63/1 (SEM–1) CC1/CHMHC1016

2024

CHEMISTRY

Paper : CHMHC 1016

(Inorganic Chemistry – I)

Full Marks : 60

Pass Marks : 24

Time : Three hours

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

1. Choose the correct answer from the following : ***(any five)*** 1×5=5

   (a) The bond order of He^{+}_{2} is

   (i) 1

   (ii) 0

   (iii) 0·5

   (iv) 2

(b) The number of radial nodes present in $3d$ orbital is

(i) 1

(ii) 2

(iii) 3

(iv) 0

(c) The limiting radius ratio of r^+/r^- of tetrahedral crystal is

(i) 0·442

(ii) 0·255

(iii) 0·414

(iv) 0·732

(d) For n=3 l=1, the orbital is designated as

(i) 3s

(ii) $3d$

(iii) $3p$

(iv) 1s

(e) The net dipole moment of CO_2 molecule is

(i) 0

(ii) 0·5

(iii) 1

(iv) 1·5

(f) The oxidation state of sulphur in $H_2S_2O_7$ is

(i) +3

(ii) +5

(iii) -6

(iv) +6

(g) The shape of PCl_5 is

(i) spherical

(ii) trigonal planar

(iii) trigonal bipyramidal

(iv) square pyramidal

(h) The co-ordination number of Na^+ ion in $NaCl$ Crystal is

(i) 4

(ii) 6

(iii) 3

(iv) 8

(i) The bond order of O_2 is

(i) 1

(ii) 1·5

(iii) 2

(iv) 3

(j) The type of hybridisation of the central atom in H_2O molecule is

(i) sp-hybridisation

(ii) sp^2-hybridisation

(iii) sp^3-hybridisation

(iv) sp^3d-hybridisation

2. Answer the following questions : ***(any five)*** 2×5=10

(a) Define resonance and resonance energy.

(b) Write the electronic configuration of fluorine molecule and find its bond order.

(c) Explain why CCl_4 is non polar but $CHCl_3$ is polar.

(d) Draw the radial probability distribution curves for 3s and 3p orbitals.

(e) Write the differences between sigma (σ) bond and pi (π) bond.

(f) Draw the Born-Haber cycle for the $LiCl$ crystal.

(g) The radius of Cs^+ and Cl^- ions are 1·69$\AA$ and 1·8$\AA$ respectively. Find out the radius ratio of $CsCl$ and the structure of $CsCl$ crystal.

3. Answer ***any five*** of the following questions : 5×5=25

(a) What is quantum number ? Classify it. Which quantum number indicates shape and which quantum number indicates size of an orbital ? 1+2+1+1=5

(b) Prove that limiting radius ratio for a trigonal site is 0·155.

(c) What do you mean by covalent character of an ionic bond ? Arrange the following compounds in increasing order of ionic character

$NaCl$, $CsCl$, KCl and $LiCl$.

(d) Describe Born-Haber cycle for an ionic solid. Explain with proper examples.

(e) What are indicatiors? Write a short note on "acid-base indicatiors" with suitable examples. 1+4=5

(f) Explain Mulliken's scale of electro-negativity. How is Mulliken's value of electronegativity related with Pauling's value of electronegativity? 3+2=5

(g) Calculate the de Broglie wavelength of a particle of mass $9{\cdot}1\times10^{-31}$ *kg*, which is accelerated by applying a potential difference of 54 volts.

(Given, $h=6{\cdot}6\times10^{-34}$ *Js*, $e=1{\cdot}6\times10^{-19}C$).

(h) Explain the term 'percent ionic character' of a covalent diatomic molecule. Calculate the percent ionic character of *H–F* bond, with the help of the following data: Dipole moment for *HF* is 1·92*D*, charge of $e=4{\cdot}8\times10^{-10}$ *esu*, *H–F* bond length is 0·92*Å*.

(i) Write the main postulates of Bohr's theory about atom. Explain the limitations of Bohr's theory.

4. Answer the following questions: ***(any two)*** 10×2=20

(a) (i) Define lattice energy. Derive Born-Landé equation for ionic solids. 1+5=6

(ii) What is a hydrogen bond? What are the conditions to form hydrogen bonding? 2+2=4

(b) (i) What is hybridisation? Using hybridisation and VSEPR theory, explain the structures and bonding of the following molecules:

NH_3, XeF_4, SF_6 1+2+2+2=7

(ii) Write the limitations of VSEPR theory. 3

(c) (i) Deduce Schrödinger's wave equation. What are the significance of ψ and ψ^2? 5+2=7

(ii) Write *any three* applications of Bohr's theory. 3

(d) (i) Describe the structures of the following types of crystal: ***(any two)*** 3×2=6

1. Wurtzite structure
2. Rutile structure
3. *CsCl* structure

(ii) Write short notes on cubic close packed (ccp) structure and hexagonal close packed (hcp) structure. 2+2=4

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