2021

CHEMISTRY — HONOURS

Fourth Paper

(Group - A)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

CHT-21a

Unit - I

Answer ***any three*** questions.

1. (a) How does inert pair effect influence the stability of the compounds of Group - 15 elements? Illustrate with examples.

(b) Structure of boron trichloride is monomeric while that of aluminium chloride is dimeric. Justify the statement. 3+2

2. (a) Compare the elemental forms of — Nitrogen (N) and Phosphorous (P).

(b) What happens when sodium is dissolved in liq. NH_3? 3+2

3. (a) B_2O_3 reacts with water to form an acid which is slippery. Explain the reason for the slippery nature of the acid.

(b) Why XeF_6 can not be stored in glass vessels? 3+2

4. (a) Compare the catenation property among the elements of Group - 14.

(b) Compare the hydrolytic behaviour of NF_3 and NCl_3. 3+2

5. (a) Compare the Lewis acid behaviour of BX_3 (X = F, Cl, Br, I) compounds.

(b) Exlpain why $MgCO_3$ is thermally less stable than $CaCO_3$. 3+2

Unit - II

Answer ***any two*** questions.

6. (a) Draw the molecular orbital diagram of nitrogen (N_2) and predict the bond dissociation energy order for N_2, N_2^+ and N_2^-.

(b) Give the name and structural formula of an ambidentate and a polydentate ligand. 3+2

7. (a) State the basic postulates of Werner's theory of coordination complexes.

(b) (i) Give the IUPAC name of $[Co(NH_3)_5(N_3)]SO_4$.

(ii) Predict all the possible isomers of $[Co(en)_2(ox)]^+$. 3+2

8. (a) The melting point and boiling point of the first member of the hydrides of Gr. 15, 16 and 17 shows anomalous behaviour in comparison to its heavier congeners. Explain.

(b) How and under what condition can an insulator be converted to semiconductor? 3+2

CHT-21b

Unit - I

Answer ***any three*** questions.

9. (a) The B – H bonds in B_2H_6 are dissimilar. Comment on the above statement citing structural features.

(b) Explain why the P – N bond distances in $P_3N_3F_6$ are shorter than those in $P_3N_3Cl_6$. 3+2

10. (a) Discuss the hybridisation of the central element in ClF_3, ClF_4^- and ClF_5 and draw the shapes of the given species.

(b) Solubility of I_2 in water increases in presence of KI. Explain. 3+2

11. (a) Complete the reactions—

(i) $XeF_4 + KI \rightarrow$

(ii) $XeF_2 + H_2O \rightarrow$

(b) Explain the ozone depletion in the atmosphere through its photochemical reactions. 3+2

12. (a) Hydrolysis of $MeSiCl_3$ produces a cross-linked polymer. Predict the polymer formed and write the reaction for its formation.

(b) $B(OH)_3 + Na_2O_2 \rightarrow X$

Identify X and draw its structure. Mention its use. 3+2

13. (a) What are interhalogen compounds? Explain why fluorine can not serve as the central element in those compounds.

(b) Hydrazine possesses both oxidizing and reducing properties. Justify. 3+2

Unit - II

Answer ***any two*** questions.

14. (a) Name the indicator used for the estimation of iron with potassium dichromate solution in acid medium. Explain the mechanism of action of this redox indicator.

(b) Give an example of disproportionation and comproportionation reaction mentioning the oxidation state of reactants and products. 3+2

15. (a) How does the common ion effect influence the precipitation of Gr. II sulphides for qualitative detection of basic radicals in an inorganic salt mixture?

(b) Which one is a stronger oxidant— acidic $K_2Cr_2O_7$ or neutral $K_2Cr_2O_7$? Comment. 3+2

16. (a) Define formal potential. How is it important in the estimation of Cu^{2+} iodometrically?

Given : $E^{o}_{Cu^{2+}/Cu^{+}} = 0{\cdot}15V$, $E^{o}_{\frac{1}{2}I_2/I^{-}} = 0{\cdot}54V$

(b) Calculate the potential at the equivalence point during titration of Fe^{2+} ion by MnO_4^- in acid medium.

Given : $E^{o}_{Fe^{3+}/Fe^{2+}} = 0{\cdot}77\,V$, $E^{o}_{MnO_4^-/Mn^{2+}} = 1{\cdot}51\,V$ 3+2