Chapter 16(A)

The *p*-Block Elements (Group 13 to Group 14)

1. In bond dissociation energy of B-F in BF_3 is 646 kJ mol^{-1} whereas that of C-F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B-F bond dissociation energy as compared to that of C-F is

[AIEEE-2009]

(1) Stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4

(2) Significant $p\pi$ - $p\pi$ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C an F in CF_4

(3) Lower degree of $p\pi$ - $p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4

(4) Smaller size of B-atom as compared to that of C-atom

2. Which of the following are Lewis acids?

[JEE (Main)-2018]

(1) PH_3 and BCl_3 (2) $AlCl_3$ and CCl_4

(3) PH_3 and $SiCl_4$ (4) BCl_3 and $AlCl_3$

3. Correct statements among a to d regarding silicones are

(a) They are polymers with hydrophobic character

(b) They are biocompatible

(c) In general, they have high thermal stability and low dielectric strength

(d) Usually, they are resistant to oxidation and used as greases **[JEE (Main)-2019]**

(1) (a), (b) and (d) only

(2) (a), (b), (c) and (d)

(3) (a), (b) and (c) only

(4) (a) and (b) only

4. The number of 2-centre-2-electron and 3-centre-2-electron bonds in B_2H_6 respectively are

[JEE (Main)-2019]

(1) 4 and 2 (2) 2 and 2

(3) 2 and 4 (4) 2 and 1

5. The chloride that CANNOT get hydrolysed is

[JEE (Main)-2019]

(1) $PbCl_4$ (2) CCl_4

(3) $SnCl_4$ (4) $SiCl_4$

6. The element that does NOT show catenation is

[JEE (Main)-2019]

(1) Sn (2) Ge

(3) Pb (4) Si

7. Diborane (B_2H_6) reacts independently with O_2 and H_2O to produce, respectively **[JEE (Main)-2019]**

(1) H_3BO_3 and B_2O_3 (2) HBO_2 and H_3BO_3

(3) B_2O_3 and H_3BO_3 (4) B_2O_3 and $[BH_4]^-$

8. C_{60}, an allotrope of carbon contains

[JEE (Main)-2019]

(1) 16 hexagons and 16 pentagons

(2) 18 hexagons and 14 pentagons

(3) 20 hexagons and 12 pentagons

(4) 12 hexagons and 20 pentagons

9. The correct statements among I to III regarding group 13 element oxides are

(I) Boron trioxide is acidic.

(II) Oxides of aluminium and gallium are amphoteric.

(III) Oxides of indium and thallium are basic.

[JEE (Main)-2019]

(1) (II) and (III) only (2) (I) and (II) only

(3) (I), (II) and (III) (4) (I) and (III) only

10. The correct order of catenation is :

[JEE (Main)-2019]

(1) C > Si > Ge $\approx$ Sn

(2) C > Sn > Si $\approx$ Ge

(3) Si > Sn > C > Ge

(4) Ge > Sn > Si > C

11. The number of pentagons in C_{60} and trigons (triangles) in white phosphorus, respectively, are :

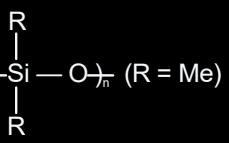
[JEE (Main)-2019]

(1) 20 and 3 (2) 12 and 3

(3) 12 and 4 (4) 20 and 4

12. The basic structural unit of feldspar, zeolites, mica, and asbestos is : **[JEE (Main)-2019]**

(1) $(SiO_4)^{4-}$

(2)  (R = Me)

(3) SiO_2

(4) $(SiO_3)^{2-}$

13. The C–C bond length is maximum in

[JEE (Main)-2019]

(1) graphite (2) C_{60}

(3) diamond (4) C_{70}

14. The correct statement among the following is

[JEE (Main)-2019]

(1) $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$

(2) $(SiH_3)_3N$ is pyramidal and more basic than $(CH_3)_3N$

(3) $(SiH_3)_3N$ is pyramidal and less basic than $(CH_3)_3N$

(4) $(SiH_3)_3N$ is planar and more basic than $(CH_3)_3N$

15. The relative stability of +1 oxidation state of group 13 elements follows the order **[JEE (Main)-2019]**

(1) Tl < In < Ga < Al

(2) Al < Ga < Tl < In

(3) Al < Ga < In < Tl

(4) Ga < Al < In < Tl

16. Aluminium is usually found in +3 oxidation state. In contrast, thallium exists in +1 and +3 oxidation states. This is due to **[JEE (Main)-2019]**

(1) Lattice effect

(2) Lanthanoid contraction

(3) Diagonal relationship

(4) Inert pair effect

17. The element that shows greater ability of form $p\pi - p\pi$ multiple bonds, is **[JEE (Main)-2019]**

(1) Sn (2) Si

(3) Ge (4) C

18. The reaction of $H_3N_3B_3Cl_3$ (A) with $LiBH_4$ in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $H_3N_3B_3(Me)_3$. Compounds (B) and (C) respectively, are **[JEE (Main)-2020]**

(1) Borazine and MeBr

(2) Borazine and MeMgBr

(3) Diborane and MeMgBr

(4) Boron nitride and MeBr

19. The correct statement about B_2H_6 is :

[JEE (Main)-2021]

(1) Terminal B – H bonds have less *p*-character when compared to bridging bonds.

(2) All B – H – B angles are of 120°.

(3) The two B – H – B bonds are not of same length.

(4) Its fragment, BH_3, behaves as a Lewis base.

20. Compound A is used as a strong oxidizing agent is amphoteric in nature. It is the part of lead storage batteries. Compound A is

[JEE (Main)-2021]

(1) Pb_3O_4 (2) $PbSO_4$

(3) PbO (4) PbO_2

21. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : In TlI_3, isomorphous to CsI_3, the metal is present in +1 oxidation state.

Reason R : Tl metal has fourteen f electrons in its electronic configuration.

In the light of the above statements, choose the most appropriate answer from the options given below : **[JEE (Main)-2021]**

(1) Both A and R are correct but R is NOT the correct explanation of A

(2) Both A and R are correct and R is the correct explanation of A

(3) A is correct but R is not correct

(4) A is not correct but R is correct

22. The **INCORRECT** statement regarding the structure of C_{60} is **[JEE (Main)-2021]**

(1) It contains 12 six-membered rings and 24 five-membered rings

(2) The six-membered rings are fused to both six and five-membered rings

(3) Each carbon atom forms three sigma bonds

(4) The five-membered rings are fused only to six-membered rings

23. Given below are the statements about diborane.

(a) Diborane is prepared by the oxidation of $NaBH_4$ with I_2.

(b) Each boron atom is in sp^2 hybridized state.

(c) Diborane has one bridged 3 centre-2-electron bond.

(d) Diborane is a planar molecule.

The option with **correct** statement(s) is:

[JEE (Main)-2021]

(1) (c) only (2) (a) and (b) only

(3) (c) and (d) only (4) (a) only

24. Which one of the following compounds of Groups-14 elements is not known?

[JEE (Main)-2021]

(1) $[GeCl_6]^{2-}$ (2) $[SiF_6]^{2-}$

(3) $[Sn(OH)_6]^{2-}$ (4) $[SiCl_6]^{2-}$

25. In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected? **[JEE (Main)-2021]**

(1) BBr_3 (2) BCl_3

(3) BI_3 (4) BF_3

26. Identify the correct statement for B_2H_6 from those given below:

(A) In B_2H_6, all B-H bonds are equivalent.

(B) In B_2H_6, there are four 3-centre-2-electron bonds.

(C) B_2H_6 is a Lewis acid.

(D) B_2H_6 can be synthesized from both BF_3 and $NaBH_4$.

(E) B_2H_6 is a planar molecule.

Choose the **most appropriate** answer from the options given below: **[JEE (Main)-2022]**

(1) (A) and (E) only (2) (B), (C) and (E) only

(3) (C) and (D) only (4) (C) and (E) only

27. Choose the correct stability order of group 13 elements in their +1 oxidation state.

[JEE (Main)-2022]

(1) Al < Ga < In < Tl (2) Tl < In < Ga < Al

(3) Al < Ga < Tl < In (4) Al < Tl < Ga < In

28. Match **List-I** with **List-II.**

List-I (Si-Compounds)	**List-II (Si-Polymeric/other Products)**
(A) $(CH_3)_4Si$	(I) Chain Silicone
(B) $(CH_3)Si(OH)_3$	(II) Dimeric Silicone
(C) $(CH_3)_2Si(OH)_2$	(III) Silane
(D) $(CH_3)_3Si(OH)$	(IV) 2D-Silicone

Choose the **correct** answer from the options given below: **[JEE (Main)-2022]**

(1) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

(2) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

(3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

(4) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

29. Match **List-I** with **List-II**.

List-I (Metal)	**List-II (Application)**
(A) Cs	(I) High temperature thermometer
(B) Ga	(II) Water repellent sprays
(C) B	(III) Photoelectric cells
(D) Si	(IV) Bullet proof vest

Choose the **most appropriate** answer from the options given below: **[JEE (Main)-2022]**

(1) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

(2) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(3) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

(4) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

30. Aqueous solution of which of the following boron compounds will be strongly basic in nature?

[JEE (Main)-2022]

(1) $NaBH_4$ (2) $LiBH_4$

(3) B_2H_6 (4) $Na_2B_4O_7$

31. The geometry around boron in the product 'B' formed from the following reaction is

$$BF_3 + NaH \xrightarrow{450\ K} A + NaF$$

$$A + NMe_3 \rightarrow B$$

[JEE (Main)-2022]

(1) Trigonal planar

(2) Tetrahedral

(3) Pyramidal

(4) Square planar

32. Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are:

[JEE (Main)-2022]

(1) $B(OH)_3$ and NH_3

(2) B_2H_6 and NH_3

(3) B_2H_6 and HN_3

(4) NH_3 and B_2O_3

33. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Boric acid is a weak acid

Reason R: Boric acid is not able to release H^+ ion on its own. It receives OH^- ion from water and releases H^+ ion.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below.

[JEE (Main)-2022]

(1) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**

(3) **A** is correct but **R** is not correct

(4) **A** is not correct but **R** is correct

34. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**

Assertion (A) : Boron is unable to form BF_6^{3-}

Reason (R) : Size of B is very small

In the light of the above statements, choose the correct answer from the options given below:

[JEE (Main)-2022]

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

(2) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**

(3) **(A)** is true but **(R)** is false

(4) **(A)** is false but **(R)** is true

❑ ❑ ❑

Chapter 16(B)

The *p*-Block Elements (Group 15 to Group 18)

1. Which one of the following reactions of Xenon compounds is not feasible? **[AIEEE-2009]**
   (1) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5\,O_2$
   (2) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$
   (3) $XeF_6 + RbF \rightarrow Rb[XeF_7]$
   (4) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$

2. In Which of the following arrangements, the sequence is not strictly according to the property written against it? **[AIEEE-2009]**
   (1) HF < HCl < HBr < HI : increasing acid strength
   (2) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength
   (3) B < C < O < N : increasing first ionization enthalpy
   (4) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power

3. Which of the following has maximum number of lone pairs associated with Xe? **[AIEEE-2011]**
   (1) XeF_2 (2) XeO_3
   (3) XeF_4 (4) XeF_6

4. The molecule having smallest bond angle is **[AIEEE-2012]**
   (1) $AsCl_3$ (2) $SbCl_3$
   (3) PCl_3 (4) NCl_3

5. Which of the following on thermal-decomposition yields a basic as well as an acidic oxide? **[AIEEE-2012]**
   (1) $KClO_3$ (2) $CaCO_3$
   (3) NH_4NO_3 (4) $NaNO_3$

6. Among the following oxoacids, the correct decreasing order of acid strength is **[JEE (Main)-2014]**
   (1) $HOCl > HClO_2 > HClO_3 > HClO_4$
   (2) $HClO_4 > HOCl > HClO_2 > HClO_3$
   (3) $HClO_4 > HClO_3 > HClO_2 > HOCl$
   (4) $HClO_2 > HClO_4 > HClO_3 > HOCl$

7. Which one of the following properties is not shown by NO? **[JEE (Main)-2014]**
   (1) It is diamagnetic in gaseous state
   (2) It is a neutral oxide
   (3) It combines with oxygen to form nitrogen dioxide
   (4) Its bond order is 2.5

8. Which among the following is the most reactive? **[JEE (Main)-2015]**
   (1) Cl_2 (2) Br_2
   (3) I_2 (4) ICl

9. Which one has the highest boiling point? **[JEE (Main)-2015]**
   (1) He (2) Ne
   (3) Kr (4) Xe

10. Assertion : Nitrogen and Oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.
    Reason : The reaction between nitrogen and oxygen requires high temperature.
    [JEE (Main)-2015]
    (1) Both assertion and reason are correct, and the reason is the correct explanation for the assertion
    (2) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion
    (3) The assertion is incorrect, but the reason is correct
    (4) Both the assertion and reason are incorrect

11. The pair in which phosphorous atoms have a formal oxidation state of +3 is **[JEE (Main)-2016]**
    (1) Pyrophosphorous and hypophosphoric acids
    (2) Orthophosphorous and hypophosphoric acids
    (3) Pyrophosphorous and pyrophosphoric acids
    (4) Orthophosphorous and pyrophosphorous acids

12. The reaction of zinc with dilute and concentrated nitric acid, respectively, produces **[JEE (Main)-2016]**

(1) NO_2 and NO

(2) NO and N_2O

(3) NO_2 and N_2O

(4) N_2O and NO_2

13. Which of the following reactions is an example of a redox reaction? **[JEE (Main)-2017]**

(1) $XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$

(2) $XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF$

(3) $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

(4) $XeF_2 + PF_5 \rightarrow [XeF]^+ PF_6^-$

14. The products obtained when chlorine gas reacts with cold and dilute aqueous NaOH are **[JEE (Main)-2017]**

(1) Cl^- and ClO^-

(2) Cl^- and ClO_2^-

(3) ClO^- and ClO_3^-

(4) ClO_2^- and ClO_3^-

15. The compound that does not produce nitrogen gas by the thermal decomposition is **[JEE (Main)-2018]**

(1) $Ba(N_3)_2$ (2) $(NH_4)_2Cr_2O_7$

(3) NH_4NO_2 (4) $(NH_4)_2SO_4$

16. Good reducing nature of H_3PO_2 is attributed to the presence of **[JEE (Main)-2019]**

(1) Two P – OH bonds

(2) One P – H bond

(3) One P – OH bond

(4) Two P – H bonds

17. The pair that contains two P-H bond in each of the oxoacids is **[JEE (Main)-2019]**

(1) $H_4P_2O_5$ and $H_4P_2O_6$ (2) $H_4P_2O_5$ and H_3PO_3

(3) H_3PO_2 and $H_4P_2O_5$ (4) H_3PO_3 and H_3PO_2

18. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y, is **[JEE (Main)-2019]**

(1) 7 (2) 1

(3) 5 (4) 3

19. Chlorine on reaction with hot and concentrated sodium hydroxide gives **[JEE (Main)-2019]**

(1) Cl^- and ClO^- (2) Cl^- and ClO_2^-

(3) ClO_3^- and ClO_2^- (4) Cl^- and ClO_3^-

20. The correct order of the oxidation states of nitrogen in NO, N_2O, NO_2, and N_2O_3 is **[JEE (Main)-2019]**

(1) $NO_2 < NO < N_2O_3 < N_2O$

(2) $N_2O < NO < N_2O_3 < NO_2$

(3) $NO_2 < N_2O_3 < NO < N_2O$

(4) $N_2O < N_2O_3 < NO < NO_2$

21. The oxoacid of sulphur that does not contain bond between sulphur atoms is : **[JEE (Main)-2019]**

(1) $H_2S_4O_6$ (2) $H_2S_2O_4$

(3) $H_2S_2O_7$ (4) $H_2S_2O_3$

22. The noble gas that does NOT occur in the atmosphere is : **[JEE (Main)-2019]**

(1) Ne (2) Kr

(3) He (4) Ra

23. In the following reactions, products (A) and (B), respectively, are

$$\underset{\text{(hot and conc.)}}{NaOH} + Cl_2 \rightarrow (A) + \text{side products}$$

$$\underset{\text{(dry)}}{Ca(OH)_2} + Cl_2 \rightarrow (B) + \text{side products}$$

[JEE (Main)-2020]

(1) NaOCl and $Ca(OCl)_2$

(2) $NaClO_3$ and $Ca(ClO_3)_2$

(3) NaOCl and $Ca(ClO_3)_2$

(4) $NaClO_3$ and $Ca(OCl)_2$

24. The number of bonds between sulphur and oxygen atoms in $S_2O_8^{2-}$ and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are **[JEE (Main)-2020]**

(1) 4 and 6 (2) 8 and 8

(3) 8 and 6 (4) 4 and 8

25. White phosphorus on reaction with concentrated NaOH solution in an inert atmosphere of CO_2 gives phosphine and compound (X). (X) on acidification with HCl gives compound (Y). The basicity of compound (Y) is **[JEE (Main)-2020]**

(1) 3 (2) 2

(3) 4 (4) 1

26. The compound that cannot act both as oxidising and reducing agent is **[JEE (Main)-2020]**

(1) H_3PO_4

(2) H_2SO_3

(3) H_2O_2

(4) HNO_2

27. On heating compound (A) gives a gas (B) which is a constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should not be:

[JEE (Main)-2020]

(1) $Pb(NO_3)_2$ (2) $(NH_4)_2Cr_2O_7$

(3) NH_4NO_2 (4) NaN_3

28. Aqua regia is used for dissolving noble metals (Au, Pt, etc.). The gas evolved in this process is

[JEE (Main)-2020]

(1) NO (2) N_2

(3) N_2O_5 (4) N_2O_3

29. In a molecule of pyrophosphoric acid, the number of P – OH, P = O and P – O – P bonds/ moiety(ies) respectively are **[JEE (Main)-2020]**

(1) 4, 2 and 0 (2) 4, 2 and 1

(3) 3, 3 and 3 (4) 2, 4 and 1

30. On heating, lead (II) nitrate gives a brown gas (A). The gas (A) on cooling changes to a colourless solid/liquid (B). (B) on heating with NO changes to a blue solid (C). The oxidation number of nitrogen in solid (C) is : **[JEE (Main)-2020]**

(1) + 3

(2) + 4

(3) + 5

(4) + 2

31. The reaction in which the hybridisation of the underlined atom is affected is **[JEE (Main)-2020]**

(1) $\underline{Xe}F_4 + SbF_5 \rightarrow$

(2) $H_2\underline{S}O_4 + NaCl \xrightarrow{420\,K}$

(3) $H_3\underline{P}O_2 \xrightarrow{\text{Disproportionation}}$

(4) $\underline{N}H_3 \xrightarrow{H^+}$

32. The structure of PCl_5 in the solid state is

[JEE (Main)-2020]

(1) Tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$

(2) Square pyramidal

(3) Trigonal bipyramidal

(4) Square planar $[PCl_4]^+$ and octahedral $[PCl_6]^-$

33. Reaction of ammonia with excess Cl_2 gives

[JEE (Main)-2020]

(1) NH_4Cl and HCl (2) NCl_3 and HCl

(3) NCl_3 and NH_4Cl (4) NH_4Cl and N_2

34. The correct statement with respect to dinitrogen is

[JEE (Main)-2020]

(1) N_2 is paramagnetic in nature

(2) It can be used as an inert diluent for reactive chemicals

(3) It can combine with dioxygen at 25°C

(4) Liquid dinitrogen is not used in cryosurgery

35. The reaction of NO with N_2O_4 at 250 K gives

[JEE (Main)-2020]

(1) N_2O_3 (2) N_2O_5

(3) N_2O (4) NO_2

36. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is _____. **[JEE (Main)-2020]**

37. The number of Cl = O bonds in perchloric acid is, "_____". **[JEE (Main)-2020]**

38. Among the following allotropic forms of sulphur, the number of allotropic forms, which will show paramagnetism is _____. **[JEE (Main)-2021]**

(A) α-sulphur

(B) β-sulphur

(C) S_2-form

39. Among the following, the number of halide(s) which is/are inert to hydrolysis is _____.

[JEE (Main)-2021]

(A) BF_3

(B) $SiCl_4$

(C) PCl_5

(D) SF_6

40. The correct order of bond dissociation enthalpy of halogens is:

[JEE (Main)-2021]

(1) $Cl_2 > Br_2 > F_2 > I_2$

(2) $F_2 > Cl_2 > Br_2 > I_2$

(3) $Cl_2 > F_2 > Br_2 > I_2$

(4) $I_2 > Br_2 > Cl_2 > F_2$

41. Given below are two statements :

Statement I :

α and β forms of sulphur can change reversibly between themselves with slow heating or slow cooling.

Statement II :

At room temperature the stable crystalline form of sulphur is monoclinic sulphur. **[JEE (Main)-2021]**

In the light of the above statements, choose the correct answer from the options given below:

(1) Both Statement I and Statement II are true.

(2) Both Statement I and Statement II are false.

(3) Statement I is true but Statement II is false.

(4) Statement I is false but Statement II is true.

42. Match **List-I** with **List-II.**

	List - I		**List - II**
(a)	Sodium Carbonate	(i)	Deacon
(b)	Titanium	(ii)	Castner-Kellner
(c)	Chlorine	(iii)	van-Arkel
(d)	Sodium hydroxide	(iv)	Solvay

Choose the correct answer from the options given below: **[JEE (Main)-2021]**

(1) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)

(2) (a) → (iii), (b) → (ii), (c) → (i), (d) → (iv)

(3) (a) → (iv), (b) → (i), (c) → (ii), (d) → (iii)

(4) (a) → (iv), (b) → (iii), (c) → (i), (d) → (ii)

43. Match List-I with List-II :

	List-I		**List-II**
	Industrial process		**Application**
(a)	Haber's process	(i)	HNO_3 synthesis
(b)	Ostwald's process	(ii)	Aluminium extraction
(c)	Contact process	(iii)	NH_3 synthesis
(d)	Hall-Heroult process	(iv)	H_2SO_4 synthesis

Choose the **correct** answer from the options given below. **[JEE (Main)-2021]**

(1) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(2) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(3) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

44. Match List-I with List-II :

	List-I		**List-II**
	Name of oxo acid		**Oxidation state of 'P'**
(a)	Hypophosphorous acid	(i)	+5
(b)	Orthophosphoric acid	(ii)	+4
(c)	Hypophosphoric acid	(iii)	+3
(d)	Orthophosphorous acid	(iv)	+2
		(v)	+1

Choose the correct answer from the options given below: **[JEE (Main)-2021]**

(1) (a)-(iv), (b)-(v), (c)-(ii), (d)-(iii)

(2) (a)-(v), (b)-(iv), (c)-(ii), (d)-(iii)

(3) (a)-(v), (b)-(i), (c)-(ii), (d)-(iii)

(4) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

45. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is

[JEE (Main)-2021]

(1) As (2) P

(3) Bi (4) Sb

46. The reaction of white phosphorus on boiling with alkali in inert atmosphere resulted in the formation of product 'A'. The reaction of 1 mol of 'A' with excess of $AgNO_3$ in aqueous medium gives _____ mol(s) of Ag.

(Round off to the Nearest Integer).

[JEE (Main)-2021]

47. Which of the following compound CANNOT act as a Lewis base? **[JEE (Main)-2021]**

(1) NF_3 (2) PCl_5

(3) ClF_3 (4) SF_4

48. The set that represents the pair of neutral oxides of nitrogen is **[JEE (Main)-2021]**

(1) NO and NO_2 (2) N_2O and N_2O_3

(3) NO and N_2O (4) N_2O and NO_2

49. Match **List-I** and with **List-II**.

List-I (Process)	**List-II (Catalyst)**
(a) Deacon's process	(i) ZSM-5
(b) Contact process	(ii) $CuCl_2$
(c) Cracking of hydrocarbons	(iii) Particles 'Ni'
(d) Hydrogenation of vegetable oils	(iv) V_2O_5

Choose the **most appropriate** answer from the options given below : **[JEE (Main)-2021]**

(1) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

(2) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

(3) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

(4) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

50. The number of ionisable hydrogens present in the product obtained from a reaction of phosphorus trichloride and phosphonic acid is **[JEE (Main)-2021]**

(1) 0 (2) 3

(3) 2 (4) 1

51. A xenon compound 'A' upon partial hydrolysis gives XeO_2F_2. The number of lone pair of electrons present on central atom in compound A is _____. (Round off to Nearest Integer). **[JEE (Main)-2021]**

52. The set in which compounds have different nature is : **[JEE (Main)-2021]**

(1) $B(OH)_3$ and H_3PO_3

(2) $B(OH)_3$ and $Al(OH)_3$

(3) $Be(OH)_2$ and $Al(OH)_3$

(4) NaOH and $Ca(OH)_2$

53. Chemical nature of the nitrogen oxide compound obtained from a reaction of concentrated nitric acid and P_4O_{10}(in 4 : 1 ratio) is : **[JEE (Main)-2021]**

(1) Acidic (2) Basic

(3) Neutral (4) Amphoteric

54. Which one of the following group-15 hydride is the strongest reducing agent? **[JEE (Main)-2021]**

(1) AsH_3 (2) PH_3

(3) SbH_3 (4) BiH_3

55. Number of Cl = O bonds in chlorous acid, chloric acid and perchloric acid respectively are **[JEE (Main)-2021]**

(1) 1, 2 and 3

(2) 4, 1 and 0

(3) 1, 1 and 3

(4) 3, 1 and 1

56. Match List-I with List-II

List-I (compound)	**List-II (effect/affected species)**
(a) Carbon monoxide	(i) Carcinogenic
(b) Sulphur dioxide	(ii) Metabolized by pyrus plants
(c) Polychlorinated biphenyls	(iii) Haemoglobin
(d) Oxides of nitrogen	(iv) Stiffness of flower buds

Choose the **correct** answer from the options given below : **[JEE (Main)-2021]**

(1) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

(2) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

(3) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

(4) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

57. The **incorrect** statement is : **[JEE (Main)-2021]**

(1) F_2 is more reactive than ClF.

(2) F_2 is a stronger oxidizing agent than Cl_2 in aqueous solution.

(3) On hydrolysis ClF forms HOCl and HF.

(4) Cl_2 is more reactive than ClF.

58. Chalcogen group elements are : **[JEE (Main)-2021]**

(1) O, Ti and Po

(2) S, Te and Pm

(3) Se, Tb and Pu

(4) Se, Te and Po

59. The number of non-ionisable hydrogen atoms present in the final product obtained from the hydrolysis of PCl_5 is : **[JEE (Main)-2021]**

(1) 3 (2) 0

(3) 2 (4) 1

60. Match **List - I** with **List - II :**

List - I **(Species)**	**List - II** **(No. of lone pairs of electrons on the central atom)**
(a) XeF_2	(i) 0
(b) XeO_2F_2	(ii) 1
(c) XeO_3F_2	(iii) 2
(d) XeF_4	(iv) 3

Choose the **most appropriate** answer from the options given below : **[JEE (Main)-2021]**

(1) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(2) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(3) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

(4) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iiii)

61. In polythionic acid, $H_2S_xO_6$ (x = 3 to 5) the oxidation state(s) of sulphur is/are : **[JEE (Main)-2021]**

(1) 0 and +5 only (2) +5 only

(3) +6 only (4) +3 and +5 only

62. Which one of the following is formed (mainly) when red phosphorus is heated in a sealed tube at 803 K? **[JEE (Main)-2021]**

(1) Yellow phosphorus (2) β-Black phosphorus

(3) α-Black phosphorus (4) White phosphorus

63. Which one of the following is used to remove most of plutonium from spent nuclear fuel? **[JEE (Main)-2021]**

(1) I_2O_5 (2) BrO_3

(3) O_2F_2 (4) ClF_3

64. The number of halogen/(s) forming halic (V) acid is _____. **[JEE (Main)-2021]**

65. The number of S = O bonds present in sulphurous acid, peroxodisulphuric acid and pyrosulphuric acid, respectively are : **[JEE (Main)-2021]**

(1) 2, 3 and 4 (2) 2, 4 and 3

(3) 1, 4 and 4 (4) 1, 4 and 3

66. Which one of the following correctly represents the order of stability of oxides, X_2O; (X = halogen)? **[JEE (Main)-2021]**

(1) I > Cl > Br (2) Cl > I > Br

(3) Br > Cl > I (4) Br > I > Cl

67. The oxide **without** nitrogen-nitrogen bond is : **[JEE (Main)-2021]**

(1) N_2O_5 (2) N_2O_3

(3) N_2O_4 (4) N_2O

68. The most stable trihalide of nitrogen is: **[JEE (Main)-2022]**

(1) NF_3 (2) NCl_3

(3) NBr_3 (4) NI_3

69. PCl_5 is well known, but NCl_5 is not. Because, **[JEE (Main)-2022]**

(1) nitrogen is less reactive than phosphorous

(2) nitrogen doesn't have d-orbitals in its valence shell.

(3) catenation tendency is weaker in nitrogen than phosphorous.

(4) size of phosphorous is larger than nitrogen

70. The number of bridged oxygen atoms present in compound B formed from the following reactions is

$$Pb(NO_3)_2 \xrightarrow{673\ K} A + PbO + O_2$$

$$A \xrightarrow{\text{Dimerise}} B$$

[JEE (Main)-2022]

(1) 0 (2) 1

(3) 2 (4) 3

71. Consider the following reactions:

$$PCl_3 + H_2O \rightarrow A + HCl$$

$$A + H_2O \rightarrow B + HCl$$

The number of ionisable protons present in the product B is **[JEE (Main)-2022]**

72. The correct order of melting points of hydrides of group 16 elements is: **[JEE (Main)-2022]**

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

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

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

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

73. Consider the following reaction:

A + alkali $\rightarrow$ B (Major Product)

If B is an oxoacid of phosphorus with no P-H bond, then A is: **[JEE (Main)-2022]**

(1) White P_4 (2) Red P_4

(3) P_2O_3 (4) H_3PO_3

74. The oxide which contains an odd electron at the nitrogen atom is **[JEE (Main)-2022]**

(1) N_2O (2) NO_2

(3) N_2O_3 (4) N_2O_5

75. Heating white phosphorus with conc. NaOH solution gives mainly: **[JEE (Main)-2022]**

(1) Na_3P and H_2O (2) H_3PO and NaH

(3) $P(OH)_3$ and NaH_2PO_4 (4) PH_3 and NaH_2PO_2

76. The gas produced by treating an aqueous solution of ammonium chloride with sodium nitrite is

[JEE (Main)-2022]

(1) NH_3 (2) N_2

(3) N_2O (4) Cl_2

77. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: Fluorine forms one oxoacid.

Reason R: Fluorine has smallest size amongst all halogens and is highly electronegative.

In the light of the above statements, choose the *most appropriate* answer from the option given below.

[JEE (Main)-2022]

(1) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

(3) **A** is correct but **R** is not correct.

(4) **A** is not correct but **R** is correct.

78. Nitrogen gas is obtained by thermal decomposition of

[JEE (Main)-2022]

(1) $Ba(NO_3)_2$ (2) $Ba(N_3)_2$

(3) $NaNO_2$ (4) $NaNO_3$

79. Given below are two statements :

Statement I : The pentavalent oxide of group-15 element, E_2O_5, is less acidic than trivalent oxide, E_2O_3, of the same element.

Statement II : The acidic character of trivalent oxide of group 15 elements, E_2O_3, decreases down the group.

In light of the above statements, choose **most appropriate** answer from the options given below:

[JEE (Main)-2022]

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I true, but Statement II is false

(4) Statement I false, but Statement II is true

80. Match **List-I** with **List-II:**

List-I (Oxide)	**List-II (Nature)**
(A) Cl_2O_7	(I) Amphoteric
(B) Na_2O	(II) Basic
(C) Al_2O_3	(III) Neutral
(D) N_2O	(IV) Acidic

Choose the correct answer from the options given below:

[JEE (Main)-2022]

(1) A-IV, B-III, C-I, D-II (2) A-IV, B-II, C-I, D-III

(3) A-II, B-IV, C-III, D-I (4) A-I, B-II, C-III, D-IV

81. Among the following, basic oxide is:

[JEE (Main)-2022]

(1) SO_3 (2) SiO_2

(3) CaO (4) Al_2O_3

82. Among the given oxides of nitrogen ; N_2O, N_2O_3, N_2O_4 and N_2O_5, the number of compound/(s) having N – N bond is:

[JEE (Main)-2022]

(1) 1 (2) 2

(3) 3 (4) 4

83. Which of the following oxoacids of sulphur contains ''S'' in two different oxidation states?

[JEE (Main)-2022]

(1) $H_2S_2O_3$ (2) $H_2S_2O_6$

(3) $H_2S_2O_7$ (4) $H_2S_2O_8$

84. The oxoacid of phosphorus that is easily obtained from a reaction of alkali and white phosphorus and has two P-H bonds, is:

[JEE (Main)-2022]

(1) Phosphonic acid (2) Phosphinic acid

(3) Pyrophosphorus acid (4) Hypophosphoric acid

85. The interhalogen compound formed from the reaction of bromine with excess of fluorine is a :

[JEE (Main)-2022]

(1) hypohalite (2) halate

(3) perhalate (4) halite

86. The metal that has very low melting point and its periodic position is closer to a metalloid is

[JEE (Main)-2022]

(1) Al (2) Ga

(3) Se (4) In

87. Which oxoacid of phosphorous has the highest number of oxygen atoms present in its chemical formula?

[JEE (Main)-2022]

(1) Pyrophosphorus acid

(2) Hypophosphoric acid

(3) Phosphoric acid

(4) Pyrophosphoric acid

88. Amongst the following, the number of oxide(s) which are paramagnetic in nature is

Na_2O, KO_2, NO_2, N_2O, ClO_2, NO, SO_2, Cl_2O

[JEE (Main)-2022]

89. The number of interhalogens from the following having square pyramidal structure is :

ClF_3, IF_7, BrF_5, BrF_3, I_2Cl_6, IF_5, ClF, ClF_5

[JEE (Main)-2022]

90. White phosphorus reacts with thionyl chloride to give

[JEE (Main)-2022]

(1) PCl_5, SO_2 and S_2Cl_2 (2) PCl_3, SO_2 and S_2Cl_2

(3) PCl_3, SO_2 and Cl_2 (4) PCl_5, SO_2 and Cl_2

91. Concentrated HNO_3 reacts with Iodine to give

[JEE (Main)-2022]

(1) HI, NO_2 and H_2O (2) HIO_2, N_2O and H_2O

(3) HIO_3, NO_2 and H_2O (4) HIO_4, N_2O and H_2O

92. Consider the following sulphur based oxoacids.

H_2SO_3, H_2SO_4, $H_2S_2O_8$ and $H_2S_2O_7$.

Amongst these oxoacids, the number of those with peroxo (O–O) bonds is_____.

[JEE (Main)-2022]

93. Dinitrogen and dioxygen, the main constituents of air do not react with each other in atmosphere to form oxides of nitrogen because

[JEE (Main)-2022]

(1) N_2 is unreactive in the condition of atmosphere

(2) Oxides of nitrogen are unstable

(3) Reaction between them can occur in the presence of a catalyst

(4) The reaction is endothermic and require very high temperature

❑ ❑ ❑

Chapter 16(A)

The *p*-Block Elements (Group 13 to Group 14)

1. Answer (2)

   In BF_3, F forms $p\pi$ - $p\pi$ back bonding with B.

2. Answer (4)

   BCl_3 – electron deficient, incomplete octet.

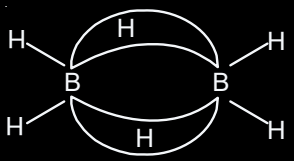
   $AlCl_3$ – electron deficient, incomplete octet.

   BCl_3 and $AlCl_3$ are electron deficient in nature.

3. Answer (1)

   Silicones are polymer with Si–O–Si linkages and are strongly hydrophobic. They are highly thermally stable with high dielectric strength. Now a days silicone greases are commony used.

4. Answer (1)



   No. of 2-c-2-e^- bond = 4

   No. of 3-c-2-e^- bond = 2

5. Answer (2)

   CCl_4 cannot be hydrolysed due to absence of d orbitals. Carbon cannot extend its coordination number beyond four.

6. Answer (3)

   Lead Pb

7. Answer (3)

   $B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O$

   $B_2H_6 + 6H_2O \longrightarrow 2H_3BO_3 + 6H_2$

8. Answer (3)

   Fullerene (C_{60}) contains 20 six membered rings and 12 five membered rings.

9. Answer (3)

   B_2O_3 is an acidic oxide.

   Al_2O_3 and Ga_2O_3 are amphoteric oxide.

   In_2O_3 and Tl_2O are basic oxide.

10. Answer (1)

    The order of catenation property amongst 14th group elements is based on bond enthalpy values of identical atoms of the same element. The decreasing order of bond enthalpy values is

    Bond enthalpy $\underset{348\ kJ/mol}{C–C} > \underset{297}{Si–Si} > \underset{260}{Ge–Ge} \approx \underset{240\ kJ/mol}{Sn–Sn}$

    $\therefore$ Decreasing order of catenation is

    C > Si > Ge ≈ Sn

11. Answer (3)

    Pentagons in C_{60} = 12

    Triangles in P_4 = 4

12. Answer (1)

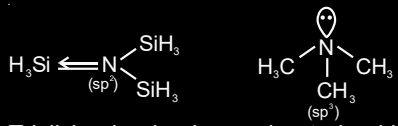
    These are examples of silicates, the basic unit being SiO_4^{4-} in each of them.

13. Answer (3)

    Carbon-carbon bond length is maximum in diamond

Species	C – C bond length
Diamond	154 pm
Graphite	141.5 pm
C_{60}	138.3 pm and 143.5 pm (double bond) (single bond)

14. Answer (1)



    Trisilylamine is planar, due to backbonding of lone pairs of nitrogen into vacant d-orbitals of Si. In trimethylamine, there is no such delocalisation and hence it is more basic.

15. Answer (3)

    Due to inert pair effect, as we move down the group-13 elements, stability of +1 oxidation state increases.

    $\therefore$ Correct order of stability is

    Al < Ga < In < Tl

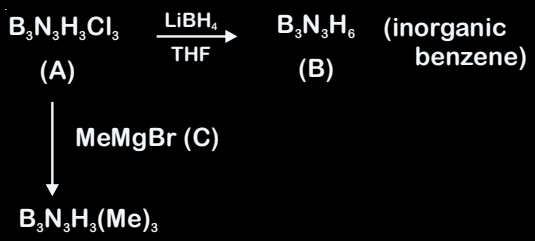
16. Answer (4)

+1 is more stable form of Thallium due to inert pair effect. For Tl +1 > +3 oxidation state.

17. Answer (4)

Carbon has small size so effective, lateral overlapping between 2p and 2p.

18. Answer (2)



19. Answer (1)

Terminal B – H bonds are shorter than the bridging B – H bonds which shows that the terminal B – H bonds have greater s-character and less p-character.

20. Answer (4)

PbO_2 is strong oxidizing agent because Pb^{+4} is not stable and can be easily reduced to Pb^{+2}.

PbO_2 is used in lead storage batteries. It is also amphoteric in nature

So, the answer should be (4)

21. Answer (1)

A : Due to inert pair effect, Tl is more stable in +1 oxidation state

Hence TlI_3 and CsI_3 are isomorphous

R : Electronic configuration of Tl (81) =

$Xe\ 4f^{14}\ 5d^{10}\ 6s^2\ 6p^1$

Both A and R are correct but R is not the correct explanation of A.

22. Answer (1)

C_{60} contains twenty six-membered rings and twelve five-membered rings.

23. Answer (4)

$$2NaBH_4 + I_2 \longrightarrow B_2H_6 + 2NaI + H_2$$

In B_2H_6, B atoms are sp^3 hybridised

B_2H_6 has two bridged 3c-2e bonds

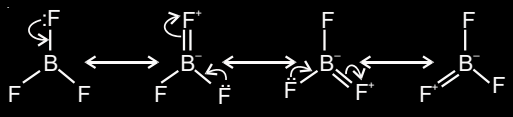
B_2H_6 is non planar

24. Answer (4)

$[SiCl_6]^{2-}$ is not known. The main reasons are (i) six large chloride ion cannot be accommodated around Si^{4+} due to limitation of its size and (ii) interaction between lone pair of chloride ion and Si^{4+} is not very strong.

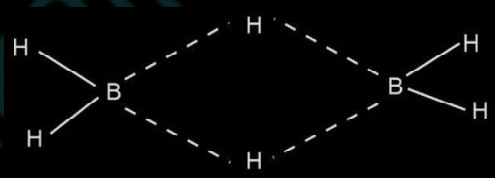
25. Answer (4)

Among the given boron trihalides, the extent of back donation is maximum in BF_3 due to smaller size of F - atom



26. Answer (3)

Structure of B_2H_6



It has two 3-centre-2-electron bonds and four 2-centre-2-electron bonds.

Hence, all B–H bonds are not equivalent.

It is an electron deficient compound as the octet of boron is incomplete.

Hence, it can behave as a Lewis acid.

It can be synthesized from both BF_3 and $NaBH_4$

$$2BF_3 + 6NaH \xrightarrow{450\ K} B_2H_6 + 6NaF$$

$$2NaBH_4 + I_2 \longrightarrow B_2H_6 + 2NaI + H_2$$

It is a non-planar molecule.

Hence, only Statements (C) and (D) are correct.

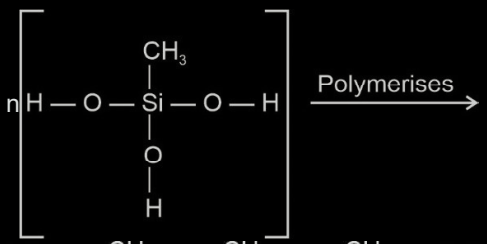
27. Answer (1)

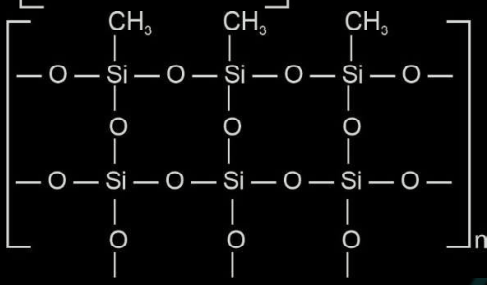
Due to inert pair effect, stability of +3 oxidation state decreases and that of +1 oxidation state increases for (down the group) group 13 elements.

So, the correct order of stability of group 13 elements in their +1 oxidation state is Al < Ga < In < Tl.

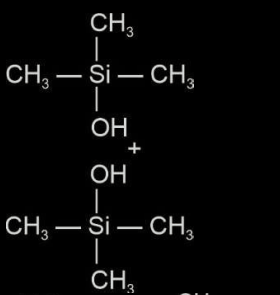
28. Answer (4)

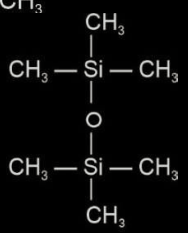
List-I (Si-Compounds)	List-II (Si-Polymeric/other Products)
(A) $(CH_3)_4Si$	(III) Silane
(B) $(CH_3)Si(OH)_3$	(IV) 2D-Silicone
(C) $(CH_3)_2Si(OH)_2$	(I) Chain Silicone
(D) $(CH_3)_3Si(OH)$	(II) Dimeric Silicone



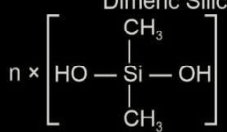


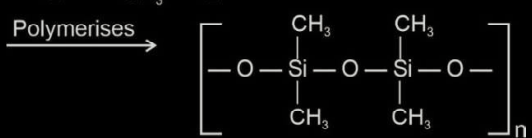
2D-Silicone





Dimeric Silicone





29. Answer (1)

Metal	Application
Cs	Photoelectric cells
Ga	High temperature thermometer
B	Bullet proof vest
Si	Water repellent sprays

30. Answer (4)

$$Na_2B_4O_7 + 7H_2O \longrightarrow 2H_3BO_3 + 2Na[B(OH)_4]$$

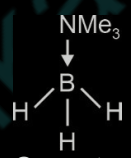
Aqueous solution of borax is buffer whose pH ≃ 9

Other compounds are less basic than this.

31. Answer (2)

$$2BF_3 + 6NaH \xrightarrow{450\ K} \underset{(A)}{B_2H_6} + 6NaF$$

$$\underset{(A)}{B_2H_6} + 2NMe_3 \longrightarrow 2BH_3 \cdot NMe_3$$



$\therefore$ Geometry of boron will be tetrahedral.

32. Answer (2)

$$3B_2H_6 + 6NH_3 \rightarrow \underset{\text{(Borazine)}}{2B_3N_3H_6}$$

33. Answer (1)

Boric acid is a weak acid

$$H_3BO_3 + H_2O \rightleftharpoons [B(OH)_4]^- + H^{\oplus}$$

Boric acid is not able to release H^+ ion on its own. It receives OH^- ion from water and releases H^+ ion as shown in the above reaction.

Hence, Both A and R are correct and R is the correct explanation of A.

34. Answer (2)

The outer most shell of Boron is 2 and its maximum covalency is 4.

Therefore, boron cannot form BF_6^{3-}.

Hence Assertion is correct

Boron is the first element of group-13 of modern periodic table. It is very small in size.

But it does not provide correct explanation of Assertion

Chapter 16(B)

The *p*-Block Elements (Group 15 to Group 18)

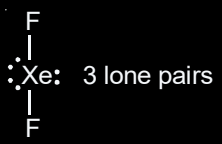
1. Answer (4)

   $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

2. Answer (2)

   NH_3 is more basic.

3. Answer (1)

4. Answer (2)

5. Answer (2)

6. Answer (3)

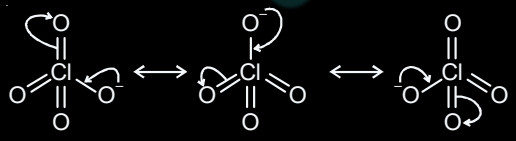
   $HClO_4 \rightleftharpoons ClO_4^- + H^+$

   $HClO_3 \rightleftharpoons ClO_3^- + H^+$

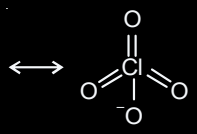
   $HClO_2 \rightleftharpoons ClO_2^- + H^+$

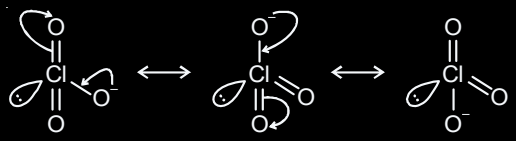
   $HOCl \rightleftharpoons ClO^- + H^+$

   Resonance produced conjugate base.

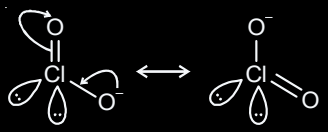
   (i) 

   (ClO_4^-)

   (ii) 

   (ClO_3^-)

   (iii) 

   (ClO_2^-)

   (iv) ClO^- is not resonance stabilized.

   As per resonance stability order of conjugate base is

   $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$

   Hence acidic strength order is

   $HClO_4 > HClO_3 > HClO_2 > HClO$

7. Answer (1)

   Nitric oxide is paramagnetic in the gaseous state as it has one unpaired electron in its outermost shell. The electronic configuration of NO is

   $$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \sigma_{2p_z}^2 \pi_{2p_x}^2 = \pi_{2p_y}^2 \pi_{2p_x}^{*1}$$

   However, it dimerises at low temperature to become diamagnetic.

   $$2NO \rightleftharpoons N_2O_2$$

   Its bond order is 2.5 and it combines with O_2 to give nitrogen dioxide.

8. Answer (4)

   Because of polarity and weak bond interhalogen compounds are more reactive.

9. Answer (4)

   Down the group strength of van der Waal's force of attraction increases hence Xe have highest boiling point.

10. Answer (1)

    $N_2 + O_2 \rightarrow 2NO$

    Required temperature for above reaction is around 3000°C which is a quite high temperature. This reaction is observed during thunderstorm.

11. Answer (4)

The phosphorous atoms of orthophosphorous acid H_3PO_3 and pyrophosphorous $H_4P_2O_5$ have a formal oxidation state +3.

12. Answer (4)

$$4Zn + 10HNO_3(dil) \longrightarrow 4Zn(NO_3)_2 + N_2O + 5H_2O$$

$$Zn + 4HNO_3(conc.) \longrightarrow Zn(NO_3)_2 + 2NO_2 + 2H_2O$$

13. Answer (3)

Xe is oxidised from +4(in XeF_4) to +6(in XeF_6)

Oxygen is reduced from +1 (in O_2F_2) to zero (in O_2)

14. Answer (1)

$$Cl_2 + \underset{\text{Cold \& dilute}}{2NaOH} \longrightarrow NaCl + \underset{\text{Sodium hypochlorite}}{NaOCl} + H_2O$$

15. Answer (4)

$$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3$$

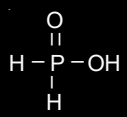
$$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$$

$$(NH_4)_2SO_4 \xrightarrow{\Delta} 2NH_3 + H_2SO_4$$

$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$$

Among all the given compounds, only $(NH_4)_2SO_4$ do not form dinitrogen on heating, it produces ammonia gas.

16. Answer (4)



Greater the number of P–H bonds in acids of phosphorous, greater is the reducing property.

17. Answer (3)

Acid	No of P-H bond
$H_4P_2O_5$	2
$H_4P_2O_6$	0
H_3PO_3	1
H_3PO_2	2

18. Answer (3)

Conc. HNO_3 oxidises I_2 to iodic acid (HIO_3).

19. Answer (4)

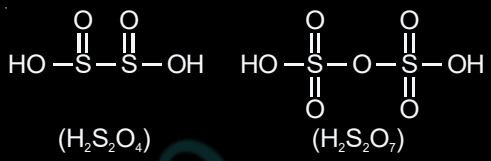
$$3Cl_2 + 6NaOH \longrightarrow 5NaCl + NaClO_3 + 3H_2O$$

20. Answer (2)

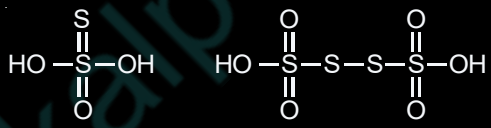
(oxide)	(oxidation state)
N_2O	+ 1
NO	+ 2
N_2O_3	+ 3
NO_2	+ 4

So, $N_2O < NO < N_2O_3 < NO_2$

21. Answer (3)



$(H_2S_2O_4)$ $(H_2S_2O_7)$



$(H_2S_2O_3)$ $(H_2S_4O_6)$

$H_2S_2O_7$ does not have S – S linkage

22. Answer (4)

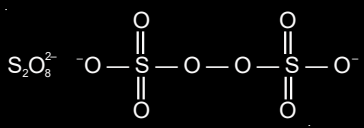
Radon is not present in atmosphere.

23. Answer (4)

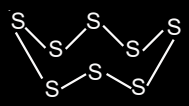
$$NaOH + Cl_2 \rightarrow NaCl + \underset{(A)}{NaClO_3} + H_2O$$

$$Ca(OH)_2 + Cl_2 \rightarrow CaCl_2 + \underset{(B)}{Ca(OCl)_2} + H_2O$$

24. Answer (2)



Number of S — O bonds in $S_2O_8^{2-}$ is 8

S_8 

Number of S — S bonds in rhombic sulphur is 8.

25. Answer (4)

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2\ (X)$$

acidification with HCl

$$\downarrow$$

H_3PO_2 (Y)

Basicity of $\underset{(Y)}{H_3PO_2} = 1$

26. Answer (1)

In H_3PO_4, P is present in +5 oxidation state and it can act as reducing agent only

27. Answer (1)

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$$

$$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3$$

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

$$2NaN_3 \xrightarrow{\Delta} 2Na + 3N_2$$

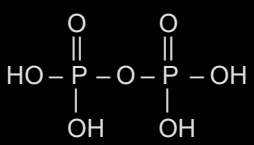
28. Answer (1)

$$Au + 4H^+ + NO_3^- + 4Cl^- \rightarrow AuCl_4^- + NO + 2H_2O$$

$$3Pt + 16H^+ + 4NO_3^- + 18Cl^- \rightarrow 3PtCl_6^{2-} + 4NO + 8H_2O$$

29. Answer (2)

Pyrophosphoric acid ($H_4P_2O_7$)



4 P – OH bonds

2 P = O bonds

1 P – O – P

30. Answer (1)

$$Pb(NO_3)_2 \xrightarrow{\Delta} PbO + NO_2\uparrow$$
(brown gas)

A is NO_2

$$2\,NO_2 \xrightarrow{\text{cooling}} \underset{(B)}{N_2O_4}$$

$$N_2O_4 + NO \longrightarrow \underset{(C)}{N_2O_3}$$

oxidation state of N in C is +3

31. Answer (1)

$$\underset{sp^3d^2}{XeF_4} + SbF_5 \rightarrow [\underset{sp^3d}{XeF_3}]^+ [SbF_6]^-$$

$$\underset{sp^3}{H_3PO_2} \xrightarrow{\text{Disproportionation}} \underset{sp^3}{H_3PO_4} + \underset{sp^3}{PH_3}$$

$$\underset{sp^3}{NH_3} \xrightarrow{H^+} \underset{sp^3}{NH_4^+}$$

32. Answer (1)

PCl_5 in solid state exist as $[PCl_4]^+ [PCl_6]^-$

$[PCl_4]^+$ is tetrahedral

$[PCl_6]^-$ is octahedral

33. Answer (2)

$$NH_3 + \underset{\text{(excess)}}{3Cl_2} \longrightarrow \underset{\text{(explosive)}}{NCl_3} + 3HCl$$

34. Answer (2)

N_2 is diamagnetic in nature.

$$N_2 + O_2 \overset{2000\ K}{\rightleftharpoons} NO(g)$$

Because of its inertness it is used where an inert atmosphere is required.

35. Answer (1)

$$2NO + N_2O_4 \xrightarrow{250\ K} N_2O_3$$

36. Answer (01.67)

$$3Cl_2 + 6NaOH \xrightarrow{\text{Conc.}} 5NaCl + NaClO_3 + 3H_2O$$

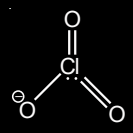
Ag^+ forms precipitate with Cl^- i.e. AgCl.

$AgClO_3$ is soluble.

$\therefore$ X is NaCl

Y is $NaClO_3$

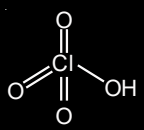
Now, structure of ClO_3^- is



$\therefore$ Bond order is $\frac{5}{3}$ i.e. 1.67

37. Answer (3.00)

The structure of perchloric acid is



The number Cl = O bonds in $HClO_4$ is 3.

38. Answer (1)

α-sulphur (Rhombic sulphur) and β-sulphur (Monoclinic sulphur) are the two allotropes of sulphur which are diamagnetic. But the S_2-form which exists at high temperature and has structure similar to O_2 is paramagnetic.

39. Answer (1)

BF_3 – Shows Partial hydrolysis

$SiCl_4$ – Undergoes hydrolysis readily

PCl_5 – Undergoes hydrolysis by addition–elimination mechanism.

SF_6 – Inert towards hydrolysis.

40. Answer (1)

$Cl_2 > Br_2 > F_2 > I_2$

Bond dissociation enthalpy of F_2 is lower than Cl_2 and Br_2. It is done to presence of e^- on fluorine atom, which create greater repulsion due to small size of fluorine.

41. Answer (3)

The stable form at room temperature is rhombic sulphur, which transformed to monoclinic sulphur on heating at 369 K.

α and β form of sulphur can change reversibly between themselves with slow heating or slow cooling.

42. Answer (4)

Compound	**Method of preparation**
Sodium Carbonate	Solvay
Titanium	van-Arkel
Chlorine	Deacon
Sodium hydroxide	Castner-Kellner

(a) $\rightarrow$ (iv), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (i), (d) $\rightarrow$ (ii)

43. Answer (4)

Process	**Application**
Haber's process	$\longrightarrow$ NH_3 synthesis
Ostwald's process	$\longrightarrow$ HNO_3 synthesis
Contact process	$\longrightarrow$ H_2SO_4 synthesis
Hall Heroults process	$\longrightarrow$ Aluminium extraction

(a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

44. Answer (3)

Hypophosphorous acid	H_3PO_2	+1
Orthophosphorous acid	H_3PO_3	+3
Hypophosphoric acid	$H_4P_2O_6$	+4
Orthophosphoric acid	H_3PO_4	+5

(a)-(v), (b)-(i), (c)-(ii), (d)-(iii)

45. Answer (3)

The stability of hydrides decreases from NH_3 to BiH_3 which can be observed from their bond dissociation enthalpy. Consequently, the reducing character of the hydrides increases.

Ammonia is only a mild reducing agent while BiH_3 is the strongest reducing agent amongst all the hydrides.

46. Answer (6)

$$P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$$

$$PH_3 + 6AgNO_3 \longrightarrow [Ag_3P.3AgNO_3] + 3HNO_3$$

$$Ag_3P.3AgNO_3 + 3H_2O \longrightarrow 6Ag + 3HNO_3 + H_3PO_3$$

So, 1 mol of PH_3(A) on reaction with excess of aq. $AgNO_3$ gives 6 moles of Ag.

47. Answer (2)

Lewis base should have at least one lone pair of electrons in the valence shell of the central atom which is available for donation. PCl_5 cannot function as a Lewis base as the central atom P does not have lone pair of electrons.

48. Answer (3)

Among nitrogen oxides

$\underbrace{NO \ \& \ N_2O}_{\text{Neutral}}$ $\underbrace{N_2O_3, \ NO_2, \ N_2O_5}_{\text{Acidic}}$

49. Answer (2)

(a) Deacon's process - $CuCl_2$

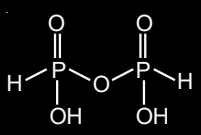
(b) Contact process - V_2O_5

(c) Cracking of hydrocarbons - ZSM-5

(d) Hydrogenation of vegetable oils - Particles 'Ni'

50. Answer (3)

$$PCl_3 + \underset{\text{Phosphonic acid}}{H_3PO_3} \longrightarrow H_4P_2O_5$$



There are two ionisable H's.

51. Answer (1)

$XeF_6 \xrightarrow{H_2O} XeOF_4 + 2HF$

$XeOF_4 \xrightarrow{H_2O} XeO_2F_2 + 2HF$

A can be both XeF_6 and $XeOF_4$. Total number of lone pair in XeF_6 is 19 and total number of lone pair in $XeOF_4$ is 15.

Lone pair present on central atom is XeF_6 and $XeOF_4$ is 1.

52. Answer (2)

$B(OH)_3$ – Acidic

H_3PO_3 – Acidic

$Be(OH)_2$ – Amphoteric

$Al(OH)_3$ – Amphoteric

NaOH – Basic

$Ca(OH)_2$ – Basic

Option-2 contain acidic and amphoteric species

53. Answer (1)

$4HNO_3 + P_4O_{10} \rightarrow 4HPO_3 + 2N_2O_5$

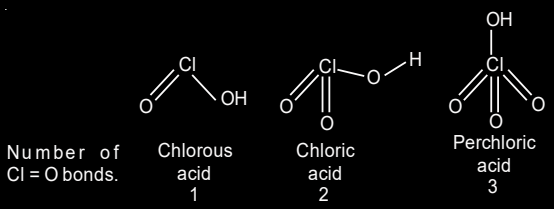
N_2O_5 is acidic in nature

54. Answer (4)

BiH_3 is most reducing among the group-15 hydrides.

Reducing property of the hydrides increases down the group.

55. Answer (1) (Bonus*)



Number of Cl = O bonds.	Chlorous acid	Chloric acid	Perchloric acid
	1	2	3

56. Answer (2)

(a) CO ..... (iii) Haemoglobin

(b) SO_2 ..... (iv) Stiffness to flower buds

(c) Polychlorinated biphenyls ...(i) Carcinogenic

(d) Oxides of nitrogen ...(ii) Metabolized by pyrus plants

57. Answer (4)

In general, interhalogen compounds are more reactive than halogens (except fluorine). This is because X–X′ bond in interhalogens is weaker than X–X bond in halogens except F–F bond.

All these undergo hydrolysis giving halide ion derived from the smaller halogen and a hypohalite (when XX′), halite (when XX'_3), halate (when XX'_5) and perhalate (when XX'_7) anion derived from the larger halogen.

$XX' + H_2O \rightarrow HX' + HOX$

$ClF \xrightarrow{H_2O} HOCl + HF$

Fluorine oxidises water to oxygen whereas chlorine and bromine react with water to form corresponding hydrohalic and hypohalous acids.

$2F_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$

$X_2(g) + H_2O(l) \rightarrow HX(aq) + HOX(aq)$

(where X = Cl or Br)

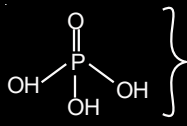
58. Answer (4)

Chalcogens are 16th group elements

–O, S, Se, Te, Po and Lv

59. Answer (2)

$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$



All hydrogens are ionisable

60. Answer (4)

No. of lone pairs of electrons on the central atom

$$= \frac{\text{(No. of valence electrons on central atom) –2 × (No. of bivalent atoms) – (No. of monovalent atoms)}}{2}$$

(a) XeF_2 : $n = \frac{8-2}{2} = 3$

(b) XeO_2F_2 : $n = \frac{8-(2\times2)-2}{2} = 1$

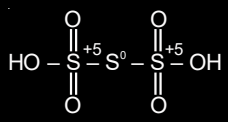
(c) XeO_3F_2 : $n = \frac{8-(2\times3)-2}{2} = 0$

(d) XeF_4 : $n = \frac{8-4}{2} = 2$

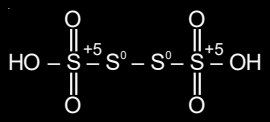
61. Answer (1)

$H_2S_nO_6$ (x = 3 to 5)

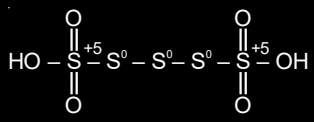
$H_2S_3O_6$



$H_2S_4O_6$



$H_2S_5O_6$



$\therefore$ Oxidation state(s) of sulphur in the above compounds are +5 and 0 only

62. Answer (3)

Black phosphorus has two forms : α-black and β-black.

α-black phosphorus is formed when red phosphorus is heated in a sealed tube at 803 K.

63. Answer (3)

O_2F_2 oxidises plutonium to PuF_6 and the reaction is used in removing plutonium as PuF_6 from spent nuclear fuel.

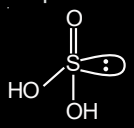
64. Answer (3)

Except F and At, all other halide can form Halic (V) acid.

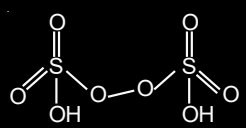
- F cannot go in +5 oxidation state.
- At is radioactive.

65. Answer (3)

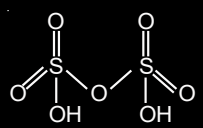
Sulphurous acid (H_2SO_3)



Peroxodisulphuric acid ($H_2S_2O_8$)



Pyrosulphuric acid ($H_2S_2O_7$)

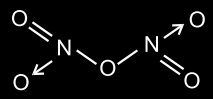


66. Answer (1)

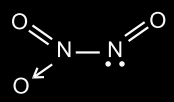
A combination of kinetic and thermodynamic factors lead to the generally decreasing order of stability of oxides formed by halogens, I > Cl > Br. The higher oxide of halogen tend to be more stable than lower one.

67. Answer (1)

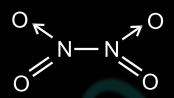
N_2O_5



N_2O_3



N_2O_4



N_2O $N \equiv N \longrightarrow O$

68. Answer (1)

The most stable trihalide is NF_3

Order of stability: $NF_3 > NCl_3 > NBr_3 > NI_3$

NCl_3 is explosive in nature.

NBr_3 and NI_3 are known only as ammoniates. The stability of trihalides decreases down the group due to weakening of N – X bond and inability of N to accommodate large sized halogen atoms (Cl, Br, I) around it.

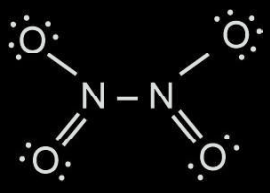
69. Answer (2)

PCl_5 is well known but NCl_5 is not because nitrogen does not have vacant d-orbitals in its valence shell. So, nitrogen cannot expand its octet. On the other hand phosphorus has vacant d-orbitals in its valence shell which enables it to expand its octet.

70. Answer (1)

$$2Pb(NO_3)_2 \xrightarrow{673\ K} \underset{A}{4NO_2} + 2PbO + O_2$$

$$\underset{A}{NO_2} \xrightarrow{\text{Dimerise}} \underset{B}{N_2O_4}$$



Hence no bridged oxygen atom is present in N_2O_4.

71. Answer (2)

$$\underset{}{PCl_3} + H_2O \longrightarrow \underset{A}{P(OH)Cl_2} + HCl$$

$$\underset{A}{P(OH)Cl_2} + H_2O \longrightarrow \underset{B}{P(OH)_2Cl} + HCl$$

Hydrogen attached with oxygen are ionisable. Hence number of ionisable protons present in compound B are 2.

72. Answer (1)

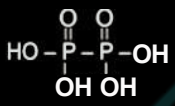
Hydride	**M.P.**
H_2O	273 K
H_2S	188 K
H_2Se	208 K
H_2Te	222 K

73. Answer (2)

White P_4 + alkali $\rightarrow H_3PO_2$

Red P_4 + alkali $\rightarrow H_4P_2O_6$

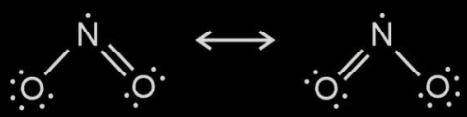
Structure of $H_4P_2O_6$ =



No P-H bond

74. Answer (2)

The oxide of nitrogen which contains odd electron is NO_2



75. Answer (4)

P_4(white) + NaOH

$\rightarrow PH_3 + NaH_2PO_2 + H_2O$

76. Answer (2)

N_2 gas is produced by treating an aqueous solution of ammonium chloride with sodium nitrite.

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

Ammonium chloride	Sodium nitrite	Nitrogen gas	Water	Sodium chloride

77. Answer (1)

Due to smaller size, fluorine forms only one oxoacid.

Both the Assertion and Reason are correct and Reason is the correct explanation.

78. Answer (2)

$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$$

79. Answer (4)

Statement I is false, as E_2O_5 is more acidic than E_2O_3

Statement II is correct.

80. Answer (2)

(A) $Cl_2O_7 \rightarrow$ Acidic

(B) $Na_2O \rightarrow$ Basic

(C) $Al_2O_3 \rightarrow$ Amphoteric

(D) $N_2O \rightarrow$ Neutral

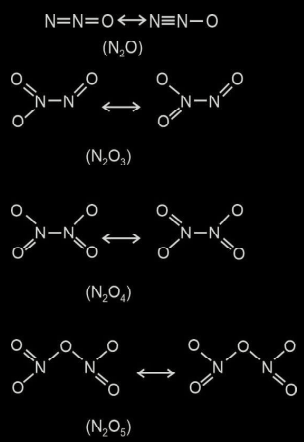
Oxides of metals are basic in nature whereas oxides of non metals are acidic in nature. N_2O is a neutral oxide.

81. Answer (3)

Since, oxides of metals are basic in nature. Hence CaO is a basic oxide

SO_3 and SiO_2 are acidic oxides and Al_2O_3 is a amphoteric oxide

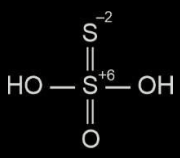
82. Answer (3)



N_2O, N_2O_3 and N_2O_4 contain N — N bond

83. Answer (1)

In $H_2S_2O_3$, sulphur exhibits two different oxidation states +6 and –2.



84. Answer (2)

White phosphorus + alkali $\rightarrow$ H_3PO_2

H_3PO_2 = phosphinic acid

85. Answer (2)

$$Br_2 + \underset{\text{(Excess)}}{5F_2} \longrightarrow 2BrF_5$$

If BrF_5 undergoes hydrolysis it will produce halide.

86. Answer (2)

Among the given elements, Gallium has the lowest melting point, Gallium is also close to a metalloid

87. Answer (4)

Pyrophosphorus acid $\rightarrow$ $H_4P_2O_5$

Hypophosphoric acid $\rightarrow$ $H_4P_2O_6$

Phosphoric acid $\rightarrow$ H_3PO_4

Pyrophosphoric acid $\rightarrow$ $H_4P_2O_7$

88. Answer (4)

Paramagnetic species: KO_2, NO_2, ClO_2, NO

Diamagnetic species are : Na_2O , N_2O, SO_2, Cl_2O

$\therefore$ There are total 4 paramagnetic molecules.

89. Answer (3)

$ClF_3 \rightarrow 3\ \sigma$ bond + 2 lone pair

$IF_7 \rightarrow 7\ \sigma$ bond + 0 lone pair

$BrF_5 \rightarrow 5\ \sigma$ bond + 1 lone pair $\rightarrow$ Square pyramidal

$BrF_3 \rightarrow 3\ \sigma$ bond + 2 lone pair

$I_2Cl_6 \rightarrow 4\ \sigma$ bond + 2 lone pair

$IF_5 \rightarrow 5\ \sigma$ bond + 1 lone pair $\rightarrow$ Square pyramidal

$ClF \rightarrow 1\ \sigma$ bond + 3 lone pair

$ClF_5 \rightarrow 5\ \sigma$ bond + 1 lone pair $\rightarrow$ Square pyramidal

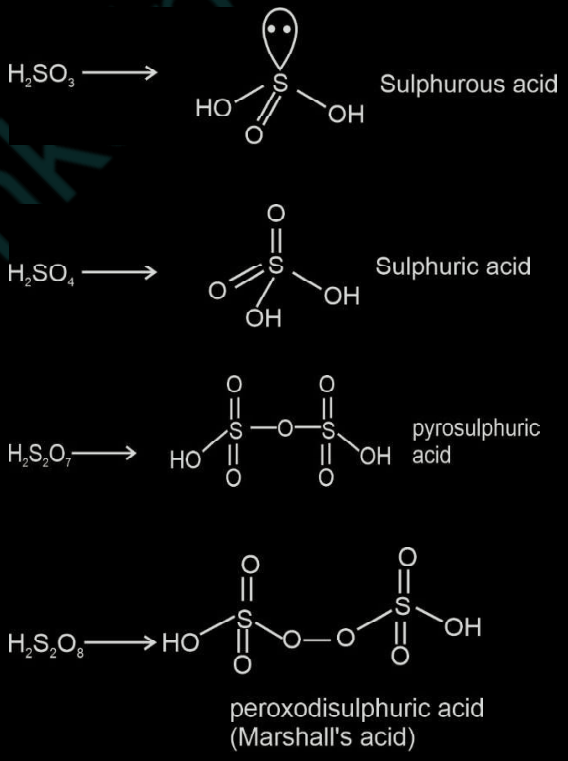
90. Answer (2)

$$\underset{\text{White phosphorous}}{P_4} + \underset{\text{Thionyl chloride}}{8SOCl_2} \longrightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$$

91. Answer (3)

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

92. Answer (1)



93. Answer (4)

N_2 is unreactive, its reaction with oxides is endothermic and require very high temperature.

❑ ❑ ❑