None of the these

15. In the previous question, further if the precipitate turns black with NH_4OH, it is
(a) $PbCl_2$
(b) AgCl
(c) Hg_2Cl_2
(d) None of these

16. Which of the following, is/are correct statement(s) about boric acid, H_3BO_3?
(a) It has layer structure in which BO_3 units are linked by H-bonds
(b) It is a strong tribasic acid
(c) It is prepared by acidifying borax solution
(d) None of these

17. Phosphine is obtained, when
(a) red P is heated with NaOH
(b) white P is heated with NaOH
(c) Ca_3P_2 reacts with water
(d) phosphorus trioxide is boiled with water

18. Sulphur trioxide, when dissolved in 98% sulphuric acid gives
(a) SO_2
(b) Oleum
(c) H_2S
(d) none of these

19. Anhydrous ferric chloride is prepared by
(a) heating hydrated ferric chloride at a high temperature in a stream of air
(b) heating metallic iron in a stream of dry chlorine gas
(c) reaction of metallic iron with hydrochloric acid
(d) none of these

20. Which of the following is true?
(a) All halogens exist as diatomic gaseous molecules at ordinary temperatures
(b) Bromine dissolves in chloroform imparting blue colour
(c) Chlorine monoxide is evolved when $KClO_3$ is treated with conc. H_2SO_4
(d) Chloride ion is confirmed by chromyl chloride test

21. Which of the following statements is (are) true ?
(a) Claude's apparatus can be used for the isolation of helium and argon
(b) Helium cannot be adsorbed by coconut charcoal
(c) CaC_2 can remove both Nitrogen & Oxygen
(d) None of these

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

23. Nitrogen(I) oxide is produced by :
(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.

24. The compounds used as refrigerant are
(a) NH_3
(b) CCl_4
(c) CF_4
(d) CF_2Cl_2
(e) CH_2F_2

25. 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
(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.

26. The material used in the solar cells contains.
(a) Cs
(b) Si
(c) Sn
(d) Ti

27. Sodium nitrate decomposes above 800° C to give
(a) N_2
(b) O_2
(c) NO_2
(d) Na_2O

28. White phosphorus (P_4) has
(a) six P-P single bonds
(b) four P-P single bonds
(c) four lone pairs of electrons
(d) PPP angle of 60°

29. Ammonia, on reaction with hypochlorite anion, can form
(a) NO
(b) NH_4Cl
(c) N_2H_4
(d) HNO_2

MARK YOUR RESPONSE	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ			

30. Which of the following substances are soluble in concentrated HNO_3 ?

(a) $BaSO_4$ (b) CuS
(c) PbS (d) HgS

31. Which of the following form dimeric halides ?

(a) Al (b) Mg
(c) In (d) Ga

32. Which of the following substances are not soluble in hot caustic soda, containing an excess of concentrated solution of bromine in water ?

(a) $Cr(OH)_3$ (b) $Mn(OH)_2$
(c) $Al(OH)_3$ (d) $Fe(OH)_3$

33. Which statements about anhydrous aluminium chloride is correct :

(a) it exists as Al_2Cl_6 molecules in solid state
(b) it is easily hydrolysed
(c) it sublimes at 180°C
(d) it reacts with air

34. Which of the following staements are correct ?

(a) lead salts are slow poisons
(b) lead metal is used in accumulators
(c) Plumbo-solvency increases by the presence of carbonates, sulphates, phosphates, etc.
(d) lead is a soft metal

35. The difference in properties of CH_4 and SiH_4 is due to :

(a) large difference in the electronegativity of carbon and silicon.
(b) large difference in size of carbon and silicon atoms
(c) the inability of carbon to expand its octet
(d) the inability of silicon to form double bonds

36. Which of the following is/are added to remove acid pollution from water that has been polluted due to decomposition of organic refuse which produces carboxylic acids on oxidation. Such a polluted acidic water is harmful to aquatic life and so such a pollution need to be removed

(a) KNO_3 (b) $CaCl_2$
(c) $Ca(OH)_2$ (d) $CaCO_3$

37. The correct reason (s) for the acidic nature of an aqueous solution of aluminium chloride is that

(a) For aluminium ions the, $\dfrac{\text{charge}}{\text{surface area}}$, ratio is large
(b) The O – H bonds in $[Al(H_2O)_6]^{3+}$ are weaker as compared to the O – H bonds in water.
(c) Aluminium chloride is covalent compound and its aqueous solution is acidic.
(d) Chloride ions (Cl^-) react with water to form hydrochloric acid.

38. Xe can be obtained from XeF_6 by treating it with _____.

(a) HCl (b) H_2
(c) OH^- (conc) (d) NH_3

39. HNO_2 is used as _____.

(a) an oxidising agent (b) a complexing agent
(c) a reducing agent (d) a bleaching agent

40. Which of the following is/are correct for the characteristics indicated against each ?

(a) $HClO < HClO_2 < HClO_3 < HClO_4$ (oxidising power)
(b) $ClO_4^- < BrO_4^- < IO_4^-$ (oxidising power)
(c) $ClO^- < BrO^- < IO^-$ (disproportionation)
(d) $HClO < HClO_2 < HClO_3 < HClO_4$ (Acidic strength)

41. The peroxolinkage is found in which of the following

(a) $H_2S_2O_3$ (b) $H_2S_2O_8$
(c) H_2SO_5 (d) $H_2S_2O_7$

42. Consider the reaction, given below which indicates the conversion of SO_2 (present in polluted atmosphere) to SO_3 by the action of nitrogen dioxide (present in polluted atmospheres)

$$NO_2 + SO_2 \longrightarrow NO \quad SO_3$$

$$2NO + O_2 \longrightarrow 2NO_2$$

In this case the role of NO_2 is that of

(a) an acid (b) a reducing agent
(c) an oxidising agent (d) a homogeneous catalyst

43. Why is it **not** suitable to add conc. H_2SO_4 to KI (s) for preparation of HI because

(a) I^- (iodide ions) are oxidized to I_2
(b) The product formed gets contaminated by compounds of sulphur.
(c) Both the acids (i.e., H_2SO_4 and HI) are strong acids
(d) All the above

44. Which of the following are sub-oxides ?

(a) C_3O_2 (b) N_2O
(c) PbO_2 (d) CO_2

45. Which reagent does not give oxygen as one of the products during its oxidation with ozone ?

(a) KNO_2 (b) $SnCl_2$/HCl
(c) SO_2(g) (d) H_2O_2

46. Which of the following are interstitial carbides ?

(a) ZrC (b) MgC_2
(c) Al_3C_4 (d) VC

MARK YOUR RESPONSE	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ
	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ
	40. ⓐⓑⓒⓓ	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ
	45. ⓐⓑⓒⓓ	46. ⓐⓑⓒⓓ			

E

MATRIX-MATCH TYPE

Each question contains statements given in two columns, which have to be matched. The statements in Column-I are labeled 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.

	p	q	r	s	t
A	●	○	○	●	●
B	○	●	●	○	○
C	●	●	○	○	○
D	○	○	○	●	○

1. Match the following mixtures with the respective solution used for their separation :

	Column I		**Column II**
(A)	N_2 & CO	p.	Water
(B)	N_2 & O_2	q.	H_2SO_4
(C)	N_2 & NH_3	r.	Ammonical Cuprous chloride
(D)	PH_3 & NH_3	s.	Pyrogallol

2.

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

3.

	Column I		**Column II**
(A)	$B(OH)_3$	p.	Acidic
(B)	$Al(OH)_3$	q.	Amphoteric
(C)	$Ga(OH)_3$	r.	Insoluble in water
(D)	$Tl(OH)_3$	s.	Basic

4.

	Column I		**Column II**
(A)	Magnalium	p.	Al
(B)	Duralumin	q.	Mg
(C)	Nickeloy	r.	Ni
(D)	Y-Alloy	s.	Used in making pistons

5.

	Column I		**Column II**
(A)	BF_3	p.	Colourless
(B)	BCl_3	q.	Solid
(C)	BI_3	r.	Liquid
		s.	Gas

6.

	Column I		**Column II**
(A)	$Na_2B_4O_7 + NH_4Cl \longrightarrow$	p.	B_2O_3
(B)	$NaH + B_2O_3 \longrightarrow$	q.	$NaBO_2$
(C)	$B + NaOH \longrightarrow$	r.	Na_3BO_3
(D)	$Na_2B_4O_7 \xrightarrow{\Delta}$	s.	$NaBH_4$

7.

	Column I		**Column II**
(A)	H_2S	p.	decolourises acidified sol. of $KMnO_4$
(B)	SO_2	q.	Disproportionation reaction
(C)	NO_2	r.	Bleaching action
(D)	HNO_2	s.	V-shaped structure

MARK YOUR RESPONSE

1.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

2.

	p	q	r	s	t	u	v	w
A	○	○	○	○	○	○	○	○
B	○	○	○	○	○	○	○	○
C	○	○	○	○	○	○	○	○
D	○	○	○	○	○	○	○	○

3.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

4.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

5.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○

6.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

7.

	p	q	r	s
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

8.

	Column I		**Column II**
(A)	F_2	p.	decomposition of water
(B)	Cl_2	q.	formation of polyhalides
(C)	Br_2	r.	extraction of gold & platinum
(D)	I_2	s.	Germicide

9.

	Column I **Product**		**Column II** **Reactant**
(A)	H_3PO_3	p.	H_3PO_4
(B)	H_3PO_4	q.	$H_4P_2O_7$
(C)	$H_4P_2O_7$	r.	P_4O_{10}
(D)	HPO_3	s.	H_3PO_3
		t.	PCl_3

10.

	Column I		**Column II**
(A)	Orthosilicate	p.	Oxygen atoms shared <2
(B)	Pyrosilicate	q.	Oxygen atoms shared ≥ 2
(C)	Single chain silicate	r.	Net charge = –2
(D)	Ring silicate	s.	Net charge = –6

11.

	Column I		**Column II**
(A)	$LiNO_3$	p.	N_2
(B)	$NaNO_3$	q.	H_2O
(C)	NH_4NO_3	r.	NO_2
(D)	NH_4NO_2	s.	O_2
		t.	N_2O

12.

	Column - I		**Column - II**
A.	$H_4P_2O_7$	p.	Reducing agent
B.	H_3PO_4	q.	Contains a minimum of one P – H bond
C.	H_3PO_3	r.	Contains P – O – P linkage
D.	H_3PO_2	s.	Gives metaphosphoric acid on being heated to a temperature above 600°C

13.

	Column - I		**Column - II**
(A)	$Li + HN_3 \longrightarrow$	p.	One of the products formed is paramagnetic
(B)	$Mg + dil.HNO_3 \xrightarrow{cold}$	q.	One of the products formed is diamagnetic
(C)	$NH_4Cl(aq) + NaNO_2(aq) \longrightarrow$	r.	It is a redox reaction
(D)	$HNO_2(aq) \longrightarrow$	s.	One of the products formed gives brown ring test

14.

	Column - I		**Column - II**
(A)	MgO	p.	Amphoteric
(B)	Al_2O_3	q.	Basic
(C)	SiO_2	r.	Covalent
(D)	P_4O_{10}	s.	Ionic

15.

	Column - I		**Column - II**
(A)	Silicates	p.	Chemically inert
(B)	Silicons	q.	Exists in planar form
(C)	Trimethyl amine	r.	Nitrogen is sp^3 hybridised
(D)	Trisilyl amine	s.	Contains Si – O – Si bonds

16.

	Column - I		**Column - II**
(A)	$H_3PO_3 \xrightarrow{Heat}$	p.	Hydrogen
(B)	$PCl_5 + H_2O \xrightarrow{Heat}$	q.	Disproportionation
(C)	$P_2O_5 + H_2O \xrightarrow{Heat}$	r.	One of the products formed has tetrahedral hybridization
(D)	$P_4 + \underset{(Conc.)}{NaOH} + H_2O \xrightarrow[CO_2]{Heat}$	s.	One of the products formed has pπ-dπ bonding

MARK YOUR RESPONSE

8.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

9.

	p	q	r	s	t
A	ⓟ	ⓠ	ⓡ	ⓢ	ⓣ
B	ⓟ	ⓠ	ⓡ	ⓢ	ⓣ
C	ⓟ	ⓠ	ⓡ	ⓢ	ⓣ
D	ⓟ	ⓠ	ⓡ	ⓢ	ⓣ

10.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

11.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

12.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

13.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

14.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

15.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

16.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

17.

	Column - I		**Column - II**
A.	NO	p.	Paramagnetic in nature
B.	N_2O_3	q.	Anhydride of nitric acid
C.	NO_2	r.	can act as an oxidising agent
D.	N_2O_5	s.	formed when copper reacts with HNO_3

18.

	Column - I		**Column - II**
A.	ClF_3	p.	sp^3d^2
B.	XeF_2	q.	sp^3d
C.	$XeOF_2$	r.	linear
D.	$XeOF_4$	s.	square pyramidal

MARK YOUR RESPONSE

17.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

18.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

Answerkey

A SINGLE CORRECT CHOICE TYPE

1	c	**2**	a	**3**	a	**4**	c	**5**	a	**6**	a	**7**	b	**8**	a	**9**	d	**10**	c
11	b	**12**	c	**13**	d	**14**	c	**15**	b	**16**	b	**17**	d	**18**	a	**19**	d	**20**	a
21	a	**22**	a	**23**	c	**24**	b	**25**	d	**26**	c	**27**	a	**28**	c	**29**	c	**30**	d
31	c	**32**	a	**33**	d	**34**	d	**35**	c	**36**	a	**37**	b	**38**	a	**39**	c	**40**	c
41	c	**42**	d	**43**	a	**44**	b	**45**	c	**46**	c	**47**	c	**48**	b	**49**	c	**50**	b
51	c	**52**	c	**53**	b	**54**	b	**55**	b	**56**	b	**57**	b	**58**	d	**59**	b	**60**	a
61	c	**62**	c	**63**	a	**64**	b	**65**	a	**66**	b	**67**	b	**68**	b	**69**	d	**70**	b
71	c	**72**	d	**73**	d	**74**	a	**75**	b	**76**	b	**77**	b	**78**	b	**79**	c	**80**	b
81	d	**82**	d	**83**	c	**84**	b	**85**	b	**86**	d	**87**	b	**88**	b	**89**	a	**90**	c
91	c	**92**	c	**93**	a	**94**	d	**95**	d	**96**	c	**97**	a	**98**	a	**99**	a	**100**	a
101	d	**102**	b	**103**	c	**104**	d	**105**	d	**106**	c	**107**	c	**108**	c	**109**	b	**110**	b
111	c	**112**	c	**113**	c	**114**	a	**115**	b	**116**	d	**117**	d	**118**	a	**119**	c	**120**	a
121	d	**122**	a	**123**	b	**124**	d	**125**	b	**126**	c	**127**	d	**128**	c				

B COMPREHENSION TYPE

1	(d)	**6**	(a)	**11**	(b)	**16**	(d)	**21**	(d)	**26**	(a)
2	(c)	**7**	(d)	**12**	(c,d)	**17**	(c)	**22**	(c)		
3	(b)	**8**	(a)	**13**	(a)	**18**	(b)	**23**	(b)		
4	(b)	**9**	(a)	**14**	(a)	**19**	(a)	**24**	(d)		
5	(c)	**10**	(d)	**15**	(b)	**20**	(a)	**25**	(b)		

C REASONING TYPE

1	(b)	**6**	(a)	**11**	(a)	**16**	(a)	**21**	(a)	**26**	(a)
2	(c)	**7**	(a)	**12**	(a)	**17**	(a)	**22**	(b)	**27**	(d)
3	(a)	**8**	(a)	**13**	(b)	**18**	(d)	**23**	(d)	**28**	(a)
4	(c)	**9**	(a)	**14**	(a)	**19**	(a)	**24**	(a)		
5	(b)	**10**	(b)	**15**	(a)	**20**	(c)	**25**	(c)		

D MULTIPLE CORRECT CHOICE TYPE

1	b, c	**2**	a,b, d	**3**	c, d	**4**	b, d	**5**	a, b, c	**6**	d	**7**	a, b, c	**8**	a, b, c	**9**	d	**10**	a, b, d
11	a, b, c	**12**	b, c	**13**	b	**14**	a, b, c	**15**	c	**16**	a, c, d	**17**	b, c, d	**18**	b	**19**	b	**20**	d
21	a, b, c	**22**	a, b	**23**	a, d	**24**	a, d	**25**	b, c	**26**	b	**27**	a, b, d	**28**	a, c, d	**29**	c	**30**	a, b, c
31	a, c, d	**32**	b, d	**33**	c, d	**34**	a, b, d	**35**	a, c	**36.**	c, d	**37.**	a, b	**38.**	a, b, d	**39.**	a, b, c	**40.**	b,d
41.	b, c	**42.**	c, d	**43.**	a, c	**44.**	a, b	**45.**	a, c	**46.**	a, d								

E MATRIX-MATCH TYPE

1. **A-r; B-s; C-q; D-p**
2. **A-t ; B-w ; C-r ; D-u**
3. **A-p; B-q, r; C-q, r; D-r, s**
4. **A-p, q, s; B-p, q; C-p, r; D-p, q, r, s**
5. **A-p, s; B-p, r; C-q**
6. **A-p; B-q, s; C-r; D-p, q**
7. **A-p, s; B-p, q, r, s; C-p, s; D-p, s**
8. **A-p; B-p, q, r, s; C-p, q, s; D-q**
9. **A-t; B-r; C-p; D-p, q, r, s**
10. **A-p; B-p, s; C-q, r; D-q, r**
11. **A-r, s; B-s; C-q, t; D-p, q**
12. **A-r, s; B-s; C-p, q; D-p, q**
13. **A-q, r; B-p, r, s; C-q, r D-q, r, s**
14. **A-q, s; B-q, r; C-r; D-q**
15. **A-p, q; B-p, q, s; C-r; D-q**
16. **A-q, r, s; B-p, r, s; C-p, q, r, s; D-p, q, r, s**
17. **A-p, r, s; B-s; C-p, r, s; D-q, r**
18. **A-q; B-q, r; C-q; D-p, s**

Solutions

3. **(a)** CO_2 is isostructural with $HgCl_2$ because both have linear structure.

4. **(c)** In an organometallic compound, a metal is directly attached to carbon.

6. **(a)** Nitric acid. This is because lead nitrate formed is soluble in water. If H_2SO_4 is used, an insoluble layer of $PbSO_4$ is deposited on the surface of powder and prevents the further reaction. Likewise, $PbCl_2$ prevents the reaction with HCl.

7. **(c)** It is the due to reduction of SO_2 to S which produces bleaching effect.

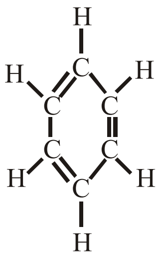
8. **(a)** NF_3 is not hydrolysed because it does not have empty d-orbital.

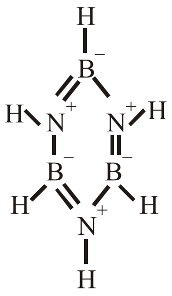
10. **(c)** $Sn + 4HNO_3 \longrightarrow \underset{\text{metastannic acid}}{H_2SnO_3} + 4NO_2 + H_2O$

11. **(b)** In all the cases octet is not fulfilled for B-atom. So in monomer form all of them are Lewis acids.

In BF_3 the Lewis acidity is internally compensated by 'B–F' π bond (back bonding) formation which is not possible for BCl_3 or BBr_3 due to the size dissimilarity between 'B–Cl' or 'B–Br'. So BCl_3 and BBr_3 have the tendency to form dimer. But due to steric factor, four 'Cl–atoms' or 'Br-atoms' cannot be arranged around 'B-atom' and they remain as monomer. But BH_3 forms B_2H_6 to satisfy Lewis acidity by the formation of 2-elctrons -3-centred bond (banana bonding).

12. **(c)** The structure of borazine is almost similar to benzene. Borazine is called inorganic benzene.


Benzene


Borazine

17. **(d)** All have nearly similar acidic strength.

18. **(a)** As we know, that the smaller the bond length, stonger the bond, and so, it has higher bond dissociation energy. However, in case of $:\ddot{F}-\ddot{F}:$, F being of extremely small size, there is a lone pair-lone pair repulsion between F–F in F_2. So F–F bond becomes weaker, and its bond-dissociation becomes lesser than that of Cl–Cl bond. So Cl–Cl bond has highest bond dissociation energy

19. **(d)** On going down, the metal hydride bond becomes longer i.e., weaker. So release of H becomes easier. So reducing character increases.

20. **(a)** Higher the bond-order, lower the bond-length and vice-versa.

Molecule/ion	O_2^-	O_2	O_2^+	O_2^{++}
Bond order	1.5	2	2.5	3.0

O_2^- has minimum bond - order. So, it has the highest bond length.

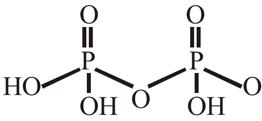
21. **(a)** CCl_4 having no vacant *d*-orbital does not undergo hydrolysis

In a particular period, on going left to right the order of extent of hydrolysis increases.

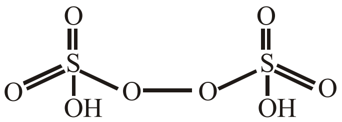
22. **(a)** Boric acid is a Lewis acid with basicity equal to one

$$\underset{\text{(Boric acid)}}{B(OH)_3} + H_2O \rightleftharpoons [B(OH)_4]^- + H^+$$

23. **(c)**


$[H_4P_2O_7]$ tetrabasic

24. **(b)**


Peroxodisulphuric acid $[H_2S_2O_8]$

25. **(d)** The oxide with the highest positive oxidation state on the element other than O should be most acidic. Oxidation state of V in V_2O_5 and N in N_2O_5 are +5. But the electronegativity of N is higher, making N_2O_5 the most acidic oxide.

26. **(c)** Volume available for the charge is increasing from left to right. So charge density is decreasing from left to right. That is why, basicity of the ions decreases from left to right.

$F^- > Cl^- > Br^- > I^-$

27. **(a)** Assume that each has lost a proton . So we get : HO^-, HS^-, HSe^-, HTe^-

It can be easily seen that the volume available for the negative charge is increasing from HO^- to HTe^-, therefore

(i) volume available for the negative charge is increasing from left to right

(ii) charge density is decreasing from left to right

(iii) basicity is decreasing from left to right

(iv) acidity of conjugate acids is increasing from left to right

$$H_2O < H_2S < H_2Se < H_2Te$$

28. **(c)** $2Pb(NO_3)_2 \xrightarrow{\text{heat}} 2PbO + 4NO_2\uparrow + O_2\uparrow$

29. **(c)** $Pb(NO_3)_2 + 2CH_3COOH \longrightarrow$

$$Pb(CH_3COO)_2 + 2HNO_3$$

$$2Pb(CH_3COO)_2 + K_2Cr_2O_7 + H_2O \longrightarrow \underset{\text{yellow}}{2PbCrO_4}\downarrow + 2CH_3COOK + 2CH_3COOH$$

30. **(d)** $$Al_2(SO_4)_3 + 3NH_4HS + 6H_2O \longrightarrow 3NH_4HSO_4 + 2Al(OH)_3 + 3H_2S$$

31. **(c)** $NaNO_2 \xrightarrow{\text{dilute acid, heat}} NO_2$ (reddish-brown gas)

32. **(a)** (X) is borax, $Na_2B_4O_7.10H_2O$

(i) $$Na_2B_4O_7 + 7H_2O \rightleftharpoons \underset{\substack{\text{(Strong)}\\ \text{Base}}}{2NaOH} + \underset{\substack{\text{(Weak)}\\ \text{acid}}}{4H_3BO_3}$$

Due to presence of NaOH, the aqueous solution is alkaline to litmus.

(ii) $$Na_2B_4O_7.10H_2O \xrightarrow[\text{(swells)}]{\text{Heat}} Na_2B_4O_7 + 10H_2O \longrightarrow 2NaBO_2 + \underset{\text{Glassy bead}}{B_2O_3}$$

(iii) $$Na_2B_4O_7 + H_2SO_4 + 5H_2O \longrightarrow Na_2SO_4 + \underset{\text{white crystals}}{4H_3BO_3}$$

33. **(d)** $$2NaNO_3 + (NH_4)_2SO_4 \longrightarrow \underset{\text{white residue}}{Na_2SO_4} + 2N_2O\uparrow + 4H_2O$$

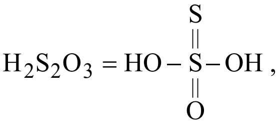
34. **(d)** The oxidation state of P is least (+1) in $H_2PO_2^{--}$ and thus it is the strongest reducing agent.

35. **(c)**

	N_2	N_2^+	N_2^-
Bond energy in KJ mole^{-1}	942	841	765

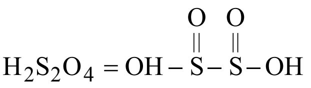
In case of N_2 to N_2^+ we expect the bond length to increase when an e^- is removed from the bonding π molecular orbitals. Actually it decreases slightly. This may be rationalised when we notice that removal of an e^- from a diatomic specis tends to decrease inter e^- repulsion and thereby shortens bond lengths.

37. **(b)**

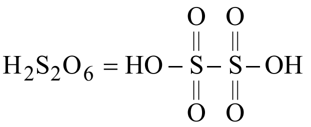


$$H_2S_2O_3 = HO-\overset{\overset{S}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$$

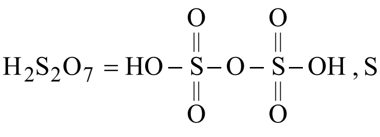
, Oxidation state of sulphur are +6 and –2



$$H_2S_2O_4 = OH-\overset{\overset{O}{\|}}{S}-\overset{\overset{O}{\|}}{S}-OH, S = +3$$



$$H_2S_2O_6 = HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH, S = +6$$



$$H_2S_2O_7 = HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH, S = +6$$

38. **(a)** The compound IF is most unstable. It disproportionates rapidly into IF_5 and I_2

40. **(c)** Option (a) is false as Coke is not found in nature. It is an artificial product. Option (d) is also false as CO_2 cannot be formed by dehydration of formic acid.

$$HCOOH \xrightarrow[H_2SO_4]{\text{Conc.}} CO + H_2O$$

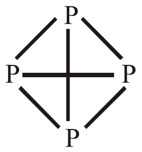
Option (b) is also false as Producer gas is a mixture of CO and N_2.

41. **(c)** PbO_2 oxidises Mn^{++} to Mn^{+7}. The reaction is as follows

$$2MnCl_2 + 5PbO_2 + 6HNO_3 \longrightarrow 2HMnO_4 + 2PbCl_2 + 3Pb(NO_3)_2 + 2H_2O$$

42. **(d)** Sulphur shows +6, 0, and +4 oxidation states in H_2SO_4, S_8 and SF_4 respectively.

43. **(a)** The structure of white phosphorus (P_4) is



Hence bonding electron pairs are 6.

44. **(b)** In molecular crystals, the lattice positions are occupied by molecules which do not carry any charge.

45. **(c)** Concentrated nitric acid forms HIO_3 with I_2

$$I_2 + 10HNO_3 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$$

46. **(c)** Na_2SO_3 is treated with conc. H_2SO_4 to form SO_2

$$Na_2SO_3 + H_2SO_4(\text{conc.}) \longrightarrow Na_2SO_4 + SO_2 + H_2O$$

47. **(c)** Because fluorine is more electronegative than chlorine.

48. **(b)** $$HOSO_2OH \xrightarrow{PCl_5} \underset{\text{Sulphuryl chloride}}{ClSO_2Cl}$$

49. **(c)** The order will depend upon the electronegativity of halogen

50. **(b)** SiO_2 is acidic, SnO_2 is more or less basic while ZnO is amphoteric.

51. **(c)** Lead exists as PbI_2 because of the oxidising power of Pb^{+4} and reducing power of I^-

52. **(c)** The gas (X) is NH_3.
Its aqueous solution is NH_4OH which turns red litmus to blue.
Step (ii),

$$CuSO_4 + 2NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4$$

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \longrightarrow \underset{\substack{\text{Tetrammine copper (II)}\\ \text{sulphate (blue colour)}}}{[Cu(NH_3)_4]SO_4} + 4H_2O$$

$$FeCl_3 + 3NH_4OH \longrightarrow \underset{\text{Brownish ppt.}}{Fe(OH)_3} + 3NH_4Cl$$

$$Fe(OH)_3 + 3HNO_3 \longrightarrow \underset{\text{Soluble}}{Fe(NO_3)_3} + 3H_2O$$

53. **(b)** $(NH_4)_2Cr_2O_7 \xrightarrow{heat} Cr_2O_3 + 4H_2O + N_2$

56. **(b)** $2Ag + O_3 \longrightarrow Ag_2O + O_2$

$Ag_2O + O_3 \longrightarrow \underset{\text{(black)}}{2Ag} + 2O_2$

57. **(b)** Nitric oxide is obtained at a very high temperature by the atmospheric oxygen and nitrogen

$N_2 + O_2 \longrightarrow 2NO$

58. **(d)** Dissolved oxides of nitrogen are removed

59. **(b)** Ammonium Nitrate (NH_4NO_3) forms laughing gas (N_2O);

$NH_4NO_3 \xrightarrow{heat} NO_2 \uparrow + 2H_2O$

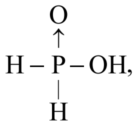
60. **(a)** Abrasive is tough material used for sharpening and grinding the uneven surfaces and silicon carbide is used for grinding glass

61. **(c)** Cl_2 is the best oxidising agent. It is reduced to HCl

$Cl_2 + H_2O \longrightarrow 2HCl + H_2O$

62. **(c)** It behaves like halogen giving white ppt. with silver nitrate.

63. **(a)** NaH_2PO_2 is the salt of hypophosphorous acid,



$H-\overset{\overset{\displaystyle O}{\uparrow}}{\underset{\underset{\displaystyle H}{|}}{P}}-OH$, a monobasic acid. The two H–atoms in NaH_2PO_2 are not replacable.

64. **(b)** Pb^{+4} ion, having maximum +ve charge, will have minimum flocculation value.

65. **(a)** SrO_2 and BaO_2 are the peroxides of highly electropositive elements. They are made up of $Sr^{+2}O_2^{2-}$ and $Ba^{+2}O_2^{2-}$ ions. PbO_2 is not peroxide.

66. **(b)** In BF_3, boron atom has vacant $2p_z$ A.O. and fluorine atom has electron pair in $2p$ A.O. so, maximum overlapping is possible between vacant $2p_z$ A.O. of boron and fully filled $2p$ A.O. of fluorine due to similar size of A.O's.

67. **(b)** Chlorine water will liberate bromine from KBr

$Cl_2 + H_2O \longrightarrow 2HCl + O$

$2Br^- + 2H^+ + O \longrightarrow Br_2 + H_2O$

70. **(b)** Glass containing boron has very small coefficient of expansion

71. **(c)** Nitrogen has stable half filled electronic configuration, hence it has highest first ionisation potential.

72. **(d)** In other reactions, oxygen is evolved but in reaction with SO_2, all oxygen is used up in the process of oxidation and no oxygen gas is evolved.

$3SO_2 + O_3 \longrightarrow 3SO_3$

73. **(d)** H_2SO_4 being less volatile than HCl displaces HCl from chloride salt, e.g,

$NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$

74. **(a)** H_2F_2 is bad conductor of electricity due to its greater stability. Further H–F is strongest, hence it does not ionise easily in aqueous solution.

75. **(b)** Xenon forms compounds only with oxygen & fluorine due to their small sizes and high electronegativity.

76. **(b)** Liquor ammonia has high vapour pressure so gas rushes out vigorously and the bottle may get burst.

77. **(b)** Red phosphorous is used in safety maches, white P due to its low ignition temperature is not used for this purpose.

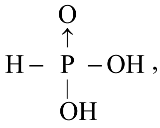
78. **(b)** $2KBr + Cl_2 \longrightarrow 2KCl + Br_2$

This is because chlorine is more reactive than bromine and displaces bromine from its salt solution.

79. **(c)** $Ca_3P_2 + 6H_2O \longrightarrow 3Ca(OH)_2 + \underset{\text{Phosphine}}{PH_3}$

80. **(b)** Oxygen - Ordinary oxygen and ozone
Sulphur - Rhombic, monoclinic, plastic, amorphous
Selenium - Red form, grey form
Polonium - α & β. Thus sulphur shows maximum number of allotropic forms.

81. **(d)** $Fe + 2HNO_3 \longrightarrow Fe(NO_3)_2 + H_2O$

82. **(d)** 

$H-\overset{\overset{\displaystyle O}{\uparrow}}{\underset{\underset{\displaystyle OH}{|}}{P}}-OH$, so dibasic acid

83. **(c)** CO_2 can not act as a reducing agent because in this molecule carbon has highest (+4) oxidation state.

84. **(b)** $BeSO_4$ has highest hydration energy hence maximum solubility in water.

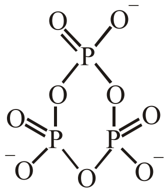
85. **(b)** Reducing capacity of halide ion increases in a group on going downwards.
$F^- < Cl^- < Br^- < I^-$

86. **(d)** $Al_2O_3.2H_2O + 3C + N_2 \xrightarrow{1800°C} 2A\ell N + 3CO + 2H_2O$

87. **(b)** Li does not form alum because Li^+ is too small to have a coordination number of six.

88. **(b)** The HNO_3 decomposes slowly in sunlight forming NO_2, which dissolves in HNO_3 to make it yellow colour, $4HNO_3 \longrightarrow 2H_2O + 4NO_2 + O_2$

89. **(a)** O does not show valency more than two due to lack of vacant orbitals in valenc shell

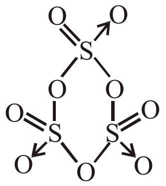
91. **(c)** 

No. of P–O–P bonds = 3. It is the most stable among all the cyclic metaphosphates

92. **(c)** NH_3 does not react with CaO, while it reacts with the other three.

93. **(a)** For oxyacids containing similar central atom, the acid strength increases with the increase in the number of oxygen atoms attached to the central atom and not attached to any other atom.

94. **(d)** S_3O_9 (also called α- sulphur trioxide) is an ice like solid with the following molecular structure.

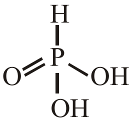


There is no S–S bond is S_3O_9

96. **(c)** $$2Ca^{++} + Na_2[Na_4(PO_3)_6] \longrightarrow 4Na^+ + \underset{\text{water soluble complex}}{Na_2[Ca_2(PO_3)_6]}$$

97. **(a)** Non metallic oxides are acidic and metallic oxides are basic. Thus the order is $CaO < CuO < H_2O < CO_2$

98. **(a)** The structure of H_3PO_3 is as given below. There are only two –OH groups and hence it is dibasic. The oxidation number of P in this acid is +3, whereas P may have +5 oxidation state also. Therefore, H_3PO_3 can be oxidised which means H_3PO_3 is a reducing agent.



99. **(a)** The boron atom in boric acid, H_3BO_3 is electron deficient i.e., boric acid is a Lewis acid with one *p*-orbital vacant. There is no *d*-orbital of suitable energy in boron atom. So, it can accommodate only one additional electron pair in its outermost shell.

101. **(d)** $$Na_2SO_3 + O_2 \longrightarrow Na_2SO_4$$

$$Na_2SO_3 + \underset{\text{(dil.)}}{H_2SO_4} + K_2Cr_2O_7 \longrightarrow \underset{\text{(Green)}}{Cr_2(SO_4)_3}$$

102. **(b)** As the solid B forms a hydrated double salt with $Al_2(SO_4)_3$, it should be a sulphate of a univalent metal, M_2SO_4.
One molecule of sulphate contains one sulphur atom, i.e., the mass of the sulphate which contains 32.1 g sulphur should be its molecular mass.
0.321 g sulphur is present in (1.422 + 0.321 = 1.743 g) of B.
32.1 g of sulphur is present in

$$= \frac{1.743}{0.321} \times 32.1 = 174.3 \text{ g}$$

Let the atomic mass of the univalent metal be x.
∴ M_2SO_4 = 2x + 32.1 + 64 = 174.3 or 2x = 78.2 and x = 39.1, which corresponds to Potassium.

103. **(c)** Since the salt '*R*' gives a white precipitate with aqueous NaOH and the white precipitate formed is soluble in excess of aqueous NaOH so the salt '*R*' contains an **amphoteric cation** i.e, it is either $Al_2(SO_4)_3$ and $ZnSO_4$. Since '*R*' gives a white ppt. with aqueous ammonia and the white precipitate is not soluble in excess of aqueous ammonia so it is not zinc salt.
Thus '*R*' is $Al_2(SO_4)_3$.

104. **(d)** Hydrated aluminium chloride is $AlCl_3.6H_2O$. It is ionic in nature and its aqueous solution contains

$[AlCl_2(H_2O)_4]^+$ and $[AlCl_4(H_2O)_2]^-$ ions

$$AlCl_3.6H_2O \xrightarrow{\text{ionisation}} [AlCl_2(H_2O)_4]^+ + [AlCl_4(H_2O)_2]^-$$

105. **(d)** The colour of solid oxygen is due to electronic transition from the triplet ground state (i.e., $\pi^* 2p_x^1\ \pi^* 2p_y^1$) to the excited singlet state (i.e., $\pi^* 2p_x^2\ \pi^* 2p_y^2$).

106. **(c)** When aqueous SO_2 is shaken with iodine solution the colour of iodine solution is discharged because I_2 is reduced to I^-.

$$\underset{\text{(Violet)}}{I_2} + SO_2 + 2H_2O \longrightarrow \underset{\text{(Colourless)}}{2HI} + H_2SO_4$$

107. **(c)** $BaSO_4$ remains insoluble where as $CaCO_3$ dissolves in HCl evolving CO_2 (colourless) gas.

$$CaCO_3 + 2HCl(aq) \longrightarrow CaCl_2 + H_2O + CO_2 \uparrow$$

108. **(c)** $$\underset{\text{(Yellow powder)}}{S} + 3F_2 \xrightarrow{\text{heat}} \underset{'X'}{SF_6}$$

$$3SCl_2 + 4NaF \xrightarrow{\text{heat}} \underset{'Y'}{SF_4} + S_2Cl_2 + 4NaCl$$

[Note : SF_6 and SF_4 consist of sulphur and fluorine]

109. **(b)** $$2XeF_6 + \underset{\text{(glass)}}{SiO_2} \longrightarrow \underset{\text{(explosive nature)}}{2XeOF_4} + SiF_4$$

$$2XeOF_4 + SiO_2 \longrightarrow 2XeO_2F_2 + SiF_4$$

$$2XeO_2F_2 + SiO_2 \longrightarrow \underset{\text{(explosive)}}{2XeO_3} + SiF_4$$

110. **(b)** Generally PH_3 (phosphine) is associated with traces of P_2H_4 (phosphorus dihydride). Phosphorus dihydride (P_2H_4) catches fire spontaneously forming rings of smoke known as "**vortex rings**".
[Note : P_2H_4 is highly inflamable]

$$2P_2H_4 + 7O_2 \longrightarrow \underset{\text{(Metaphosphoric acid)}}{4HPO_3} + 2H_2O$$

111. **(c)** Both the methods (a) and (b) can be used.
When passed through freezing mixture the P_2H_4 present condenses and pure PH_3 is obtained.

When passed through HI, PH_3 is absorbed forming PH_4I.PH_4I when treated with KOH (aq) yields pure phosphine.

$$PH_3 + HI \longrightarrow PH_4I$$

$$PH_4I + KOH(aq) \longrightarrow KI + H_2O + PH_3 \uparrow$$

112. (c) $CaO + (NH_4)_2SO_4 \longrightarrow CaSO_4 + 2NH_3 + H_2O$

Because of above reaction both CaO and $(NH_4)_2SO_4$ get depleted and now CaO fails to reduce acidity of soil and $(NH_4)_2SO_4$ fails to act as fortilizer.

113. (c) Red phosphorus does **not** glow in air.

114. (a) The ship carries a mixture of CaC_2 and Ca_3P_2. When a hole is made and the ship is immersed in sea water, phosphine and acetylene gets formed. Phosphine catches fire in air and lights up acetylene. This acts as a signal for the approaching ship.

$$CaC_2 + H_2O \longrightarrow Ca(OH)_2 + \underset{\text{(acetylene)}}{C_2H_2}$$

$$Ca_3P_2 + 6H_2O \longrightarrow 2Ca(OH)_2 + \underset{\text{(Phosphine)}}{2PH_3}$$

115. (b) Phosphine burns in air to give clouds of P_2O_5 which act as smoke screen.

116. (d) It has blue colour in solid state.

117. (d) HNO_4 is explosive in nature

118. (a) Amatol is 80% NH_4NO_3 + 20% TNT

119. (c) Electrical conductivity of Selenium (Se) is negligible in dark but increases on exposure to light. Due to this property Se is used in photoelectric cells.

120. (a) $S + 4CoF_3 \longrightarrow SF_4 + 4CoF_2$

121. (d) The statements (a), (b) and (c) are true.

122. (a) Corrundum is α-Al_2O_3

123. (b) The cubic form of BN with ZnS structure is as hard as diamond.

124. (d) All the above statements are correct.

125. (b) It causes laughing hysteria.

126. (c) NH_4Cl is used to clear metal surfaces because HCl (obtained from NH_4Cl) forms a volatile chloride.

127. (d) It is the correct answer.

128. (c) In liquid state BrF_3 dissociates into BrF_2^+ and BrF_4^- ions most easily.

B COMPREHENSION TYPE

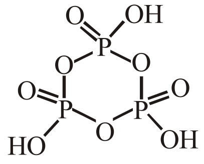
1. (d) Oxidation state of P is +1 in A, +3 in B, +4 in C & +5 in D, E & F.

2. (c) The basicity is determined by the number of OH groups attached to the P atom.

3. (b) In the above three acids although the number of –OH groups (ionisable hydrogen increases, yet the acidity does not increase very much. This is due to the fact that *the number of unprotonated oxygen, responsible for the enhancement of acidity due to inductive effect, remains the same* with the result dissociation constant also remains nearly same.

4. (b) It is clear from the 3rd & 4th sentence of the passage that the *ous acids* show reducing properties.

5. (c) Number of P–O–P bonds in cyclic tri-metaphosporic acid is three.



6. (a) $\underset{\text{(D) ortho–}}{H_3PO_4} \longrightarrow \underset{\text{meta–}}{HPO_3} + H_2O;$

$$\underset{\text{(F) pyro–}}{H_4P_2O_7} \longrightarrow \underset{\text{meta–}}{2HPO_3} + H_2O$$

7. (d) As the two adjacent layers can easily slide over each other (mentioned in the second paragraph), it makes graphite soft (it marks paper), greasy and hence has a lubricant character and a low density.

8. (a) $C_{(Diamond)} + O_2(g) \longrightarrow CO_2(g);\ \Delta H_1 = -395.1\ kJ/mol$

$$C_{(graphite)} + O_2(g) \longrightarrow CO_2(g);\ \Delta H_2 = -393.3\ kJ/mol$$

Required equation : $C_{graphite} = C_{diamond}$

$\therefore\ \Delta H = \Delta H_2 - \Delta H_1 = -393.3 - (-395.1) = 1.8\ kJ\ mol^{-1}$

9. (a) $C_{(graphite)} \rightleftharpoons C_{(diamond)}$

Density of diamond = 3.51, Density of graphite = 2.26

As per Le Chatelier principle,

(i) increase of temperature will shift the reaction towards left in case of exothermic reactions and to right in case of endothermic reactions

(ii) increase of pressure (decrease in volume) will shift the reaction to the side having fewer moles of the gas; while decrease of pressure (increase is volume) will shift the reaction to the side having more moles of the gas.

(iii) if no gases are involved in the reaction, higher pressure favours the reaction to shift towards higher density solid or liquid.

So from point (iii), the equilibrium will shift towards right (more dense) only at high pressures as there is no gas involved. Both graphite and diamond are solids.

10. **(d)** In diamond each carbon atom is in sp^3 hybridised state and is linked to 4 other neighbouring carbon atoms held at the corners of a regular tetrahedron by covalent bonds.

11. **(b)** Graphite has sp^2 hybridization and C–C bond involves sp^2–sp^2 hybridized carbon. Diamonds has sp^3 hybridization and C–C bond involves sp^3–sp^3 hybridization. Furthermore, more is s character (in sp^2) in hybridized atoms, smaller is size of hybridized orbital, more is overlapping, shorter is bond length.

12. **(c,d)** All valence electrons of each carbon are used in bond formation with four neighbouring atoms and there is no mobile electron in the system and hence the diamond crystal is bad conductor of current. Graphite has sp^2 hybridized carbons with layer structure alongwith π electrons (p–p bond) free to move throughout the entire layers hence graphite is good conductor of current.

13. **(a)** The figure in option(a) represents the phase diagram of CO_2. The various curves in the diagram show the equilibrium between two phases and the areas represent different phases. The point, called triple point, describing the equilibrium between the three phases and has specific values of temperature and pressure (217 K, 515 kPa). The area to the left of the point O represents the solid phase, to the top of the point O represents the liquid phase and to the right represents the gaseous phase.

14. **(a)** The passage states that sulfuric acid reacts with Cu(*s*) to produce Cu^+ and SO_2. Thus, sulfuric acid is converted into sulfur dioxide, or $H_2SO_4 \rightarrow SO_2$.

O.S. of S in $H_2SO_4 = +6$ $[2 \times (+1) + S + 4 \times (-2) = 0]$

O.S. of S in $SO_2 = +4$ $[S + 2 \times (-2) = 0]$

15. **(b)** The boiling point of HNO_3 is given in the question as 86ºC. Because HNO_3 must boil out of the flask and be trapped in the tube, the temperature of the flask must be above the boiling point of HNO_3 (i.e., $< 86^\circ C$) and the temperature of the tube must be less than the boiling point of HNO_3 (i.e, $< 86^\circ C$). Answer (b) meets these criteria; the other answers do not.

16. **(d)** The combustion of elemental sulfur involves a reaction between oxygen (O_2) and sulfur (S). [Note: Though sulfur exists as S_8 molecules, its reactions are normally written in terms of its empirical formula S.]

17. **(c)** The reaction involves the formation of gaseous SO_3 from gaseous O_2 and gaseous SO_2.

$$O_2(g) + 2\,SO_2(g) \rightarrow 2\,SO_3(g)$$

According to Le Châtelier's principle, any action that causes the reaction to shift toward the right will cause O_2 and SO_2 to react and increase the yield of SO_3. Of the four possible actions, the removal of SO_3 as it forms will shift the reaction toward the right and is the most likely action to increase the yield of SO_3.

18. **(b)** The passage states that concentrated H_2SO_4 is 98% H_2SO_4 and 2% water by mass and that the density of concentrated H_2SO_4 is 1.84 g/mL.

$$\frac{(1.84\text{ g conc. }H_2SO_4)}{(1\text{ mL solution})} \times \frac{(2\text{ g }H_2O)}{(100\text{ g conc. }H_2SO_4)}$$

$$\times \frac{(1\text{ mol }H_2O)}{(18\text{ g }H_2O)} = \frac{(1.84)(0.02)}{18}$$

19. **(a)** The problem hypothesizes the liberation of hydrogen in accordance with the unbalanced equation :

$$Fe(s) + H_2SO_4 \rightarrow H_2(g)$$

In the conversion, hydrogen goes from an oxidation state of +1 in sulfuric acid to 0 (zero) in H_2. Thus, the hydrogen in H_2SO_4 is reduced (i.e., it undergoes an algebraic decrease in oxidation state). Fe(*s*) is the reducing agent (i.e., it causes the reduction).

20. **(a)** The first ionization of sulfuric acid, H_2SO_4, is normally 100% in water. However, under conditions of low water content, all of the H_2SO_4 cannot ionize. Qualitatively, the only source of SO_4^{2-} is HSO_4^-. The K_a for the second ionization step of a parent acid is a few orders of magnitude smaller than that of the first step; therefore, SO_4^{2-} must be the least abundant species, because it is only formed in the second ionization step.

Quantitatively, the mass relationship in 100 g of 98% H_2SO_4 is 98 g H_2SO_4 and 2 g H_2O. The molar mass of H_2SO_4 is 98 g/mol and of water is 18 g/mol. Thus, in 100 g of 98% H_2SO_4 there is one mole of H_2SO_4 and 2/18 or 1/9 mole of H_2O. In excess water, H_2SO_4 would ionize completely. However, in this case (i.e., very low water content), only about 1/9 of a mole can react stoichiometrically with water to form H_3O^+ and HSO_4^-. Of this 1/9 mol, only a small fraction of the HSO_4^- further ionizes to H_3O^+ and SO_4^{2-}, because HSO_4^{2-} is a weak acid. Therefore, SO_4^{2-} is the chemical with the lowest concentration. Thus, answer choice (a) is the best answer.

21. **(d)** Acidic character of oxides decreases as we move down the group (group 15). P is above all others.

22. **(c)** NH_3 is most basic of the given hydrides.

23. **(b)** It contains Argon (or inert gas) as impurity.

24. **(d)** In this process molten cryolite acts as solvent.

25. **(b)** The greatest affinity for oxygen is shown by Al.

26. **(a)** It is about 2100°C.

C REASONING TYPE

1. **(b)** Nitrogen cannot form pentahalides because it cannot expand its octet due to non-availability of d-orbitals. So E is not correct explanation of S.

2. **(c)** F has slightly less electron affinity than chlorine because F has very small atomic size (only two shells). Hence there is a tendency of electron-electron repulsion, which results in less evolution of energy in the formation of F^- ion. Assertion correct but reason incorrect.

3. **(a)** Both assertion and reason are correct and reason explains assertion.

4. **(c)** $SiCl_4$ undergoes hydrolysis due to the presence of empty *d*-orbitals in the valence shell of Si, while C has no vacant *d* orbitals to accommodate electron pairs donated by water molecules during hydrolysis.

5. **(b)** **Correct explanation :** Boric acid does not act as a proton-donor but behaves as a Lewis acid i.e., it accepts a pair of electrons from OH^- ion of H_2O and releases a proton in solution.

10. **(b)** **Correct explanation :** Alums exist only in the solid state and lose their identity when dissolved in water.

13. **(b)** **Correct explanation :** White phosphorus exists as P_4 tetrahedral molecule having P-P-P bond angle 60º. Hence the molecule is under strain and more reactive. On the other hand red phosphorus exists as P_4 tetrahedra which are joined together through covalent bonds giving polymeric structure.

18. **(d)** **Correct R :** Solubility of noble gases in water increasees with increasing size of the gas.

20. **(c)** Assertion is true. Reason is false (orthoboric acid acts a **lewis acid**). It is not a proton donor.

21. **(a)** Both assertion and reason are true and reason is the correct explanation of assertion.

$$\underset{\text{(metal)}}{M} + \underset{\text{(conc.)}}{HNO_3} \longrightarrow \underset{\text{(metal nitrate)}}{MNO_3} + \underset{\text{(nascent hydrogen)}}{H}$$

$$2HNO_3 + \underset{\text{(nascent hydrogen)}}{2H} \longrightarrow 2NO_2 + 2H_2O$$

22. **(b)** Both assertion and reason are true but reason is not a correct explanation of assertion.

The acidic nature of a solution of aluminium chloride isdue to the following reaction.

$$[Al(H_2O)_5]^{3+} + H_2O \longrightarrow [Al(H_2O)_5(OH)]^{2+} + H^+$$

23. **(d)** Anhydrous aluminium chloride can not be prepared by heating dehydrated aluminium chloride ($AlCl_3 \,.\, 6H_2O$). Assertion is incorrect, Reason is correct.

$$2AlCl_3.6H_2O \longrightarrow 2Al(OH)_3 + 6HCl$$

$$2Al(OH)_3 \longrightarrow Al_2O_3 + 3H_2O$$

24. **(a)** Both assertion and reason are correct and reason is the correct explanation of assertion.

25. **(c)** Assertion is correct, reason is incorrect. Si – Si double bonds are not formed.

26. **(a)** Both assertion and reason are correct and reason is the correct explanation of assertion.

27. **(d)** Assertion is incorrect. Hydrolysis of XeF_6 is not an example of redox reaction, reason is correct.

28. **(a)** Both assertion and reason are correct and reason is the correct explanation of assertion.

D MULTIPLE CORRECT CHOICE TYPE

1. **(b, c)** In Al_2Cl_6, four chlorine atoms (terminal) are equivalent and two chlorine atoms form bridges through coordination between two aluminium atoms. These are different from terminal chlorine atoms. Borax when heated with NH_4Cl forms boron nitride and boric anhydride. Anhydrous $AlCl_3$ hydrolyses in moist air and gives fumes of HCl.

$$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl\uparrow$$

3. **(c, d)** Certain molecules absorb strongly in the infrared region and its presence in the atmosphere decreases the loss of heat from the earth by radiation. This global warming is called green house effect. Gases causing such effect are CO_2 and freons (CF_2Cl_2)

4. (b, d) In P_4O_6 the oxidation state of P atom is (+3). In P_4O_7 & P_4O_8, P atoms have (+3) & (+5) oxidation states. In P_4O_{10}, oxidation state of P atom is only (+5)

6. **(d)** As can be seen from the structure of $S_2O_7^{2-}$, there is no S–S bond. All bonds are S–O–S bonds.

7. **(a, b, c)** $2MnSO_4 + 5PbO_2 + 6HNO_3$
$\rightarrow 2HMnO_4 + 3Pb(NO_3)_2 + 2PbSO_4 + 2H_2O$

9. **(d)** Pb(IV) is a strong oxidising agent and I^- is a strong reducing agent. Hence they cannot co-exist together.

11. **(a, b, c)** Conc. H_2SO_4, anhydrous $CaCl_2$ and P_4O_{10} directly reacts with ammonia.

$$H_2SO_4 + 2NH_3 \longrightarrow (NH_4)_2SO_4\,;$$

$$CaCl_2 + 8NH_3 \longrightarrow CaCl_2.8NH_3\,;$$

$$P_4O_{10} + 12NH_3 + 6H_2O \longrightarrow 4(NH_4)_3PO_4$$

12. **(b, c)** When treated with Na_2O_2, $FeSO_4$ yields brown residue $Fe(OH)_3$, $Al_2(SO_4)_3$ yields soluble $NaAlO_2$, while chrome alum gives yellow filtrate of Na_2CrO_4.

13. **(b)**

$$SiO_2 + 2H_2F_2 \longrightarrow SiF_4 + 2H_2O\,;$$

$$SiF_4 + H_2F_2 \longrightarrow H_2SiF_6$$

14. **(a, b,c)** The chloride ions have combined with the metal ions to give the precipitate of a chloride as sodium nitrate is soluble.

$$\text{Metal nitrate} + NaCl \longrightarrow \underset{\text{(Insoluble)}}{\text{Metal chloride}} + \underset{\text{(Soluble)}}{NaNO_3}$$

The metal chloride may be $PbCl_2$ or AgCl or Hg_2Cl_2.

15. **(c)** If the precipitate dissolves in NH_4OH, it is AgCl and if the precipitate turns black with NH_4OH, it is Hg_2Cl_2.

16. **(a, c, d)** Boric acid behaves like a weak monobasic acid. It does not lose a proton, but behaves like a Lewis acid. It accepts e^- pair from hydroxide ion of water molecule whose proton is set free in solution.

$$B(OH)_3 + H^+OH^- \longrightarrow [B(OH)_4]^- + H^+$$

17. **(b, c, d)** Red P does not react with alkali

18. **(b)** $SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7\,(\text{oleum})$

19. **(b)** $2Fe + 3Cl_2 \longrightarrow FeCl_3$

20. **(d)** The first statement is false because F_2 and Cl_2 are gases, Br_2 is liquid while I_2 is a solid. Bromine dissolves in chloroform imparting reddish-brown colour. Chlorine dioxide is evolved when $KClO_3$ is treated with conc. H_2SO_4.

21. **(a, b, c)** All the three are true. A & B need no explanation. For C,

$$CaC_2 + N_2 \longrightarrow \underset{\text{Calcium cyanamide}}{CaCN_2} + C$$

$$2C + O_2 \longrightarrow 2CO\,;\ 2CO + O_2 \longrightarrow 2CO_2\,;$$

$$C + O_2 \longrightarrow CO_2$$

22. **(a, b)** Because of high melting point (2050ºC), pure alumina cannot be electrolysed. Hence a mixture of alumina, cryolite (m.p. 1000ºC) and calcium fluoride (to lower the temperature of the melt) is electrolysed at about 900ºC. The function of cryolite is to increase the electrical conductivity of the electrolyte, and to lower the temperature of the melt.

23. **(a, d)** $NH_4NO_3 \xrightarrow{\text{heat}} N_2O + 2H_2O$

$NH_2OH.HCl + NaNO_2 \longrightarrow N_2O + NaCl + 2H_2O$

24. **(a, d)** NH_3 and CF_2Cl_2 (freon-12) are used as refrigerants.

25. **(b, c)** to make the fused mixture very conducting and to reduce the temperature of the melt.

26. **(b)** Silicon is used in solar cells.

27. **(a, b, d)** Sodium nitrate on decomposition upto 500ºC gives $NaNO_2$ and oxygen.

$$2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2\uparrow$$

While at higher temperature (i.e. above to 800ºC), $NaNO_2$ further decomposes into Na_2O, N_2 and O_2.

$$2NaNO_2 \xrightarrow{800°C} Na_2O + 3/2O_2\uparrow + N_2\uparrow$$

28. **(a, c, d)** The four atoms in a P_4 molecule are situated at the corners of a tetrahedron. There are six P - P single bonds with PPP bond angle equal to 60º. Each phosphorus has a lone pair of electrons.

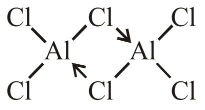
29. **(c)** $2NH_3 + OCl^- \rightarrow NH_2.NH_2 + H_2O + Cl^-$

30. **(a, b, c)** PbS, CuS and $BaSO_4$ will dissolve in conc. HNO_3. HgS will not dissolve in HNO_3; it is solube in aqua regia (aqua regia is a mixture of HCl and HNO_3 in the ratio of 3 : 1)

$\therefore$ (a), (b), (c) are correct.

31. **(a, c, d)** Halides of Al, In and Ga form dimeric halides, e.g. Dimeric halide of Al is

$AlCl_3 + AlCl_3 \longrightarrow$



(Al_2Cl_6)

32. **(b,d)** $Cr(OH)_3$ and $Al(OH)_3$ are soluble in hot caustic soda containing an excess of concentrated solution of water, while $Mn(OH)_3$ and $Fe(OH)_3$ are insoluble in the same solution.

$\therefore$ (b, d) are correct

33. **(c, d)** Anhydrous $AlCl_3$ hydrolyses in moist air and gives fumes of HCl.

$$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl\uparrow$$

Anhydrous aluminium chloride is a white, deliquescent solid which fumes in air. On heating it sublimes at 180°C and the vapour density corresponds to the formula Al_2Cl_6.

34. **(a, b, d)** It is a bluish grey metal with bright metallic lustre when freshly cut and leaves a black mark on paper.

It is soft in nature and can be cut with knife

It is a heavy metal (sp. gr. 11.35g/cm^3) and melts at 327°C. Compound of lead are poisonous.

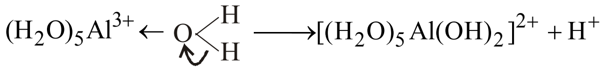
The dissolution of lead in water is known as Plumbo-Solvency. Plumbo-Solvency increases if the water contains nitrates, organic acids and ammonium salts and decreases in the presence of soluble sulphates, phosphates, carbonates etc., due to formation of a protective thin layer of insoluble lead salts.

35. **(a, c)** The difference in stability between alkanes and silanes has been explained on the basis of difference in the elecronegativity values (C = 2.5, H = 2.1, Si = 1.8)

36. **(c,d)** Since the pollution is due to presence of carboxylic acids we are required to remove the acidity of water. It can be achieved by adding either $Ca(OH)_2$ or $CaCO_3$ which produce basic solution and so help in removing the acidity.

The aqueous solutions of KNO_3 and $CaCl_2$ are neutral and will not help to reduce acidity of polluted water.

37. **(a,b)** There is a high charge (+3) on aluminium ion (Al^{3+}) and the ratio, $\frac{\text{charge}}{\text{surface area}}$, is high (i.e., charge density is high) so it polarises the H_2O (ligand) and H^+ ions are removed. Due to this (i.e., polarisation of Al^{3-} ion) there occurs a drift of electron density towards Al^{3+} ion and thus the O – H bond weakens i.e., the O – H bond in $[Al(H_2O)_6]^{3+}$ is weaker than in water.



$$(H_2O)_5Al^{3+} \leftarrow O\begin{matrix}H\\H\end{matrix} \longrightarrow [(H_2O)_5Al(OH)_2]^{2+} + H^+$$

38. **(a,b,d)**

$$XeF_6 + 6HCl \longrightarrow Xe + 6HF + 3Cl_2$$

$$XeF_6 + 3H_2 \longrightarrow Xe + 6HF$$

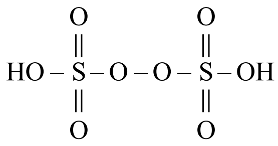
$$XeF_6 + 8NH_3 \longrightarrow Xe + 6NH_4F + N_2$$

39. **(a,b,c)** HNO_2 finds use as an oxidising agent, as a complexing agent as also a reducing agent.

40. **(b,d)** In case of oxy-acids of halogens, acidic strength increases with increase in number of oxygen atom. Thus the correct acidic strength is $HClO < HClO_2 < HClO_3 < HClO_4$.

For the given ions the correct order of oxidising power is $ClO_4^- < BrO_4^- < IO_4^-$

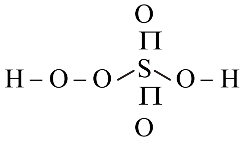
41. **(b,c)** $H_2S_2O_8$ is



$$HO-\overset{\overset{\large O}{\|}}{\underset{\underset{\large O}{\|}}{S}}-O-O-\overset{\overset{\large O}{\|}}{\underset{\underset{\large O}{\|}}{S}}-OH$$

(– O – O – is peroxo linkage)

H_2SO_5 is



$$H-O-O-\overset{\overset{\large O}{\|}}{\underset{\underset{\large O}{\|}}{S}}-O-H$$

42. **(c,d)** NO_2 acts as an oxidising agent and it oxidises SO_2 to SO_3.

The NO_2 consumed in oxidation of SO_2 is regenerated in the second reaction and so NO_2 remains unconsumed. Thus NO_2 acts as a catalyst since the catalyst (NO_2) is in same phase (gasseous) as other reactants, so it is homogeneous catalyst.

43. **(a,c)** I^- is a strong reducing agent and so it is oxidised by H_2SO_4 (conc.) to I_2.

The products obtained by reduction of H_2SO_4 are SO_2, S and H_2S (compounds of sulphur) and so they act as contaminants for the product.

44. **(a,b)** Both these are sub-oxides.

45. **(a,c)** In their reaction no oxygen is formed.

46. **(a,d)** These are interstitial carbides.

E MATRIX-MATCH TYPE

1. **A-r; B-s; C-q; D-p**

CO & N_2 can be separated by bubbling through ammonical cuprous chloride in which CO is absorbed but not N_2. N_2 & O_2 can be separated by bubbling through alkaline solution of pyrogallol in which oxygen is absorbed but not N_2. NH_3 & N_2 can be separated by bubbling through H_2SO_4 when NH_3 is absorbed but not N_2. Ammonia is recovered by heating the solution of $(NH_4)_2SO_4$ with excess of NaOH. PH_3 & NH_3 can be separated by bubbling through water in which NH_3 dissolves but not PH_3.

2. **A-t ; B-w ; C-r ; D-u**

Fe_2O_3 (Fe^{3+}) is paramagnetic as it has unpaired electrons.

$Pb(N_3)_2$ is used as an explosive. Cu is reduced from its sulphide Cu_2S by auto (self) reduction.

3. **A-p; B-q, r; C-q, r; D-r, s**

The acidic nature of oxides and hydroxides changes from acidic to basic through amphoteric (Al_2O_3, Ge_2O_3) from B to Tl.

Acidic nature	B_2O_3	>	Al_2O_3	>	Ga_2O_3	>	In_2O_3	>	Tl_2O_3
nature	$B(OH)_3$		$Al(OH)_3$		$Ga(OH)_3$		$In(OH)_3$		$Tl(OH)_3$
	(acidic)		(amphoteric)		(amphoteric)		(basic)		(strong basic)

Boric acid, $B(OH)_3$ is soluble in water as it accepts lone pair of electron to act as Lewis acid. Rest all hydroxides of group 13 are insoluble in water and form a gelatinous precipitate.

$$B(OH)_3 + H_2O \longrightarrow B(OH)_4^- + H^+$$

4. **A-p, q, s; B-p, q; C-p, r; D-p, q, r, s**

Name of the alloy	Approximate Composition	Uses
1. Magnalium	95% **Al** + 5% **Mg**	In the construction of airships, balances and **pistons** of motor engines.
2. Duralumin	95% **Al** + 4% Cu + 0.5% **Mg** + 0.5% Mn	Aeroplanes and automobile parts, as its strength of toughness is comparable to mild steels.
3. Nickeloy	95% **Al** + 4% Cu + 1% Ni	Aircrafts parts
4. Y-alloy	93% **Al** + 4% Cu + 2% Ni + 1% **Mg**	For making **pistons** and machinery parts.

5. **A-p, s; B-p, r; C-q**

BF_3 is a colourless gas, BCl_3 is a colourless fuming liquid (b.pt. 13°C) while BI_3 is a white fusible solid (m.pt. 310°C).

6. **A-p; B-q, s; C-r; D-p, q**

(A) $Na_2B_4O_7 + NH_4Cl \longrightarrow 2BN + B_2O_3 + 2NaCl + 4H_2O$

(B) $4NaH + 2B_2O_3 \longrightarrow NaBH_4 + 3NaBO_2$

(C) $2B + 6NaOH \longrightarrow 2Na_3BO_3 + 3H_2 \uparrow$

(D) $Na_2B_4O_7 \xrightarrow{\Delta} NaBO_2 + B_2O_3$

7. **A-p, s; B-p, q, r, s; C-p, s; D-p, s**

A → H_2S decolourises acidified solution of $KMnO_4$

$$2KMnO_4 + 3H_2SO_4 + 5H_2S \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5S$$

The shape of the H_2S molecule is similar to that of the water molecule i.e. V-shaped structure with bond length (H–S) 1.35Å and bond angle (H–S–H) 92.5° involving sp^3 hybridization of S atom.

B → SO_2 undergoes disproportionation (oxidation of two molecules of the same compound at the expense of the third which is reduced) reaction.

$$3SO_2 \xrightarrow{\text{Heat}} 2SO_3 + S$$

Decolourises $KMnO_4$

$$5SO_2 + 2KMnO_4 + 2H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$$

Sulphur dioxide acts as bleaching agent in the following way :

In the presence of water, it is oxidised with the liberation of nascent hydrogen which reduces the colouring matter to colourless.

$$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2[H]$$

$$\text{Colouring matter} + 2[H] \underset{\text{air}}{\rightleftharpoons} \text{Colourless compound}$$

Sulphur dioxide has a **planar triangular (V-shaped) structure** involving sp^2 hybridisation of the sulphur atom (sp^2 hybridisation occurs between $3s^2 3p_x^1$ and $3p_y^1$ electrons).

C → NO_2 undergoes decolourisation of $KMnO_4$

$$2KMnO_4 + 3H_2SO_4 + 10NO_2 + 2H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 10HNO_3$$

NO_2 molecule has angular structure (V-shape) with O–N–O bond angle of about 132° and N–O distance of about 1.19Å which is intermediate between a single and a double bond.

D → **HNO_2 decolourises $KMnO_4$:** $2KMnO_4 + 3H_2SO_4 + 5HNO_2 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5HNO_3$

X-ray and Raman spectral studies indicate an angular structure for nitrite ion (NO_2^-) with O–N–O angle of 132° and bond length (N–O) of 1.13 Å.

8. **A-p; B-p, q, r, s; C-p, q, s; D-q**

Fluorine reacts with water readily even at low temperature and in dark forming mixture of O_2 and O_3, Cl_2 decomposes water in presence of sunlight while bromine decomposes water very slowly in presence of sunlight. Iodine does not decompose water.

Fluorine does not form poly halides while other halogens form poly halide e.g. I_3^-, Br_3^- and Cl_3^- ions. This is due to absence of d-orbitals in valence shell of fluorine and thus it cannot expand its octet.

Cl_2 helps in the extraction of Gold and Platinum.

9. **A-t; B-r; C-p; D-p, q, s, r**

$$PCl_3 + 3H_2O \longrightarrow H_3PO_3 + 3HCl$$

$$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$$

$$2H_3PO_4 \longrightarrow H_4P_2O_7 + H_2O$$

$$\underset{\text{ortho-}}{H_3PO_4} \longrightarrow \underset{\text{meta-}}{HPO_3} + H_2O$$

$$\underset{\text{pyro-}}{H_4P_2O_7} \longrightarrow \underset{\text{meta-}}{2HPO_3} + H_2O$$

$$P_4O_{10} + 2H_2O \longrightarrow 4HPO_3$$

$$H_3PO_3 + Br_2 \longrightarrow HPO_3 + 2HBr$$

10. **A-p; B-p, s; C-q, r; D-q, r**

Types of silicate	Structural formula	Number of oxygen atom(s) shared	Net charge
Island (Orthosilicate)	$(SiO_4)^{4-}$	0	Si = +4 O = –8 Net = –4
Island (Pyrosilicate)	$(Si_2O_7)^{6-}$	1	Si = +8 O = –14 Net = –6
Single chain	$(SiO_3)^{2-}$	2	Si = +4 O = –6 Net = –2
Ring	$(SiO_3)^{2-}$	2	Si = +4 O = –6 Net = –2

11. **A-r, s; B-s; C-q, t; D-p, q**

$4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

$2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

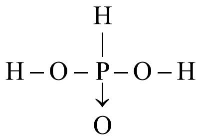
$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

12. **A-r, s; B-s; C-p, q; D-p, q**

(A) $H_4P_2O_7 \xrightarrow{\text{Heat}} 2HPO_3 + H_2O$. It also contains P – O – P bond.

(B) $H_3PO_4 \xrightarrow[600°C]{\text{Heat}} HPO_3 + H_2O$

(C) 

$$H-O-\overset{\displaystyle H\atop|}{\underset{\displaystyle \downarrow\atop O}{P}}-O-H$$

(D) H_3PO_2 acts as a reducing agent.

13. **A-q, r; B-p, r, s; C-q, r D-q, r, s**

Hints: $4Li + 6HN_3 \longrightarrow 4LiN_3 + 2NH_3 + 2N_2$

In it one of the products (i.e., N_2) is diamagnetic . It is a redox reaction.

$$\underset{(Dil)}{Mg + 2HNO_3} \xrightarrow{cold} Mg(NO_3)_2 + H_2$$

In it H_2 (one of the products) is diamagnetic. It is a redox reaction.

NO_3^- [present in $Mg(NO_3)_2$] gives ring test.

$NH_4Cl(aq) + NaNO_2(aq) \longrightarrow N_2(g) + NaCl(aq) + 2H_2O(\ell)$

N_2 (one of the products) is diamagnetic. It is a redox reaction.

$3HNO_2 \longrightarrow HNO_3 + 2NO + H_2O$

NO (one of the products is paramagnetic)

It is a redox reaction.

NO_3^- (in HNO_3) gives brown ring test.

14. **A-q, s; B-q, r; C-r; D-q**

(A) MgO is ionic in nature and has basic character.

(B) Al_2O_3 is covalent in nature and is an amphoteric oxide.

(C) SiO_2 is covalent compound

(D) P_4O_{10} is covalent compound

[Note : Both SiO_2 and P_4O_{10} are acidic in nature]

15. **A-p, q; B-p, q, s; C-r; D-q**

Silicates are chemically inert and they also exist in planar form **silicons** are chemically inert, exist in planar form and contain Si-O-Si bond.

In trimethylamine nitrogen is sp^3 hybridised.

Trisilylamine exists in planar form.

16. **A-q, r, s; B-p, r, s; C-p, q, r, s; D-p, q, r, s**

H_3PO_3 shows disproportionation and one of the products formed has tetrahedral hybridization where as the other product contains pπ-dπ-bonding. PCl_5 gets hydrolysed in moist air.

17. **A-p, r, s; B-s; C-p, r, s; D-q, r**

NO is paramagnetic due to presence of unpaired electrons. It can act as an oxidising agent. It is formed when copper reacts with dil . HNO_3.

$$3Cu + 8HNO_3(dil) \to 3Cu(NO_3)_2 + 2NO + 4H_2O$$

N_2O_3 is formed when copper reacts with conc. HNO_3

NO_2 is paramagnetic in nature as it contains seventeen electrons. It can act as an oxidising agent and is formed when copper reacts with conc. HNO_3.

$$Cu + 4HNO_3(conc.) \to Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

N_2O_5 is anhydride of HNO_3. It is formed when copper reacts with conc. HNO_3.

18. **A-q; B-q, r; C-q; D-p, s**

ClF_3 shows sp^3d hybridisation of Cl.

XeF_2 is linear molecule. In it Xe shows sp^3d hybridisation.

$XeOF_2$ shows sp^3d hybridisation.

$XeOF_4$ shows sp^3d^2 hybridisation and has square pyramidal shape.

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