3 (Sem–1/CBCS) CHE HC 1

2023

CHEMISTRY

(Honours Core)

Paper : CHE–HC–1016

(Inorganic Chemistry–I)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer ***all*** questions from the following : 1×7=7

   (a) An electron is present in the valence shell of Lithium. Write all possible values of *n*, *l*, *m* and *s*.

   (b) Arrange the following in decreasing order of their ionic character

   HF, HI, HCl, HBr

(c) Choose the correct answer :

Geometry of ClF_3 is

(i) Tetrahedral

(ii) Pyramidal

(iii) Trigonal planar

(iv) T-shaped

(d) In the reaction

$$SnCl_2 + 2HgCl_2 \rightarrow SnCl_4 + Hg_2Cl_2$$

predict the oxidising and reducing agent.

(e) Which of the following molecules are polar ?

CO_2, SO_2, NH_3

(f) Name the region of electromagnetic spectrum in which Lyman series lie.

(g) Name *two* defects in stoichiometric compounds.

2. Answer ***all*** questions from the following : 2×4=8

(a) Explain the following reactions in the light of group electronegativity.

$$CF_3I + OH^- \rightarrow CF_3H + IO^-$$

$$CH_3I + OH^- \rightarrow CH_3OH + I^-$$

(b) What do you mean by well-behaved function ?

(c) With the help of VSEPR theory predict the shape of the following molecules

(i) H_2O

(ii) XeF_4

(d) State Heisenberg's uncertainty principle and give the mathematical form of the principle.

3. Answer ***any three*** questions from the following : 5×3=15

(a) Define electron affinity. Explain the factors on which it depends. Why N has negative electron affinity ? 1+3+1=5

(b) Explain disproportionation reaction? Will Cu^{2+} undergo disproportionation in an aqueous solution? Discuss. 2+3=5

(c) What is Born-Haber cycle? How is it used to calculate the lattice energy of *NaCl*? 1+4=5

(d) (i) The dipole moment of *HF* molecule is 1.91*D*. Calculate the per cent ionic character in *HF*. (Bond length of *HF* = 0.92*Å*) 3

(ii) Explain why *NaCl* is water soluble but *NaI* is not. 2

(e) What is polarisation in ionic compounds? Which of the following will exhibit the greater polarising power? Give reason. 2+3=5

(i) K^+ or Ag^+

(ii) K^+ or Li^+

(iii) Ti^{2+} or Ti^{4+}

4. Answer ***any three*** questions from the following : 10×3=30

(a) (i) What do you mean by de-Broglie wavelength? 1

(ii) Describe the experimental verification of de-Broglie equation. 4

(iii) What are the significance of Heisenberg's Uncertainty Principle? 2

(iv) Calcuate the uncertainty in the position of an electron moving with a velocity of 300 ms^{-1} along with an accuracy of 0.001%. 3

(b) (i) Discuss the physical significance of each quantum numbers. $1^1/_2$×4=6

(ii) 's-orbital has spherical shape'. Explain the comment on the basis of Angular wave function. 3

(iii) How many quantum numbers are obtained from Schrödinger equation? 1

(c) (i) What do you understand by the terms Bonding and Antibonding molecular orbital? Draw the electron charge density diagram for each. 2+2=4

(ii) Write the *MO* electron configuration for the NO^- ion. What is the bond order? Will the bond length be shorter or longer than in *NO*? Will the unpaired electrons be concentrated more on the *N* or *O*? Explain. 2+1+1+2=6

(d) (i) Define atomic and ionic radii. How do atomic radii vary in groups and periods? 2+4=6

(ii) What are isoelectronic ions? How effective nuclear charge affects the Na^+, Mg^{2+}, Al^{3+}, F^-, O^{2-}? Arrange them in increasing order of size. 1+2+1=4

(e) (i) What do you mean by equivalent hybrid orbital? Give example. 1+1=2

(ii) What shapes are associated with the molecules involving sp^2 and sp^3d^2 hybridisation? 1

(iii) Explain Bent's rule. 3

(iv) What is radial node? Draw radial wave function of 2s and 3p orbitals. Predict the number of radial nodes for each. 1+2+1=4

(f) Write about the following :

(i) Band theory 5

(ii) Hydrogen Bond 3

(iii) Normality of a solution 2