Total number of printed pages–7

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 :
$1 \times 7 = 7$

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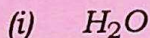
(g) Name *two* defects in stoichiometric compounds.

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

Contd.

(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 $1.91D$. Calculate the per cent ionic character in HF. (Bond length of $HF = 0.92\text{Å}$) 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

Contd.

(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

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