

## LEVEL-V

## SINGLE ANSWER QUESTIONS

1. SO<sub>2</sub> gas is used as a bleaching agent. Its bleaching action is:  
 a) temporary and due to its oxidising nature  
 b) temporary and due to its reducing nature  
 c) permanent and due to its oxidising nature  
 d) permanent and due to its reducing nature
2. Which of the following compounds is formed, when Na<sub>2</sub>SO<sub>3</sub> is boiled with sulphur?  
 a) Na<sub>2</sub>SO<sub>4</sub>      b) Na<sub>2</sub>S<sub>2</sub>O<sub>5</sub>  
 c) Na<sub>2</sub>S<sub>2</sub>O<sub>6</sub>      d) Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>
3. The most acidic and most thermally stable set of chalcogen hydrides are respectively:  
 a) H<sub>2</sub>O, H<sub>2</sub>S      b) H<sub>2</sub>Te, H<sub>2</sub>O  
 c) H<sub>2</sub>O, H<sub>2</sub>Te      d) H<sub>2</sub>S, H<sub>2</sub>Te
4. Which of the following has more number of  $\pi$ -  $\pi$  bonds? (all central atoms are in excited states)  
 a) SO<sub>2</sub>      b) SO<sub>3</sub>      c) SO<sub>3</sub><sup>2-</sup>      d) CO<sub>3</sub><sup>2-</sup>
5. Which is not a reducing agent?  
 a) Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>      b) Na<sub>2</sub>SO<sub>3</sub>  
 c) Na<sub>2</sub>S      d) K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>
6. Which of the following compounds does not give oxygen on heating?  
 a) HgO      b) KMnO<sub>4</sub>  
 c) (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>      d) KClO<sub>3</sub>
7. The correct order of the O - O bond length in O<sub>2</sub>, H<sub>2</sub>O<sub>2</sub> and O<sub>3</sub> is:  
 a) O<sub>2</sub> > O<sub>3</sub> > H<sub>2</sub>O<sub>2</sub>      b) O<sub>2</sub> > H<sub>2</sub>O<sub>2</sub> > O<sub>3</sub>  
 c) O<sub>3</sub> > H<sub>2</sub>O<sub>2</sub> > O<sub>2</sub>      d) H<sub>2</sub>O<sub>2</sub> > O<sub>3</sub> > O<sub>2</sub>
8. Which of the following statements regarding thiosulphate ion is incorrect?  
 a) Shape of thiosulphate ion is tetrahedral  
 b) The two sulphur atoms in thiosulphate ion are equivalent  
 c) There is S - S bond in thiosulphate ion  
 d) with iodine thiosulphate ion is tetrathionate ion

9. When H<sub>2</sub>S gas is passed into aqueous sulphur dioxide  
 a) H<sub>2</sub>S is only converted into yellow precipitate of sulphur  
 b) SO<sub>2</sub> is only converted into yellow precipitate of sulphur  
 c) A clear solution of H<sub>2</sub>SO<sub>4</sub> is formed  
 d) SO<sub>2</sub> as well H<sub>2</sub>S are converted into yellow precipitate of sulphur
10. Which of the following is not correct description?  
 a) SO<sub>2</sub> - sp<sup>2</sup> hybridised sulphur - angular shape - one lone pair over sulphur - one (d $\pi$  - p $\pi$ ) and one (p $\pi$  - p $\pi$ ) bond  
 b) SO<sub>3</sub> - sp<sup>3</sup> hybridised sulphur - pyramidal shape - one (d $\pi$  - p $\pi$ ) bond  
 c) SO<sub>4</sub><sup>2-</sup> - sp<sup>3</sup> hybridised sulphur - tetrahedral shape - two (d $\pi$  - p $\pi$ ) bonds  
 d) SO<sub>3</sub> - sp<sup>2</sup> hybridised sulphur - planar triangle shape - two (p $\pi$  - p $\pi$ ) and one (d $\pi$  - p $\pi$ ) bonds
11. SCl<sub>4</sub> on hydrolysis gives:  
 a) H<sub>2</sub>SO<sub>3</sub>      b) H<sub>2</sub>SO<sub>4</sub>      c) H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>      d) H<sub>2</sub>S<sub>2</sub>O<sub>8</sub>
12. Which of the following is correct?  
 a) SCl<sub>4</sub> has one lone pair of electrons on equatorial plane  
 b) SCl<sub>4</sub> has two lone pairs of electrons on equatorial plane  
 c) SCl<sub>4</sub> has two lone pairs of electrons on axial plane  
 d) SCl<sub>4</sub> has one lone pair of electrons on axial plane
13. In which of the following conversions all the three oxygen atoms of O<sub>3</sub> molecules are utilised for oxidation:  
 I. Ferrous oxide to ferric oxide  
 II. Acidified stannous chloride to stannic chloride  
 III. Moist iodine to iodic acid  
 IV. Sulphur dioxide to sulphur trioxide  
 a) I and II only      b) II and IV only  
 c) I, III and IV only      d) II, III and IV only

14. Which of the following statements are incorrect  
 a) SO<sub>3</sub> is stronger oxidising agent and more acidic than SO<sub>2</sub>  
 b) Selenium forms only two oxoacids i.e., selenous acid (H<sub>2</sub>SeO<sub>3</sub>) and selenic acid (H<sub>2</sub>SeO<sub>4</sub>)  
 c) The acidic strength and oxidation power of oxoacids is greater in +6 oxidation state than in +4.  
 d) SO<sub>2</sub> < SeO<sub>2</sub> < TeO<sub>2</sub>
15. Orange solid  $\xrightarrow{\Delta}$  diamagnetic + green (gas) (residue)  
 Orange solid (X<sub>1</sub>)  $\xrightarrow{\Delta}$  para magnetic + green + yellow (gas) (residue) (solid)  
 X<sub>1</sub> and X<sub>2</sub> are respectively:  
 a) Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>  
 b) (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>  
 c) K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>  
 d) (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, KNO<sub>3</sub>
16. Which of the following reaction depict the oxidising behaviour of H<sub>2</sub>SO<sub>4</sub>:  
 a) 2HI + H<sub>2</sub>SO<sub>4</sub>  $\rightarrow$  I<sub>2</sub> + SO<sub>2</sub> + 2H<sub>2</sub>O  
 b) NaCl + H<sub>2</sub>SO<sub>4</sub>  $\rightarrow$  NaHSO<sub>4</sub> + HCl  
 c) 2NaOH + H<sub>2</sub>SO<sub>4</sub>  $\rightarrow$  Na<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O  
 d) 2PCl<sub>3</sub> + H<sub>2</sub>SO<sub>4</sub>  $\rightarrow$  2POCl<sub>3</sub> + 2HCl + SO<sub>2</sub>Cl<sub>2</sub>
17. The product 'A' in the equation:  
 2KMnO<sub>4</sub>  $\xrightarrow{\Delta}$  A + MnO<sub>2</sub> + O<sub>2</sub>  
 a) Mn<sub>2</sub>O<sub>7</sub>      b) K<sub>2</sub>MnO<sub>4</sub>  
 c) K<sub>2</sub>O      d) K<sub>2</sub>O<sub>2</sub>
18. In which of the following reaction does SO<sub>2</sub> acts as oxidising agent?  
 a) acidified KMnO<sub>4</sub>      b) acidified K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>  
 c) acidified C<sub>2</sub>H<sub>5</sub>OH      d) H<sub>2</sub>S
19. Which of the following is not oxidised by ozone?  
 a) KI      b) FeSO<sub>4</sub>  
 c) KMnO<sub>4</sub>      d) K<sub>2</sub>MnO<sub>4</sub>
20. At room temperature H<sub>2</sub>O is liquid while H<sub>2</sub>S is a gas. The reason is:  
 a) Electronegativity of O is greater than S  
 b) Difference in the B.A. of both the molecules  
 c) Association takes place in H<sub>2</sub>O due to H-bonding while no H-bonding in H<sub>2</sub>S  
 d) O and S belong to different periods
21. Which of the following reaction cannot change SO<sub>2</sub>  $\rightarrow$  SO<sub>4</sub><sup>2-</sup>?  
 a) SO<sub>2</sub> + MnO<sub>4</sub><sup>-</sup>  $\xrightarrow{H^+}$  SO<sub>4</sub><sup>2-</sup> + Ba(OH)<sub>2</sub>  $\rightarrow$   
 c) SO<sub>2</sub> + Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>  $\xrightarrow{H^+}$  SO<sub>4</sub><sup>2-</sup> + Fe<sup>3+</sup>  $\xrightarrow{H^+}$
22. Which of the following statements regarding SO<sub>2</sub> is not correct?  
 a) It is an angular molecule  
 b) It is an anhydride of sulphuric acid  
 c) It is an acidic oxide  
 d) The S - O bond length is smaller than the expected value
23. Concentrated sulphuric acid cannot be used to prepare HBr or HI from KBr or KI because it  
 a) reacts too slowly with KBr or KI  
 b) reduces HBr or HI  
 c) oxidises HBr or HI  
 d) oxidises KBr to KBrO<sub>3</sub> or KI to KIO<sub>3</sub>
24. NaOH + Sulphur  $\xrightarrow[\text{(excess)}]{\text{Boil}}$  X + Y + H<sub>2</sub>O  
 then X and Y are:  
 a) Na<sub>2</sub>SO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>      b) Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Na<sub>2</sub>S<sub>2</sub>  
 c) Na<sub>2</sub>S, Na<sub>2</sub>SO<sub>4</sub>      d) Na<sub>2</sub>S, Na<sub>2</sub>SO<sub>3</sub>
25. The correct order in which oxygen - oxygen bond dissociation energy increases is:  
 a) H<sub>2</sub>O<sub>2</sub> < O<sub>2</sub> < O<sub>3</sub>      b) H<sub>2</sub>O<sub>2</sub> < O<sub>3</sub> < O<sub>2</sub>  
 c) O<sub>2</sub> < O<sub>3</sub> < H<sub>2</sub>O<sub>2</sub>      d) O<sub>2</sub> < H<sub>2</sub>O<sub>2</sub> < O<sub>3</sub>
26. In thiosulphuric acid  
 a) each sulphur atom is in identical oxidation state  
 b) there is a S=S linkage present  
 c) one S atom is in +2 and other sulphur atom is +4 oxidation state  
 d) there is only one replaceable hydrogen atom

27. (i)  $KI + H_2O + O_3 \rightarrow A + B + O_2$   
(A turns moist starch paper blue, B turns red litmus blue)  
(ii)  $A(\text{dry}) + O_3 \rightarrow X + O_2$
- What is true about X in the above sequence of reactions?  
 a) It is a monobasic acid  
 b) Molecular formula of A is  $KIO_4$   
 c) Molecular formula of A is  $I_2O_6$   
 d) Average oxidation state of iodine in X is +5
28.  $SF_4$  is unreactive towards hydrolysis because:  
 a) sulphur has very small size  
 b) fluorine is most electronegative element  
 c) sulphur shows +6 oxidation state  
 d) due to steric hindrance water molecule cannot attack S atom
29. Which of the following statements is correct?  
 a)  $SF_4$  is polar and non reactive  
 b)  $SF_4$  is prepared by fluorinating  $SCl_2$  with NaF  
 c)  $SF_6$  is non polar and very reactive  
 d)  $SF_6$  is strong fluorinating agent
30. The gases respectively absorbed by alkaline pyrogallol and oil of cinnamon is:  
 a)  $N_2O, O_3$       b)  $O_2, O_3$   
 c)  $O_3, CO$       d)  $SO_2, CH_4$
31.  $P_4$  (white) +  $SOCl_2 \rightarrow X$  (halide of P)  
 + Y (oxide) + Z (halide of S)

Incorrect statement among the following is:  
 a) X on hydrolysis gives a dibasic acid  
 b) Y turns acidified  $K_2Cr_2O_7$  solution to green  
 c) Z has angular structure  
 d) Hydrolysis of Z is a disproportionation reaction

32. Which one of the following contains more number of peroxy linkages?  
 a)  $H_2TiO_4$     b)  $CrO_5$     c)  $H_3PO_5$     d)  $H_2S_2O_8$

33. A crystalline solid X reacts with dilute HCl to liberate a gas Y. The gas Y decolorises acidified  $KMnO_4$ . When a gas Z is slowly passed into aqueous solution of Y, colloidal sulphur is obtained. X and Z could be respectively.  
 a)  $Na_2S, SO_3$     b)  $Na_2SO_4, H_2S$   
 c)  $Na_2SO_3, H_2S$     d)  $Na_2SO_4, SO_2$
34. An inorganic compound X reacts with water to form two acids Y and Z. X also reacts with NaOH to form two salts B and C which remain in solution. The solutions gives white precipitate with both  $AgNO_3$  and  $BaSO_4$  solutions. What is X  
 a)  $SO_2Cl_2$     b)  $AlCl_3$     c)  $SbCl_3$     d)  $PCl_3F_2$
35. A small iodine crystal is added to each of the following aq solutions:  
 I. sodium sulphate  
 II. sodium thiosulphate  
 III. sodium tetrathionate IV. sulphuric acid  
 In which solutions the purple colour disappears  
 a) only in I    b) only in I and II  
 c) only in III and IV    d) only in II
36. Aqueous solution of  $Na_2S_2O_3$  on reaction with  $Cl_2$  gives  
 a)  $Na_2S_4O_6$     b)  $NaHSO_4$     c)  $NaCl$     d)  $NaOH$
37. A solution of sodium thiosulphate on addition of few drops of ferric chloride gives violet colour due to the formation of  
 a)  $Na_2S_4O_6$     b)  $Na_2SO_4$   
 c)  $Fe_2(S_2O_3)_3$     d)  $Fe_2(S_2O_3)_2$
38.  $Na_2S_2O_3$  is oxidised by  $I_2$  to  
 a)  $Na_2S$     b)  $Na_2SO_4$     c)  $NaHSO_3$     d)  $Na_2S_4O_6$
39. The formula of the product formed, when sodium thiosulphate solution is added to silver bromide is  
 a)  $Na_3[Ag(S_2O_3)_2]$     b)  $Ag_2S$   
 c)  $Na_4[Ag_2(SO_3)_3]$     d)  $Ag_3[Na(S_2O_3)_2]$

40. The primary standard solution for estimation of  $Na_2S_2O_3$  is  
 a)  $I_2$  solution    b)  $KMnO_4$   
 c)  $K_2Cr_2O_7$     d) oxalic acid

#### MULTIPLE ANSWER QUESTIONS

41. Which of the following are correct statements  
 a)  $O_3$  oxidises  $PbS$  to  $PbSO_4$   
 b)  $O_3$  oxidises nitric oxide to nitrogen dioxide  
 c) Ozone oxidises aqueous KI at pH = 9.2  
 d) The two O - O bond lengths in ozone are different

42. In which of the following reactions,  $SO_2$  acts as an oxidising agent?  
 a)  $I_2 + SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2I^-$   
 b)  $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$   
 c)  $3Fe + SO_2 \rightarrow FeS + 2FeO$   
 d)  $K_2Cr_2O_7 + 3SO_2 + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + K_2SO_4 + H_2O$

43. Peroxide linkage is present in:  
 a)  $MnO_2$     b)  $CrO_3$   
 c)  $H_2SO_5$     d)  $BaO_2$

44. Sodium thiosulphate is prepared by:

- a) boiling  $Na_2SO_3$  solution with elemental sulphur in alkaline medium  
 b) boiling  $Na_2SO_3$  solution with elemental sulphur in acidic medium  
 c) oxidation of  $Na_2S_2$  with air  
 d) heating sulphur with NaOH

45. Which of the following statements are correct?

- a) Sulphur exists as octa atomic  $S_8$  molecule with pucker ring structure  
 b) In  $S_8$  molecule sulphur atom undergoes  $sp^3$  hybridization involving both bonding and non bonding pairs of electrons.  
 c) There are two single covalent bonds and two lone pairs of electrons associated with each S atom in  $S_8$  molecule.  
 d) The S - S - S bond angle in  $S_8$  molecule is  $109^\circ 28'$ .

46. Which of the following statements are correct for  $SO_4^{2-}$  ion?  
 a) It is tetrahedral  
 b) All the S - O bond lengths are equal and shorter than expected  
 c) It contains four sigma bonds between S and O atoms, two pi bonds delocalised over the S and four O atoms and all the S - O bonds have the bond order 1.5  
 d) It is square planar

47. Which of the following solutions change its colour on passing ozone through it  
 a) Starch iodide solution  
 b) Alcoholic solution of benzidine

- c) Acidified  $K_2Cr_2O_7$   
 d) Acidified solution of  $FeSO_4$

48. Select the correct statements about  $Na_2S_2O_3 \cdot 5H_2O$ ?  
 a) It is also called as hypo  
 b) It is used in photography to form complex with AgBr

- c) It can be used as antichlor  
 d) It is used to remove stains of  $I_2$

49. Which of the following statement(s) is/are correct?  
 a) Rhombic sulphur is stable at room temp.  
 b) Monoclinic sulphur is stable at room temp.

- c) Both rhombic and monoclinic sulphur has the molecular formula  $S_8$   
 d) Both rhombic and monoclinic sulphur are soluble in  $CS_2$

50. Which of the following statements are correct?  
 a) Pure  $H_2SO_4$  may be used as non aqueous solvent and as a sulphonating agent  
 b) Concentrated  $H_2SO_4$  forms azeotropic mixture

- c) Concentrated  $H_2SO_4$  does not dehydrate  $HNO_3$

- d) In  $H_2SO_4$  all the S - O bond lengths are not equal but in  $SO_4^{2-}$  all the S - O bond lengths are equal

- 51. Sulphuric acid is used:**
- a) In making fertilizers b) as a dehydrating agent
  - c) As a pickling reagent d) as a dehydrating agent
- 52. Which of the following are correct**
- a)  $O_3 + \text{moist iodine} \rightarrow HO_3$
  - b)  $FeCl_3 + H_2S \rightarrow \text{Colloidal sulphur}$
  - c)  $O_3 + \text{Starch iodide paper} \rightarrow \text{blue}$
  - d)  $O_3 + Ag \rightarrow \text{Black silver}$
- 53. Which of the following acts as an oxidising agent well as reducing agent?**
- a)  $HNO_2$  b)  $H_2O_2$  c)  $H_2S$  d)  $SO_2$
- 54. Which of the following statements are true**
- a)  $Cr_2O_3$  is an acidic oxide
  - b)  $KO_2$  is peroxide which is diamagnetic
  - c)  $ZnO$  and  $SnO_2$  reacts with both acids and basis
  - d)  $SO_3$  is an acidic oxide and oxidizing agent
- 55. An organic acid (A) reacts with concentrated  $H_2SO_4$  to give a neutral oxide (B), acidic oxide (C) and a diatomic oxide (D). When D reacts with chlorine gas a poisonous gas (E) is evolved. This gas with ammonia gives an organic compound (F). Which of the following are true.**
- a) The compound A =  $H_2C_2O_4$
  - b) The compound D is neutral oxide
  - c) In the compound E the central atom undergoes  $sp^2$  hybridization
  - d) The compound F =  $NH_2CONH_2$

**COMPREHENSION TYPE QUESTIONS**

- Passage-I (Q No: 56 to 59)**
- Sulphuric acid is considered as the king of chemicals. The prosperity of any country is measured by the amount of sulphuric acid it consumes. Sulphuric acid is, thus, a substance of very great commercial importance as it is used practically in every important industry. This is due to the following properties of sulphuric acid:
- a) acidic nature b) oxidising nature
  - c) dehydrating nature d) sulphonation

- 56. Sulphuric acid has very corrosive action on skin because**
- a) It reacts with proteins
  - b) It acts as an oxidising agent
  - c) It acts as a dehydrating agent
  - d) It acts as a dehydrating agent and absorption of water is highly exothermic
- 57. Sulphuric acid is used**
- a) In real storage batteries
  - b) In making fertilizers
  - c) In making explosives
  - d) All of these
- 58. Concentrated  $H_2SO_4$  cannot be used to prepare HBr or HI from KBr or KI because it**
- a) Reacts two slowly with KBr or KI
  - b) Reduces HBr or HI
  - c) Oxidises HBr or HI
  - d) Oxidises KBr to  $KBr \cdot O_3$  or KI to  $KIO_3$
- 59. Only carbon is obtained when concentrated  $H_2SO_4$  is added to**
- a) Formic acid b) Cane sugar
  - c) Oxalic acid d) Ethyl alcohol
- Passage-II (Q No: 60 to 62)**
- $$\begin{array}{c} A \\ | \\ H_2O \\ | \\ SO_2 \xrightarrow{\text{H}_2S} B \xrightarrow{\text{sodium salt of A}} C \xrightarrow{AgNO_3} D \\ \downarrow \xrightarrow{+23^\circ C} E + Na_2SO_4 \end{array}$$

- 60. Which of the following w.r.t. B are correct?**
- i) B on heating with alkali undergoes disproportionation to C and E.
  - ii) In rubber industries, B is a good cross linking agent for rubbers for making them hard
  - iii) The oxidation state of B in B is zero
  - iv) The formation of E confirms catenation property of B
- 61. D on long standing turn to yellow then to brown and finally to a precipitate F. D and F are respectively:**
- a)  $Ag_2S_2O_3$  (white ppt.) b)  $Ag$  (black ppt.)
  - c)  $Ag_2S$  (black ppt.),  $Ag_2S_2O_3$  (white ppt.) d)  $Ag_2S$  (black ppt.),  $Ag_2S_2O_3$  (white ppt.)
- 62. Number of lone pairs,  $\sigma$  bonds and  $\pi$  bonds in A are respectively:**
- a) 1,3,1 b) 7,3,1 c) 6,5,1 d) 7,5,1
- Passage-III (Q No: 63 to 65)**
- Properties of elements X:**
- (i) Its amide is used as a reducing agent
  - (ii) Its amalgam is used as reducing agent
- Properties of element Y:**
- (i) It is an octatomic molecule
  - (ii) It is diamagnetic in ground state but paramagnetic in vapour phase
- Properties of element Z:**
- (i) Its diatomic molecule is paramagnetic
  - (ii) Its allotrope is an absorber of UV radiation
  - (iii) It supports combustion
- 63. Compound of X and Z + Compound of Y and Z → product(s).**
- Oxidation number of Y in the final compound may be:
- a) +4 or +6 b) 0 and +2
  - c) +3 and +5 d) -2 and +4

- 64. Compound of X, Y and Z on reaction with Y form a compound A. Out of the following which statement is not correct about compound A?**
- a) used in iodometry
  - b) used in development of photographic plates
  - c) on reaction with  $FeCl_3$  it gives violet colour, which disappear after some time
  - d) The oxidation number of Y in this compound is +4
- 65. Which statement is not correct about these following compounds?**
- a) Compound of X and Z is basic in aq solution
  - b) Compound of X and Y is basic in aq solution
  - c) Compound of Y and Z is basic in aq solution
  - d) Compound of X, Y and Z in which Y is in its maximum oxidation state is neutral in aq medium
- MATRIX MATCHING QUESTIONS**
- 66. Match the following:**
- | Column I | Column II |
|----------|-----------|
| Column I | Column II |

- 67. Match the following:**
- | Column I | Column II                   |
|----------|-----------------------------|
| f, t     | a) $S_2O_3^{2-}$            |
| f, t     | p) contains S-S linkage     |
| s, t     | c) $S_2O_8^{2-}$            |
| s, t     | r) contains S-O-S linkage   |
| p, t     | d) $S_2O_6^{2-}$            |
| p, t     | s) contains S-O-O-S linkage |
| t        | t) contains S=O linkage     |
- 68. Match the following:**
- | Column I    | Column II   |
|-------------|---|
| $Q_1\gamma$ | a) Dithionous acid  |
| $Q_1\gamma$ | b) Caro's acid  |
| $Q_1\gamma$ | c) Marshall's acid  |
| $Q_1\gamma$ | d) Thiosulphuric acid   |
| $Q_1\gamma$ | e) All S - atoms in the molecule has oxid. st. +6                     |
| $Q_1\gamma$ | f) All S - atoms in the molecule has oxid. st. +6                     |
| $Q_1\gamma$ | g) $Q_1\gamma$ S-O-S bond is not present                              |
| $Q_1\gamma$ | h) Acidic strength of all hydrogen present in the molecule is same    |
| $Q_1\gamma$ | i) At least one S - atom has oxidation state +6 or +4 in the molecule |
- 69. Match the following:**
- | Column I                               | Column II               |
|--|-------------------------|
| a) $Na_2S_2O_3 + HCl$                  | p) $NaCl$               |
| b) $Na_2S_2O_3$ (conc) + $AgNO_3$ (aq) | q) $Na_2[Ag(S_2O_3)_2]$ |
| c) $Na_2S_2O_3 + Cl_2 + H_2O$          | r) $Na_2SO_4$           |
| d) $Na_2S_2O_3 + I_2$                  | s) $Na_2S_4O_6$         |
| e) $Na_2S_2O_3 + HgS$                  | t) $Cinnabar S$         |
| f) $Gypsum \gamma$                     | u) $Gypsum \gamma$      |
| g) $Barytes Q_1$                       | v) $BaSO_4$             |
| h) $Epsom salt P$                      | w) $MgSO_4 \cdot 7H_2O$ |
| i) $HgS$                               | x) $CaSO_4 \cdot 2H_2O$ |
- ASSERTION & REASONING QUESTIONS**
- 71. Assertion: In presence of ozone, mercury loses its merricus and sticks to glasses. This is called tailing of mercury**
- 72. Assertion: Bleaching action of  $SO_2$  is due to reduction**
- C Reason: Bleaching action of all bleaching agents is due to reduction**
- 73. Assertion: Dry  $SO_2$  does not bleach dry flowers**
- Reason: The bleaching action of  $SO_2$  is due to its reducing nature**

## 16TH GROUP ELEMENTS

74. Assertion: Conc  $H_2SO_4$  cannot be used for drying up  $H_2S$   
**Reason:** Conc  $H_2SO_4$  oxidises  $H_2S$  to  $S$
75. Assertion: A white turbidity is obtained by passing  $H_2S$  through aq solution of  $SO_2$   
**Reason:** Aq solution of  $SO_2$  and  $H_2S$  undergoes redox change to produce colloidal sulphur
76. Assertion: A white precipitate is obtained when an aq solution of sodium thiosulphate is treated with  $AgNO_3$  solution and if the precipitate is heated with water, a black precipitate is obtained, and the supernatant liquid then gives a white precipitate with  $BaCl_2$  solution.  
**Reason:**  $Ag^+$  ion forms a complex with thiosulphate ions which upon hydrolysis undergoes disproportionation to yield  $SO_4^{2-}$  ion (supernatant liquid) and  $Ag_2S$  (black precipitate)

77. Assertion: The oxidation number of S in  $H_2S_2O_8$  is +7  
**Reason:** The maximum oxidation number of S is +6, because the maximum possible oxidation state of element is its number of valence electron(s) or, group number.

78. Assertion: The O–O bond lengths in ozone molecule are intermediate between single and double bonds.

Reason:  $O_3$  molecule is a resonance hybrid.

79. Assertion: Conc  $H_2SO_4$  has low volatility and viscous nature acid  
**Reason:** It has hydrogen bonding.

80. Assertion: Among chalcogens, catenation tendency is maximum for sulphur  
**Reason:** S–S bond is stronger than O–O single bond.

### INTEGER TYPE QUESTIONS

81. Give the total number of peroxide linkages present in Caro's acid, Marshall's acid and hydrogen peroxide
82. Oxygen is a gas while others are solids and S, Se, Te exists as staggered rings in normal conditions. How many number of atoms are present in one ring?

83. How many S–O single bond linkages are present in peroxydisulphuric acid?  
**Reason:** Octahedral crystalline variety of sulphur contain "X" S–S bonds in which covalency of sulphur = y. It contains "Z" lonepair of electrons, then  $(z - x - y) =$
84. Octahedral crystalline variety of sulphur contain "X" S–S bonds in which covalency of sulphur = y. It contains "Z" lonepair of electrons, then  $(z - x - y) =$
85. How many of the following species can act as both bleaching agent and reducing agent  
 $O_3, H_2O_2, SO_2, HCl, SO_3$

### LEVEL-V - KEY

#### SINGLE ANSWER

- 01.b 02.d 03.b 04.b 05.d 06.c  
 07.d 08.b 09.d 10.d 11.a 12.a  
 13.b 14.d 15.b 16.a 17.b 18.d  
 19.c 20.c 21.b 22.b 23.c 24.b  
 25.b 26.b 27.c 28.d 29.b 30.b  
 31.c 32.b 33.c 34.a 35.d 36.b  
 37.c 38.d 39.a 40.a

#### MULTIPLE ANSWER

- 41.abc 42.bcd 43.bcd  
 44.acd 45.abc 46.abc  
 47.abd 48.abcd 49.acd  
 50.abd 51.abcd 52.abcd  
 53.abd 54.acd 55.abcd

#### COMPREHENSION TYPE

- Passage-I: 56.d 57.d 58.c 59.b  
 Passage-II: 60.c 61.d 62.d  
 Passage-III: 63.a 64.d 65.c

#### MATRIX MATCHING TYPE

66. a – qr; b – p; c – s; d – t  
 67. a – qt; b – pt; c – st; d – pt  
 68. a – qr; b – pqs; c – pqrs; d – qrs  
 69. a – p; b – q; c – r; d – s  
 70. a – s; b – r; c – q; d – p

#### ASSERTION - REASONING TYPE

- 71.a 72.c 73.b 74.a 75.a 76.c  
 77.d 78.a 79.a 80.a

#### INTEGER TYPE

- 81.3 82.8 83.4 84.6 85.3

### LEVEL-V - HINTS SINGLE ANSWER QUESTIONS

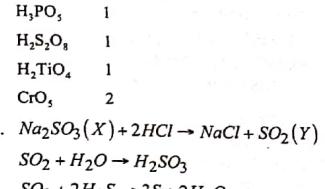
01.  $SO_3 + 2H_2O \rightarrow H_2SO_4 + 2(H)$   
 02.  $Na_2SO_3 + S \xrightarrow{\Delta} Na_2S_2O_3$   
 03.  $H_2O$  to  $H_2Te$ : Thermal stability decreases  
 $H_2O$  to  $H_2Te$ : acidic nature increases  
 04.  $SO_3$ : two ( $\pi - d\pi$ ) bonds  
 05.  $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + H_2O$   
 06. Bond order of  $H_2O_2 = 1.0; O_3 = 1.5; O_2 = 2$ . Hence O–O bond length order is:  
 $H_2O_2 > O_3 > O_2$   
 11.  $SCl_4 + 3H_2O \rightarrow H_2SO_3 + 4HCl$   
 12.  $SCl_4$ : sp<sup>3</sup>d hybridised sulphur; see - saw  
 13.  $3SnCl_2 + 6HCl + O_3 \rightarrow 3SnCl_4 + 3H_2O$   
 $3SO_2 + O_3 \rightarrow 3SO_3$

16.  $2I^- + H_2SO_4 \xrightarrow{+6} I_2 + SO_2 + 2H_2O$   
 17.  $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$   
 18.  $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$   
 19.  $KMnO_4$  act as only oxidant  
 20.  $H_2O$  is an associated liquid due to intermolecular hydrogen bond  
 22.  $SO_2$  is an anhydride of sulphurous acid  
 23.  $H_2SO_4$  oxidises HBr to  $Br_2$  and  $HI$  to  $I_2$   
 25. O–O bond length:  $H_2O_2 > O_3 > O_2$   
 O–O bond dissociation energy:  
 $H_2O_2 < O_3 < O_2$   
 26. Thiosulphuric acid:  $H_2S_2O_3$   
 28.  $SF_6$ : chemically inert

29.  $3SCl_2 + 4NaF \rightarrow SF_4 + S_2Cl_2 + 4NaCl$   
 30. alkaline pyrogallol: oxygen absorber oil of cinnamon : ozone absorber

31.  $P_4 + 8SOCl_2 \rightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$   
 $S_2Cl_2 + 2H_2O \rightarrow SO_2 + S + 4HCl$

32. Number of peroxy linkages



36.  $Na_2S_2O_3 + 4Cl_2 + 5H_2O \rightarrow 2NaHSO_4 + 8HCl$

### MULTIPLE ANSWER QUESTIONS

42.  $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$   
 $3Fe + SO_2 \rightarrow FeS + 2FeO$   
 43.  $CrO_3, H_2SO_4, BaO_2$   
 44.  $Na_2SO_3 + S \xrightarrow{\Delta} Na_2S_2O_3$  (in an alk. medium)  
 45. Dithionic acid:  $H_2S_2O_6$ ; Thiosulphuric acid:  $H_2S_2O_3$ ; Peroxonomonosulphuric acid:  $H_2SO_5$ ; Peroxodisulphuric acid:  $H_2S_2O_8$   
 48. Hypo is used in photography (as developer), as antichlor and in the volumetric estimation off I  
 49. Rhombic sulphur is stable at room temperature  
 51. Sulphuric acid is used: in lead storage batteries, as a dehydrating reagent, in making fertilizers, as a pickling agent (pickling is an industrial process for removing layers of basic oxides from metals like Fe and Cu before electroplating, enamelling, galvanising and soldering.  $H_2SO_4$  being strong acid dissolves all the basic oxides from the surface).  
 53.  $H_2S$ : reducing agent  
 55.  $(COOH)_2(A) \xrightarrow{Conc. H_2SO_4}$   
 $H_2O(B) + CO_2(C) + CO(D)$   
 $CO + Cl_2 \rightarrow COCl_2(E) \xrightarrow{NH_3}$   
 $NH_2CONH_2(F)$

## 16TH GROUP ELEMENTS

### COMPREHENSION TYPE QUESTIONS

Passage-I (QNo: 56 to 59)  
 $X = H_2S_2O_8$ ;  $Y = H_2SO_4$ ;  $Z = H_2SO_4$

Passage-II (QNo: 60 to 62)  
 $A = H_2SO_4$ ;  $B = S$ ;  $C = Na_2S_2O_3$ ,

$D = Ag_2S_2O_3$ ;  $E = Na_2S_2$ ;  $F = Ag_2S$

Passage-III (QNo: 63 to 65)  
 $X = Na$ ,  $Y = \text{ sulphur}$ ,  $Z = O_2$

### MATRIX MATCHING TYPE

66.  $\alpha$ -sulphur: Rhombic sulphur, octahedra;

$\beta$ -sulphur: Prismatic sulphur

$\gamma$ -sulphur: nacreous;

$\chi$ -sulphur: Plastic sulphur

67.  $S_2O_3^{2-}$ : contains S-S bond;

$S_2O_8^{2-}$ : contains S-S bond

$S_2O_8^{2-}$ : contains S-O-O-S bond;

$S_2O_6^{2-}$ : contains S-S (single) bond

68.  $H_2SO_4$ ,  $H_2S_2O_8$  - peroxy acids

69.  $Na_2S_2O_3 + HCl \rightarrow NaCl + H_2O + SO_2 \uparrow + S \downarrow$

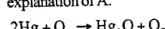
$Na_2S_2O_3 + AgNO_3 \rightarrow Na_3[Ag(S_2O_3)_2]$

$Na_2S_2O_3 + Cl_2 + H_2O \rightarrow Na_2SO_4 + HCl + S$

$Na_2S_2O_3 + I_2 \rightarrow Na_2S_2O_6 + NaI$

### ASSERTION & REASONING TYPE

71. Both A and R are correct and R is the correct explanation of A.



72.  $SO_2 + 2H_2O \rightarrow H_2SO_4 + 2(H)$

Bleaching action of  $Cl_2$ ,  $H_2O_2$ ,  $O_3$  is their oxidising nature

73.  $SO_2$  acts as a bleaching agent in the presence of moisture



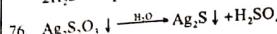
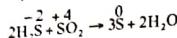
74. Both A and R are correct and R is the correct explanation of A

75. Both A and R are correct and R is the correct

## 16TH GROUP ELEMENTS

### JEE-ADV CHEM-VOL-III

explanation of A



77. The oxidation number of sulphur in  $H_2S_2O_8 = +6$

78. Both A and R are correct and R is the correct explanation of A

79. Both A and R are correct and R is the correct explanation of A

80. Both A and R are correct and R is the correct explanation of A

### INTEGER TYPE

Number of peroxy bonds

81. Caro's acid: 1  
 Marshall's acid: 1  
 $H_2O_2$ : 1

82.  $S_2Se_2Te$ : octaatomic

83. Peroxosulphuric acid:  $H_2S_2O_8$   
 (dibasic acid)(contains S-O-O-S linkage)  
 (4 S=O bonds)

### LEVEL-VI

### SINGLE ANSWER QUESTIONS

1. Which of the following is incorrect for oxygen

a)  $KMnO_4(s)$  on strong heating gives oxygen gas

b) Oxygen mixed with helium is used for artificial respiration

c) It has two unpaired electrons in bonding  $\pi$  molecular orbitals

d)  $HgO$  on heating gives  $Hg$  and  $O_2$

2. I.  $H_2S$  reduces acidified  $KMnO_4$  to  $MnSO_4$

II.  $H_2S$  reduces acidified  $K_2Cr_2O_7$  to red colour  $Cr_2(SO_4)_3$

III.  $H_2S$  reduces nitric acid to  $NO_2$

IV.  $H_2S$  oxidises ferrous sulphate to ferric sulphate

Then the correct statement(s) is/are:

- a) only I  
 b) only I and III  
 c) only II and III  
 d) I, II, III and IV

## 16TH GROUP ELEMENTS

### JEE-ADV CHEM-VOL-III

3.  $S_1 : 2Se_2Cl_2 \rightarrow SeCl_4 + 3Se$

$S_2$  : Dioxides like  $MnO_2$ ,  $PbO_2$  do not form  $H_2O_2$  with dilute acids but they evolve oxygen with concentrated  $H_2SO_4$ .

$S_3$  : Sodium thiosulphate with  $FeCl_3$  solution develops a pink or violet colour which soon vanishes.

$S_4$  : White precipitate of  $PbS_2O_3$  get soluble when boiled with water.

- a) FTTT b) TFTT c) FFTT d) TTTF

4. Which of the following acids contain peroxy linkage?

- |                      |                        |
|----------------------|------------------------|
| I. Oleum             | II. Marshall's acid    |
| III. Caro's acid     | IV. Sulphuric acid     |
| a) I and II only     | b) II and III only     |
| c) I, II and IV only | d) II, III and IV only |

5.  $H_2S$  reacts with lead acetate forming black compound which reacts with  $O_3$  to form another compound Y. The colour of the compound Y is:

- a) black b) violet c) white d) green

6. Which one of the following is incorrect?

- a) Cyclic trimer structure of  $SO_3$  contains six S=O bonds and six S-O-S bonds.

b) The number of S-S bonds in  $H_2S_2O_6$  is  $n-1$

c)  $S_2$  form of sulphur shows paramagnetic behaviour

d)  $S_2O_3^{2-}$  ion does not contain S-S bond

7. Which one of the following is incorrect statement regarding  $S_8$ ?

a) Sulphur is in  $sp^3$  - hybridised state

b) S-S bond length is 204pm

c) Both valency and oxidation state of sulphur are zero

d) The bond angle S-S-S is  $107^\circ$

8. Pick out the incorrect statement regarding ozone:

a) The two O-O bonds in ozone are equal in length due to resonance

b) Ozone is diamagnetic

c) Formation of ozone from dioxygen is endothermic

d) Bond angle in ozone is  $180^\circ$

9. The number of S-S bonds in sulphur trioxide trimer ( $\gamma$  form) is:

- a) three b) two c) zero d) one

10. A gas 'X' turns lime water milky. The milkeness disappears if excess of 'X' is passed. Milkeness appears on heating the colourless solution. Then 'X' is:

- a)  $NO_2$  b)  $CO_2$  or  $SO_2$  c)  $H_2S$  d)  $NH_3$

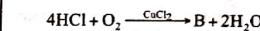
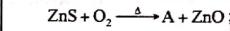
11.  $S_1 : (HPO_3)_n$  can be prepared by heating phosphorous acid and bromine in a sealed tube.

$S_2$  : dry iodine reacts with ozone and formed yellow solid,  $I_4O_9$ .

$S_3$  :  $\beta$  sulphur is stable below 369 K.

- a) FTF b) TFTT c) TTTT d) TFF

12. In the following reaction:



$A + B \xrightarrow{hv} C$ , Then A, B and C are:

- a)  $SO_2, Cl_2, SOCl_2$  b)  $SO_2, Cl_2, SO_2Cl_2$

- c)  $SO_3, Cl_2, SOCl_2$  d)  $SO_3, HClO_3, HClO_4$

13. A mixture of two gases  $AsH_3$  and  $SbH_3$  is passed through a tube heated at the middle position. Two mirror like depositions are observed of which (I) is before the hot position and (II) is after the hot position. These depositions I and II are of

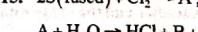
- a) Sb and As b) As and Sb

- c) Both As d) Both Sb

14. When concentrated hypo solution is added to  $AgNO_3$  solution a white ppt is formed. With excess of hypo a complex is formed. The oxidation state and coordination number of central metal ion in the anion are:

- a) +3,6 b) +1,2 c) +3,4 d) +1,8

15.  $2S(\text{fused}) + Cl_2 \rightarrow A$  ;



A, B and C in the above equations are:

- a)  $S_2Cl_2, SO_2, S$  b)  $SCl_2, SO_2, SO_3$

- c)  $S_2Cl_2, SO_3, SO_4^{2-}$  d)  $S_2Cl_2, SO_2, H_2SO_4$

## 16TH GROUP ELEMENTS

16. Which of the following compounds can be used for drying of  $H_2S$  gas?

- I. Conc  $H_2SO_4$  II.  $P_2O_{10}$   
 III. anhydrous  $CaCl_2$  IV. anhydrous  $Al_2O_3$   
 a) only II, III and IV b) only I  
 c) only II and III d) only III

17.  $SO_2$  is a strong reducing agent however it also act as an oxidising agent. Which of the following reactions shows its oxidising nature?

- a) Bleaching flower petals  
 b) Decolourising acidified  $KMnO_4$  solution  
 c) Reaction with  $H_2S$  to give colloidal sulphur  
 d) Turning acidified dichromate paper green

18. Which of the following statement is incorrect regarding the complete hydrolysis of Marshall's acid?

- a) Caro's acid is an intermediate product  
 b) Two molecules of  $H_2SO_4$  and one molecule of  $H_2O_2$  are the final product  
 c) Hybridisation and oxidation state of central atom remain unchanged in the final product  
 d) Both final products can act as oxidising as well as reducing agent

19. When sulphur is boiled with  $Na_2SO_3$ , a compound 'A' is produced. 'A' with  $AgNO_3$  solution gives unstable white precipitate B, which on standing turns to black C. Compound A, B and C will be respectively:

- a)  $Na_2S_2O_3$ ,  $Ag_2S_2O_3$ ,  $Ag_2S$   
 b)  $Na_2SO_4$ ,  $Ag_2S_2O_3$ ,  $Ag_2S$   
 c)  $Na_2S_2O_3$ ,  $Ag_2SO_4$ ,  $Ag_2S$   
 d)  $Na_2S_2O_3$ ,  $Ag_2SO_4$ ,  $Ag_2S$

20. Which of the following is correct?

- a)  $H_2S_2O_6$  contains  $-O-O-$  linkage  
 b)  $H_2S_2O_8$  contains  $-S-S-$  linkage  
 c)  $S_2O_6^{2-}$  contain  $-S-O-S-$  linkage  
 d)  $H_2S_2O_3$  contains  $-S-O-S-$  linkage

21. In the given oxides of chromium, the oxide with higher ionic character and the oxide with higher basic nature respectively are:

- (i)  $CrO$  (ii)  $CrO_3$  (iii)  $Cr_2O_3$  (iv)  $CrO_2$   
 a)  $CrO_3$  and  $CrO$  b)  $CrO$  and  $CrO_3$   
 c)  $CrO_2$  and  $CrO_3$  d)  $CrO$  and  $CrO_2$

22. Which of the following option is correctly matched

- a)  $S_3O_9$ ; contains no S - S linkage  
 b)  $S_2O_6^{2-}$ ; contains  $-O-O-$  linkage  
 c)  $(HPO_3)_3$ ; contains P - P linkage  
 d)  $S_2O_8^{2-}$ ; contains S - S linkage

23. Identify the correct sequence of increasing number of  $\pi$ -bonds in structures of the following molecules:

- I.  $H_2S_2O_6$  II.  $H_2SO_3$  III.  $H_2S_2O_5$   
 a) I,II,III b) II,III,I c) II,I,III d) I,III,II  
 24. An inorganic compound 'A' reacts with water to form two acids B and C. 'A' also reacts with  $NaOH$  to form two salts D and E which remain in solution. The solution gives white precipitate with both  $AgNO_3$  and  $BaCl_2$  solution respectively. 'A' is:

- a)  $SO_2Cl_2$  b)  $SeF_6$  c)  $SeF_6$  d)  $SF_4$

25. Sulphur on reaction with concentrated  $HNO_3$  gives 'A' which reacts with  $NaOH$  gives 'B'. A and B are:

- a)  $H_2SO_3$ ,  $Na_2S_2O_3$  b)  $NO_2$ ,  $Na_2S$   
 c)  $H_2SO_4$ ,  $Na_2SO_4$  d)  $H_2S_2O_3$ ,  $Na_2S_2O_3$

26. When an inorganic compound reacts with  $SO_2$  in aq medium produces 'A'. 'A' on reaction with  $Na_2CO_3$  gives the compound 'B' which reacts with sulphur gives a substance 'C' used in photography. The compound 'C' is:

- a)  $Na_2S_2O_3$  b)  $Na_2SO_4$  c)  $Na_2S$  d)  $Na_2SO_3$

27. An yellow metallic powder is heated in a stream of fluorine to obtain colourless gas 'X' which is thermally stable and chemically inert. Its molecule is octahedral geometry. Another colourless gas 'Y' with same constituent atoms as that of 'X' is obtained when sulphur is heated with cobalt fluoride. Its molecule has trigonal bipyramidal geometry. Gases 'X' and 'Y' respectively are

- a)  $SF_4$  and  $S_2F_2$  b)  $SF_6$  and  $SF_4$   
 c)  $NaF$  and  $NaCl$  d)  $SF_4$  and  $SF_6$

28. An aq solution of a gas X gives the following reactions:

- (i) It decolourises an acidified  $K_2Cr_2O_7$  solution  
 (ii) On boiling with  $H_2O_2$ , cooling it and then adding an aq solution of  $BaCl_2$ , a precipitate insoluble in dilute  $HCl$  is obtained.  
 (iii) On passing  $H_2S$  in the solution, white turbidity is obtained.  
 Then X is:

- a)  $SO_2$  b)  $SO_3$  c)  $CO_2$  d)  $CO$

29. Compounds A and B are treated with dilute  $HCl$  separately. The gases liberated are Y and Z respectively. Y turns acidified potassium dichromate paper green while Z turns lead acetate paper black. The compounds A and B are respectively:

- a)  $Na_2SO_3$  and  $Na_2S$  b)  $Na_2S$  and  $Na_2SO_3$   
 c)  $Na_2SO_3$  and  $Na_2SO_4$  d)  $NaCl$  and  $Na_2CO_3$

30. The correct order of decreasing stability of hexafluorides of group 16 members is:

- a)  $TeF_6 > SeF_6 > SF_6$  b)  $SF_6 > TeF_6 > SeF_6$   
 c)  $SeF_6 > SF_6 > TeF_6$  d)  $TeF_6 > SF_6 > SeF_6$

31. Which of the following statements regarding the manufacture of  $H_2SO_4$  by contact process is not true.

- a) Sulphur is burnt in air to form  $SO_2$   
 b)  $SO_2$  is catalytically oxidised to  $SO_3$   
 c)  $SO_3$  is dissolved in water to get 100% sulphuric acid  
 d)  $H_2SO_4$  obtained by contact process is of higher purity than obtained by lead chamber process.

32. Which of the following is incorrect?

- a)  $O_2$  is weaker oxidant than  $O_3$   
 b)  $O_2$  has small bond length than  $O_3$   
 c) both  $O_2$  and  $O_3$  are paramagnetic  
 d)  $O_3$  is angular in shape

33. A white solid reacts with dilute  $HCl$  to give colourless gas that de-colourises aqueous bromine. The solid is likely to be.

- a) Sodium carbonate b) Sodium chloride  
 c) Sodium acetate d) Sodium thiosulphate

34. When concentrated sulphuric acid was treated with potassium ferrocyanide,  $CO$  gas was evolved. By mistake, somebody used dilute sulphuric acid instead of concentrated sulphuric acid, then the gas evolved was:

- a)  $CO$  b)  $HCN$  c)  $N_2$  d)  $CO_2$

35. Identify the incorrect statement

- a)  $SF_6$  is known but not  $SCl_6$   
 b) There are two ' $d\pi - p\pi$ ' bonds in  $SO_2$   
 c) In  $\gamma - SO_3$  there are six ' $S - O'$  and ' $S = O'$  bonds  
 d)  $SO_2$  is more powerful reducing agent in alkaline medium than in acidic medium.

36. Which of the following species has the same number of X-O-X linkages, where X=S or P?

- I.  $S_4O_6^{2-}$  II.  $S_3O_6$  III.  $S_2O_3^{2-}$  IV.  $P_3O_9^{3-}$

- a) II and III b) II and IV c) I and II d) I and IV

37. Which has the smallest bond angle  $X - S - X$  in the given molecules? ( $X=F, Cl, Br, I$ )

- a)  $SOF_2$  b)  $SOCl_2$  c)  $SOBr_2$  d)  $SOI_2$

38. Choose correct statement:

- a)  $Na_2S_2O_3 \cdot 5H_2O$  cannot be dehydrated to  $Na_2S_2O_3$  on heating at  $215^\circ C$

- b) Hypo forms penta sulphide on heating at or above 500K

- c) The reaction of chlorine with hypo is an oxidation reaction involving change in oxidation of both sulphur atoms from +2.5 to +6.

- d) A dilute solution of hypo gives a white precipitate with both  $BaCl_2$  and  $CaCl_2$

39. Which one of the following does not give tetrathionate as the product, when treated with an aq solution of hypo?

- a)  $Cl_2$  b)  $I_2$  c)  $CuCl_2$  d)  $FeCl_3$

## 16TH GROUP ELEMENTS

40. A calculated amount of  $I_2$  is used in the preparation of hypo by Spring's reaction because:  
 a) Hypo oxidises  $I_2$  if excess  $I_2$  is present  
 b) Excess  $I_2$  oxidises hypo  
 c) Excess hypo decreases the solubility of  $I_2$  in water  
 d) Hypo and  $I_2$  form an addition compound

## MULTIPLE ANSWER QUESTIONS

41. Identify the correct statement(s)?  
 a) Ozone is a powerful oxidising agent as compared to dioxygen  
 b) Ozone reacts with KOH and gives an orange coloured solid  $KO_3$   
 c) There is a decrease in volume when ozone decomposed to form  $O_2$   
 d) The decomposition of  $O_3$  to  $O_2$  is exothermic
42. Which one of the following statement(s) is/are correct?  
 a) Nitric acid cannot be used to prepare  $H_2S$   
 b) Liquid  $O_2$  sticks to magnetic poles but liquid  $N_2$  do not  
 c) Ozone destroys mercury meniscus  
 d) Oxygen is not evolved during oxidation of  $SnCl_2$  to  $SnCl_4$  by ozone in acidic medium
43. Which of the following order represents correctly according to the property given:  
 a)  $H_2O > H_2S > H_2Se > H_2Te$ : polarity of the molecule  
 b)  $H_2Te > H_2Se > H_2O > H_2S$ : boiling points  
 c)  $H_2O > H_2S > H_2Se > H_2Te$ : bond angles  
 d)  $S > Se > Te > O$ : electron affinity
44. Which one of the following basic radical(s) is/are precipitated as sulphides in acidic medium in qualitative analysis?  
 a)  $Pb^{2+}$  b)  $Cu^{2+}$  c)  $Cd^{2+}$  d)  $Zn^{2+}$

45. Which one of the following statement(s) is/are correct regarding  $SO_2$ ?  
 a) It acts as both an oxidising agent and reducing agent  
 b) Bleaching action of  $SO_2$  is due to its reducing nature  
 c) It is more acidic than  $SO_3$   
 d) Bleaching action of  $SO_2$  is due to its oxidising nature
46. In which of the following cases, the element is oxidised into its highest oxidation state when it reacted with ozone under moist condition.  
 a) S b)  $I_2$  c) P d) As

47. Which of the following statements are true about sodium thiosulphate?  
 a) It is used in the estimation of iodine  
 b) It gives a white precipitate with  $AgNO_3$ , which turns black on standing  
 c) It is used to remove the unexposed AgBr from photographic films  
 d) The reaction of sodium thiosulphate with iodine gives sodium sulphite.
48. When a compound X reacts with ozone in aq medium, a compound Y is produced. Ozone also reacts with moist Y and produces compound Z. Z acts as an oxidising agent, then X, Y and Z will be:  
 a) X = HI, Y =  $I_2$  and Z =  $HIO_3$   
 b) X = KI, Y =  $I_2$  and Z =  $HIO_3$   
 c) X = KI, Y =  $I_2$  and Z =  $HIO_4$   
 d) X = HI, Y =  $I_2$  and Z =  $HIO_4$
49. Which one of the following is/are cannot be hydrolysed?  
 a)  $TeF_6^-$  b)  $SiF_6^-$  c)  $NCl_3$  d)  $NF_3$
50. Which statements are correct for ozone?  
 a) It is obtained by silent electric discharge on oxygen  
 b) It can be obtained by the action of ultraviolet rays on oxygen(modified)  
 c) It is regarded as an allotrope of oxygen  
 d) Ozone molecule is paramagnetic like oxygen molecule.

## 16TH GROUP ELEMENTS

## JEE-ADV CHEM-VOL-III

51. Which of the following statement(s) is/are incorrect for  $SF_4$  molecule?  
 a) It has a square planar shape with S - atom having two lone pairs  
 b) All S - F bonds are equal in length  
 c) It is hydrolysed by water  
 d)  $H_2SO_4$  is the final product during the hydrolysis of  $SF_4$
52. Which of the following statement(s) is/are correct?  
 a) Caro's acid has sulphur atom in  $sp^3$  hybridised state  
 b) Caro's acid contains one peroxy linkage  
 c) Cane sugar reacts with concentrated sulphuric acid to form oxalic acid  
 d) The reaction of sodium thiosulphate with iodine gives sodium sulphite.
53. Which of the following is/are not oxidised by ozone?  
 a)  $K_2MnO_4$  b)  $Fe_2(SO_4)_3$   
 c)  $KMnO_4$  d)  $K_2Cr_2O_7$
54. Which of the following does not give hydrogen peroxide on hydrolysis?  
 a)  $H_2S_2O_3$  b)  $H_2SO_3$  c)  $H_2S_2O_7$  d)  $H_2S_4O_6$
55. Which of the following does not have O - O linkage but have sulphur - sulphur linkage?  
 a)  $S_2O_8^{2-}$  b)  $S_2O_6^{2-}$  c)  $S_2O_5^{2-}$  d)  $S_2O_3^{2-}$
56. Which of the following compounds can be used for drying of  $H_2S$  gas  
 a) Conc.  $H_2SO_4$  b)  $P_2O_5$   
 c) fused  $CaCl_2$  d) anhydrous  $Al_2O_3$
57. Which of the following statement(s) is/are true about ozone?  
 a) It is a pale blue gas at room temperature  
 b) It oxidises S and P evolving oxygen gas  
 c) It oxidises  $SnCl_2/HCl$  and  $SO_2$  evolving oxygen gas  
 d) It reacts with  $BaO_2$  and  $H_2O_2$  evolving oxygen gas
58. Which one of the following is/are true for  $O_3$ ?  
 a) It oxidises lead sulphide  
 b) It oxidises potassium iodide  
 c) It oxidises mercury  
 d) It cannot act as bleaching agent in dry state.
59. Which of the following solution(s) change its colour on passing ozone through it is/are:  
 a) starch iodide solution  
 b) alcoholic solution of benzidine  
 c) acidic solutions of potassium dichromate  
 d) acidified solution of ferrous sulphate
60. Which one of the following about  $CH_2SF_4$  and  $SiF_4, SOF_4, OCF_2$  molecules is/are incorrect?  
 a) Equatorial F-SF bond angle in  $SiF_4$  will be less than in  $SF_4$  molecule  
 b) The two hydrogens, carbon, sulphur and two fluorines of equatorial position in molecule  $CH_2SF_4$  will be lying in the same plane.  
 c) The axial F-SF bond angle in  $SiF_4$  =  $180^\circ$   
 d) The bond angle FCO will be  $< 120^\circ$  in molecule  $OCF_2$
61. Sulphur having same oxidation state is:  
 a)  $H_2S_2O_8$  b)  $H_2S_2O_7$  c)  $H_2SO_5$  d)  $H_2S_2O_5$
62. Which of these statements incorrectly compare between  $SF_4$  and  $SiF_4$ ?  
 a) both molecule have same hybridisation for S atom  
 b) both molecules have at least one linear F - S - F link  
 c)  $SiF_4$  has higher boiling point than  $SF_4$   
 d)  $SF_4$  reacts vigorously with water whereas  $SiF_4$  is inert towards water
63. In  $SOCl_2$  and  $SO_2Cl_2$  which are incorrect  
 a) The oxidation states of sulphur is same  
 b) The hybridization states of sulphur is same  
 c) The shape of both  $SOCl_2$  and  $SO_2Cl_2$  are same  
 d) The  $CISCl$  angle in both  $SOCl_2$  and  $SO_2Cl_2$  is same



Gas B is passed into aqueous solution C to form A. Select the correct statement based on the above facts

a) Colour of C changes from yellow to very light green  
b) Gas 'B' turns lead acetate paper black

c) A form deep blue colour with  
d) 'B' act as both lewis acid as well as lewis base

e) Which of the following order represents correctly according to the property given?

a)  $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$ : order of acidic strength  
b)  $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$ : polarity of the molecule

c)  $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$ : reducing nature  
d)  $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$ : thermal stability

e) It turns starch iodide paper blue

f) Its reaction with cold water is a co proportionation reaction

g) Its reaction with cold water is a disproportionation reaction

h) It turns starch iodide paper blue

i) Its reaction with cold water is a co proportionation reaction

j) Its reaction with cold water is a disproportionation reaction

Passage-I : (QNo: 66 to 68)

Gas X and Gas Y in solution state react to give a turbid substance Z. X has unpleasant odour and turns lead acetate paper black. In the first reaction X is oxidised and Y is reduced. Y on further oxidation with  $\text{O}_3$  gives a compound W

66. X and Y are:

a)  $\text{SO}_2$  and  $\text{SO}_3$   
b)  $\text{H}_2\text{S}$  and  $\text{SO}_2$

c)  $\text{CO}_2$  and  $\text{SO}_2$   
d)  $\text{SO}_2$  and  $\text{O}_3$

67. The gas formed when Y reacts with ozone is:

a)  $\text{O}_2$   
b)  $\text{SO}_2$   
c)  $\text{H}_2\text{S}$   
d)  $\text{SO}_3$

68. In which of the following reactions also the above turbidity(Z) is seen

a)  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Na}_2\text{SO}_3 \xrightarrow{\text{acidic medium}}$   
b)  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Cl}_2 + \text{H}_2\text{O} \rightarrow$   
c)  $\text{SCL}_4 + \text{H}_2\text{O} \rightarrow$   
d)  $\text{SO}_2 + \text{H}_2\text{O}_2 \rightarrow$

Passage-II : (QNo: 69 to 72)

(A) yellow solid  
Boiling with (C)  
 $\xrightarrow{\text{Conc HNO}_3}$   
acidification  
(D) (E)  
(colourless gas) + (white turbidity)

69. Yellow solid is:

a)  $\text{H}_2\text{SO}_4$ , b)  $\text{S}_2\text{O}_8$ , c) Sulphur d)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$

e)  $\text{H}_2\text{O}_2$  is used as a bleaching agent in presence of moisture

f) Assertion: The bleaching action of  $\text{SO}_2$  is due to its oxidising nature

g) Assertion: Number of S-S bonds in  $\text{H}_2\text{S}_n\text{O}_6$  is (n-1)

h) Assertion:  $\text{H}_2\text{S}_2\text{O}_6$  shows  $\text{HO}_2\text{S}-\text{S}_{(n-2)}-\text{SO}_2\text{H}$  essentially liberates  $\text{O}_2$

i) Assertion:  $3\text{SnCl}_4 + 6\text{HCl} + \text{O}_2 \rightarrow 3\text{SnCl}_4 + 3\text{H}_2\text{O}$  is possible reaction showing oxidising nature of  $\text{O}_2$  and by reduction

j) Assertion: Bleaching action of  $\text{SO}_2$  is temporary due to crowding in  $\text{SCl}_6$  makes it unstable

Passage-III : (QNo: 73 to 75)

Sulphur forms hexahalides tetrahalides dihalides and monohalides. Sulphur forms only exafluoride but not hexachlorides, hexabromides and hexiodides. Sulphur halides tend to hydrolyse easily. Sulphur hexafluoride is an exception of the oxo halides the most important are those of sulphur especially sulphur dichloride oxide (Thionyl chloride)  $\text{SO}_2\text{Cl}_2$  and sulphur dichloride dioxide (sulphonyl chloride)  $\text{SO}_2\text{Cl}_2$ . These also hydrolyse in water.

73.  $\text{SF}_6$  do not hydrolyse in water because

a) Due to strong S-F bonds which cannot be broken easily

b) Because of steric hindrance of six fluorine atoms surrounding sulphur  $\text{H}_2\text{O}$  molecules cannot approach sulphur

c) Due to double bond character of S-F bonds because of back bonding from fluorine to sulphur

d) All the above

74. Thionyl chloride is dissolved in water. Which of the following statement is wrong about the solution?

a) The solution will give white precipitate with barium water soluble in dil.  $\text{HCl}$

b) The solution turns orange dichromate to green

c) The solution turns the lead acetate paper to black

d) The solution is acidic in nature

75. Sulphuryl chloride is dissolved in water. which of the following statement is wrong about the solution.

a) Give white ppt with barium chloride in soluble in any acid

b) The solution contain two different types of acids a monobasic and a dibasic acid

c) The solution can decolorize the permanganate

d) The osication states of the elements is  $\text{SO}_2\text{Cl}_2$  donot change when dissolved in water

### MATRIX MATCHING QUESTIONS

### ASSERTION & REASONING QUESTIONS

81. Assertion: Conc  $\text{H}_2\text{SO}_4$  is not used to prepare HBr from  $\text{KBr}$

Reason: Sulphuric acid oxidises HBr to Br<sub>2</sub>

Assertion:  $\text{SO}_2$  is used as a bleaching agent in presence of moisture

Reason: The bleaching action of  $\text{SO}_2$  is due to its oxidising nature

83. Assertion: Number of S-S bonds in  $\text{H}_2\text{S}_n\text{O}_6$  is (n-1)

84. Assertion:  $\text{H}_2\text{S}_2\text{O}_6$  shows  $\text{HO}_2\text{S}-\text{S}_{(n-2)}-\text{SO}_2\text{H}$  essentially liberates  $\text{O}_2$

Reason:  $3\text{SnCl}_4 + 6\text{HCl} + \text{O}_2 \rightarrow 3\text{SnCl}_4 + 3\text{H}_2\text{O}$  is possible reaction showing oxidising nature of  $\text{O}_2$  and by reduction

85. Assertion: Bleaching action of  $\text{SO}_2$  is temporary due to crowding in  $\text{SCl}_6$  makes it unstable

Reason: Due to large size of Cl-atom, steric

oxidation by air

86. Assertion:  $\text{SF}_6$  is known but  $\text{SCl}_6$  is not known

Reason: The colour of material is regained due to oxidation by air

87. Assertion: Cyclic trimer of  $\text{SO}_3$  possesses have six membered hetero cyclic chains made up of S and O atoms

Reason: Cyclic trimer of  $\text{SO}_3$  is referred as  $\text{Y}-\text{SO}_3$

88. Assertion:  $\text{S}_2\text{O}_8^{2-}$  ion acts as an oxidising agent

Reason: S-S linkage is not present in this ion

89. Assertion: The thermal stability of hydrides of oxygen family decreases with molecular weight

Reason: The decomposition of M - H bond requires lesser energy in O - H than S - H.

90. Assertion:  $\text{SF}_6$  is known but  $\text{OF}_6$  is not.

Reason: Electron affinity of oxygen is less than sulphur

91. Assertion: Ozone is a powerful oxidising agent in comparison to  $\text{O}_2$

Reason: Ozone is diamagnetic while  $\text{O}_2$  is paramagnetic.

92. Assertion:  $\text{SeCl}_4$  does not have a tetrahedral structure

Reason: Se in  $\text{SeCl}_4$  has two lone pairs

93. Assertion:  $\text{SO}_2$  acts as an oxidising agent as well as a reducing agent

Reason:  $\text{SO}_2$  acts as an oxidising as well as a reducing agent

94. Assertion:  $H_2S_2O_3$  and  $H_2SO_3$  act as an oxidising agent while  $H_2S_2O_4$  can't  
Reason:  $H_2S_2O_3$  and  $H_2SO_3$  both have O-O bond while in  $H_2S_2O_4$ , molecule S=O bond is present

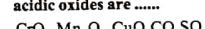
95. Assertion: Sodium thiosulphate is not prepared by boiling  $Na_2SO_3$  with sulphur in acidic medium  
Reason:  $Na_2S_2O_3 + H^+ \rightarrow 2Na^+ + H_2SO_4 + S \downarrow$

### INTEGER TYPE QUESTIONS

96. Let us consider the gases:  $H_2S, CO_2$  and  $NH_3$ . How many of these gases can be dried by conc  $H_2SO_4$ ?

97.  $O_3$  reacts with dry iodine to form an oxide having 'x' number of oxygen atoms in its molecule. 'x' is:

98. Number of  $sp^3$  atoms in tetrathionic acid:  
99. Among the oxides given below the number of acidic oxides are ....



100. Among the following the number of compounds that can act as dehydrating agent are ....  
Conc.  $H_2SO_4$ , Anhyd.  $CaCl_2$ , Conc.  $HNO_3$ ,  $CaO$ ,  $CuSO_4 \cdot 5H_2O$ ,  $P_2O_5$

### LEVEL-VI - KEY

#### SINGLE ANSWER

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

#### MULTI ANSWER

- 41.abd 42.abcd 43.acd 44.abc  
45.ab 46.acd 47.abcd 48.ab  
49.bcd 50.abc 51.abd 52.ab  
53.bcd 54.acd 55.bcd 56.bcd  
57.abd 58.abc 59.abd 60.ab  
61.abc 62.abc 63.acd 64. abcd  
65. abd

#### COMPREHENSION TYPE

- Passage-I : 66.b 67.d 68.b  
Passage-II : 69.c 70.b 71.b 72.c  
Passage-III : 73.b 74.c 75.c

#### MATRIX MATCHING TYPE

76. a - q; b - r; c - pt; d - t

77. a - p; b - pr; c - qs; d - s

78. a - qr; b - qr; c - ps; d - pt

79. a - rs; b - p; c - q; d - r

80. a - qrt; b - q; c - pq; d - qst

#### ASSERTION - REASON TYPE

- 81.a 82.c 83.b 84.d 85.a 86.a  
87.b 88.b 89.c 90.b 91.b 92.c

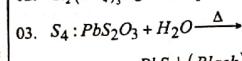
93.d 94.b 95.a

#### INTEGER TYPE

- 96.1 97.9 98.6 99.3 100.4

#### LEVEL-VI - HINTS

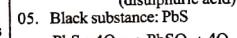
02.  $Cr_2(SO_4)_3$ : green;  $H_2S$ : reducing agent



04. Marshall's acid:  $H_2S_2O_8$  (perdisulphuric acid)

Caro's acid:  $H_2SO_5$  (permonosulphuric acid)  
Oleum:  $H_2S_2O_7$  (pyrosulphuric acid)  
(disulphuric acid)

05. Black substance:  $PbS$

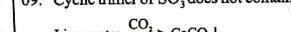


06. Cyclic trimer of  $SO_3$  contains six S=O bonds and three S-O-S bonds.

07. Oxidation state = zero; Valency = 2

08. Bond angle in ozone: 116.8°

09. Cyclic trimer of  $SO_3$  does not contain S-S bonds



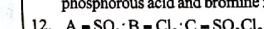
↓ excess  $CO_2$



↓ excess  $SO_2$

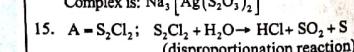


11. Meta phosphoric acid is prepared by heating phosphorous acid and bromine in a sealed tube

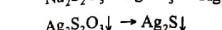
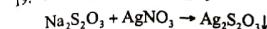
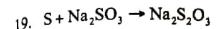
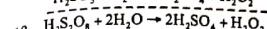
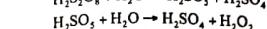
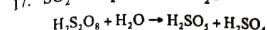
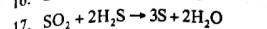


14. White precipitate:  $Ag_2S_2O_3$

Complex is:  $Na_3[Ag(S_2O_3)_2]$

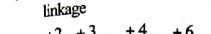


16. Conc  $H_2SO_4$  oxidises  $H_2S$  to S

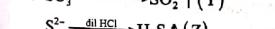
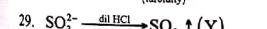
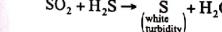
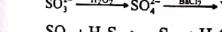
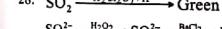
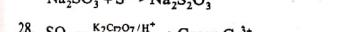
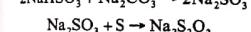
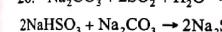
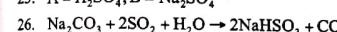
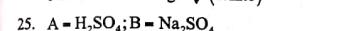
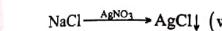
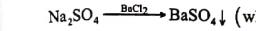
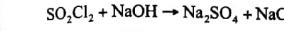
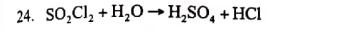
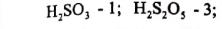
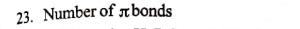


(black)

20.  $S_3O_9$ : cyclic trimer of  $SO_3$ ; contains S-O-S linkage



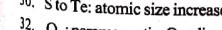
23. Number of  $\pi$  bonds



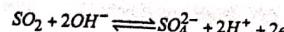
30. S to Te: atomic size increases

32.  $O_2$ : paramagnetic;  $O_3$ : diamagnetic

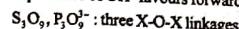
33.  $(HO)_2SO_2 + 2PCl_3 \rightarrow SO_2Cl_2 + 2POCl_3 + 2HCl$



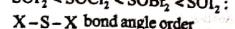
35. The reducing property is represented as



Addition of acid favours reverse reaction where as presence of  $OH^-$  favours forward reaction.



: three X-O-X linkages

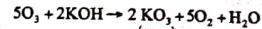
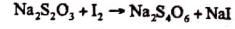


X-S-X bond angle order

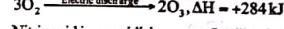
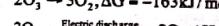
38. Hypo forms pentasulphide on heating at or above 500K



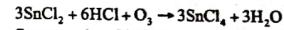
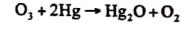
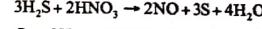
40. Excess  $I_2$  oxidises hypo.



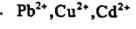
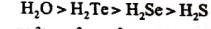
(orange)



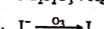
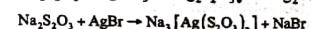
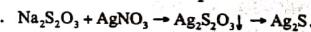
42. Nitric acid is an oxidising agent. It will oxidise  $H_2S$ .



43. Correct order of boiling points is.



45.  $SO_2$  is more acidic than  $SO_3$

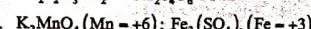
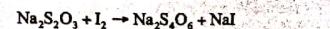
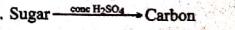
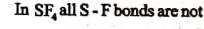


49.  $SF_6, NF_3$  : does not undergo hydrolysis

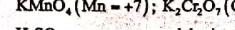
50.  $O_2$  : paramagnetic;  $O_3$  : diamagnetic

51.  $SF_4$  : see saw (one lone pair)

In  $SF_4$ , all S-F bonds are not equal in length



54.  $H_2SO_5$  - peroxy monosulphuric acid



## 16TH GROUP ELEMENTS

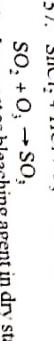
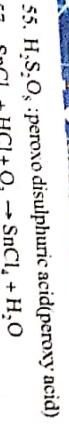
55. $\text{H}_2\text{S}_2\text{O}_8$ : peroxy disulphuric acid(peroxy acid)	$\text{Ag}^+ + 2\text{S}_2\text{O}_4^{2-} \rightarrow [\text{Ag}(\text{S}_2\text{O}_4)_2]^{3-}$
57. $\text{SnCl}_2 + \text{HCl} + \text{O}_2 \rightarrow \text{SnCl}_4 + \text{H}_2\text{O}$	$\text{Na}_2\text{S}_2\text{O}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{SO}_2 + \text{S} + \text{H}_2\text{O}$
58. It can act as bleaching agent in dry state.	$\text{SO}_3 + \text{O}_2 \rightarrow \text{SO}_4$
59. $\text{I}^- \xrightarrow{\text{O}_2} \text{I}_2$ (blue)	$\text{alcoholic benzidine} \xrightarrow{\text{O}_2} \text{brown}$
61. Compound oxidation state of sulphur	$\text{Fe}^{2+}/\text{H}^+ \xrightarrow{\text{O}_2} \text{Fe}^{3+} : \text{Cr}_2\text{O}_7^{2-} - \text{Cr}(+6)$
$\text{H}_2\text{S}_2\text{O}_8$ +6	$\text{SO}_3 + 2\text{HBr} \rightarrow \text{SO}_2 + \text{Br}_2 + \text{H}_2\text{O}$
$\text{H}_2\text{S}_2\text{O}_7$ +6	$\text{H}_2\text{SO}_4 + 2\text{PCl}_5 \rightarrow \text{SO}_2 + \text{Cl}_2 + 2\text{POCl}_3 + 2\text{HCl}$
$\text{H}_2\text{SO}_5$ -6	
$\text{H}_2\text{S}_2\text{O}_4$ +4	
62. $\text{SF}_6$ : sp <sup>3</sup> d hybridised sulphur	
$\text{SF}_6$ : sp <sup>3</sup> d <sup>2</sup> hybridised sulphur	
$\text{SF}_6$ : polar ( $\text{BP} = -40^\circ\text{C}$ )	
$\text{SF}_6$ : non-polar ( $\text{BP} = -63^\circ\text{C}$ )	
63. $\text{N} = \frac{\text{Volume strength}}{5.6} : \left( \frac{\text{H}}{17} \% = \frac{17}{54} \times \text{Vol. Str} \right)$	
64. $\text{H}_2\text{O}$ is a polar molecule	
65. $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$ : reducing nature	
<b>Passage-I (QNo: 66 to 68)</b>	
X = $\text{H}_2\text{S}$ , Y = $\text{SO}_2$	
$\text{H}_2\text{S} + \text{SO}_2 \rightarrow \text{S} + \text{H}_2\text{O}$	
$\text{SO}_2 + \text{O}_3 \rightarrow \text{SO}_3$	
$\text{Na}_2\text{S}_2\text{O}_3 + \text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{Na}_2\text{SO}_4 + \text{HCl} + \text{S}$	
<b>Passage-II (QNo: 69 to 71)</b>	
B = $\text{NO}_2$ ; C = $\text{Na}_2\text{S}_2\text{O}_3$ ; D = $\text{SO}_2$ ; E = S	
<b>MATRIX MATCHING QUESTIONS</b>	
76. Dithionic acid: $\text{H}_2\text{S}_2\text{O}_6$ ;	
Thiosulphuric acid: $\text{H}_2\text{S}_2\text{O}_3$ ;	
Caro's acid: $\text{H}_2\text{SO}_5$ (peroxo acid)	
Marshall's acid: $\text{H}_2\text{S}_2\text{O}_6$ (peroxo acid)	
77. $\text{S}_2\text{O}_8$ - cyclic trimer of $\text{SO}_3$	
78. $\text{H}_2\text{S}_2\text{O}_8$ contain S-O-O-S linkage	
$\text{H}_2\text{SO}_3, \text{H}_2\text{S}_2\text{O}_8$ : peroxy acids	
$\text{H}_2\text{S}_2\text{O}_3$ : contains S=S linkage	
79. $\text{Na}_2\text{S}_2\text{O}_3 + 4\text{Cl}_2 + 5\text{H}_2\text{O} \rightarrow 2\text{NaHSO}_4 + 8\text{HCl}$	

## PREVIOUS IIT QUESTIONS

### SINGLE CORRECT ANSWER TYPE

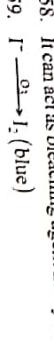
1. There is no S - S(single/double) bond in

(IIT 1991)



(IIT JEE - 2010)

a)  $\text{SO}_3$  b)  $\text{BrF}_3$  c)  $\text{SiO}_3^{2-}$  d)  $\text{OSF}_2$



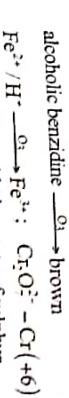
(IIT 1996)

a) two moles of sulphuric acid

b) two moles of peroxy monosulphuric acid

c) one mole of sulphuric acid, one mole of peroxymonosulphuric acid and one mole of hydrogen peroxide

d) one mole of sulphuric acid and one mole of peroxymonosulphuric acid



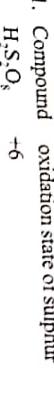
(IIT JEE - 2013)

a) Both A and R are correct and R is the correct explanation of A

b) Both A and R are correct and R is the not correct explanation of A

c) Both A and R are correct and R is the correct explanation of A

d) Both A and R are correct and R is the not correct explanation of A



(IIT 1999)

a) angular and non-zero b) angular and zero

c) linear and zero d) linear and non-zero



(IIT 1999)

a) 0,+1 and +5 b) +2,+1 and -2

c) 0,+1 and -2 d) -2,+1 and -2



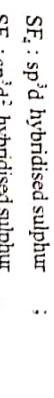
(IIT 2000)

a)  $\text{H}_2\text{O}$  because of hydrogen bonding

b)  $\text{H}_2\text{Te}$  because of higher molecular weight

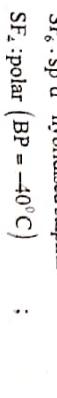
c)  $\text{H}_2\text{S}$  because of hydrogen bonding

d)  $\text{H}_2\text{Se}$  because of lower molecular weight



(IIT 2001)

a) 3 b) 2 c) 1 d) zero



(IIT 2004)

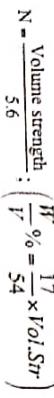
a) Both A and R are correct and R is the correct explanation of A

b) Both A and R are correct and R is the not correct explanation of A



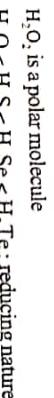
(IIT 2008)

a)  $\text{Na}_2\text{S}_4\text{O}_6$  b)  $\text{NaHSO}_4$  c)  $\text{NaCl}$  d)  $\text{NaOH}$



(IIT JEE - 2010)

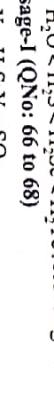
a)  $\text{SO}_3$  b)  $\text{BrF}_3$  c)  $\text{SiO}_3^{2-}$  d)  $\text{OSF}_2$



(IIT JEE - 2013)

a)  $\text{K}_2\text{Cr}_2\text{O}_7$  b)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$

c)  $\text{KClO}_3$  d)  $\text{Zn}(\text{ClO}_3)_2$



(IIT JEE - 2016)

$\text{S}_2\text{O}_3^{2-} \xrightarrow{\text{Ag}^+} \text{X} \xrightarrow{\text{Ag}^+} \text{Y} \downarrow \xrightarrow{\text{with time}} \text{Z} \downarrow$

(Black)



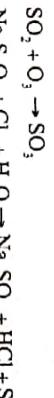
(IIT JEE - 2014)

a)  $\text{Na}$  and excess of  $\text{NH}_3$

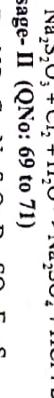
b) K and excess of  $\text{O}_2$

c)  $\text{Cu}$  and dilute  $\text{HNO}_3$

d)  $\text{O}_2$  and 2-ethylanthraquinol



O, Cl, F, N, P, Sn, Ti, Na, Ti (IIT JEE - 2010)



(IIT JEE - 2010)

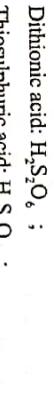
a) 2 b) 3 c) 4 d) 5



In neutral or faintly alkaline solution, 8 moles of permanganate anion quantitatively oxidised

thiosulphate anions to produce X moles of a sulphur containing product, the magnitude of X is

(IIT JEE - 2016)



permanganate anion quantitatively oxidised

thiosulphate anions to produce X moles of a sulphur containing product, the magnitude of

X is

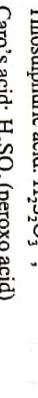
(IIT JEE - 2016)

Green solution X and Y are:

(IIT 2003)

a)  $\text{SO}_3^{2-}, \text{SO}_2$  b)  $\text{Cl}^-, \text{HCl}$

c)  $\text{S}^{2-}, \text{H}_2\text{S}$  d)  $\text{CO}_3^{2-}, \text{CO}_2$



a)  $\text{H}_2\text{S}_2\text{O}_3$  b)  $\text{H}_2\text{S}_2\text{O}_6$  c)  $\text{H}_2\text{S}_2\text{O}_8$  d)  $\text{H}_2\text{S}_2\text{O}_6$

20. Which of the following is not oxidised by  $\text{O}_3$ ? (IIT 2005)

a)  $\text{KI}$  b)  $\text{FeSO}_4$  c)  $\text{KMnO}_4$  d)  $\text{K}_2\text{MnO}_4$

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## PREVIOUS IIT - KEY

55. 01) d 02) d 03) a 04) c 05) a 06) d  
07) a 08) c 09) c 10) b 11) d 12) b  
13) a

## MULTIPLE CORRECT ANSWERS TYPE

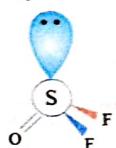
- 14) a, b, c

## INTEGER ANSWER TYPE

- 15) 2 16) 3 17) 5 18) 6

## PREVIOUS IIT - HINTS

61.  $S_2O_3^{2-}$  contains S - O - S linkage  
62.  $H_2S_2O_3 + H_2O \rightarrow H_2SO_3 + H_2SO_4$   
03. bent, non-zero  
04. 0, -1, -2  
05.  $H_2S < H_2Se < H_2Te < H_2O$ : boiling point  
06.  $S_2O_3$  contains three S - O - S linkages  
07.  $X = SO_3^{2-}$ ;  $Y = SO_2$ , Green  $Cr^{3+}$   
08. Peroxodisulphuric acid:  $H_2S_2O_8$

09.  $KMnO_4$ 10.  $Na_2S_2O_3 + 4Cl_2 + 5H_2O \rightarrow 2NaHSO_4 + 8HCl$ 11.  $OSF_2$ 

Pa 52.  $sp^3$  Hybridisation, three bond pairs, one lone pair, pyramidal shape.

12.  $(NH_4)_2Cr_2O_7$  on heating gives  $N_2(g)$ .

76.  $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$   
whereas compounds is (a), (c) and (d) all gives oxygen on heating.

a)  $4K_2Cr_2O_7 \xrightarrow{\Delta} 4K_2CrO_4 + 2Cr_2O_3 + 3O_2$ 

77. When  $K_2Cr_2O_7$  is heated it decomposes with the evolution of  $O_2$

c)  $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2(g)$ 

Potassium chlorate

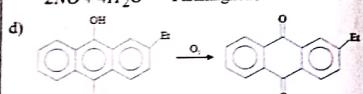
79

- d)
- $Zn(ClO_3)_2 \xrightarrow{\Delta} ZnCl_2 + 3O_2(g)$

Zinc chloride

## MULTIPLE CORRECT ANSWERS TYPE

14. a)
- $Na + (x+y)NH_3 \rightarrow Na^\oplus(NH_3)x +$

 $e^-(NH_3)_y \rightarrow$  Paramagneticb) K + excess  $O_2 \rightarrow KO_2$  (superoxide)  $\rightarrow$  Paramagneticc)  $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 +$  $2NO + 4H_2O \rightarrow$  Paramagnetic $+ H_2O \rightarrow$  Diamagnetic

## INTEGER ANSWER TYPE

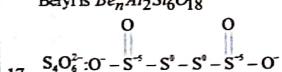
15. Among the following O, Cl, F, N, P, Ti, Na, Ti,
- 
- the number elements showing only one non-zero oxidation state is 2. (F and Na)

16. The value of n in the molecular formula

 $Be_nAl_2Si_6O_{18}$  is 3.

$$2n + (2 \times 3) + (4 \times 6) + (18 \times 2) = 0$$

or n = 3

Beryl is  $Be_nAl_2Si_6O_{18}$ 

So difference in oxidation number of two types of S - atom = (5 - 0) = 5

- 18.
- $MnO_4^- + S_2O_3^{2-} \rightarrow MnO_2 + SO_4^{2-}$

Equivalents of  $MnO_4^-$  = Equivalents of  $SO_4^{2-}$ Moles of  $MnO_4^- \times n$  - factor = moles of $SO_4^{2-} \times n$  - factor.

$$8 \times 3 = x \times 4, \quad \therefore x = 6$$