1 SEM TDC CHMH (CBCS) C 1

2022

(Nov/Dec)

CHEMISTRY

(Core)

Paper : C–1

(Inorganic Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer : 1×6=6

(a) Which of the following are the possible values of n, l and m for an atom having maximum value of $m = \pm 2$?

(i) $n = 4,\ l = 3,\ m = +2$

(ii) $n = 3,\ l = 2,\ m = -2$

(iii) $n = 3,\ l = 3,\ m = +2$

(iv) $n = 4,\ l = 3,\ m = -2$

(b) The ground-state energy for H atom is −13·6 eV. Ground-state energy for Li^{2+} is

(i) −3·4 eV

(ii) −13·6 eV

(iii) −40·8 eV

(iv) −122·5 eV

(c) Which of the following species has the highest electronegativity?

(i) C [*sp*-hybridized]

(ii) N [sp^2-hybridized]

(iii) N [*sp*-hybridized]

(iv) C [sp^3-hybridized]

(d) Which of the following has highest lattice energy?

(i) BeO

(ii) MgO

(iii) CaO

(iv) SrO

(e) What type of hybridization is possible in square planar complexes?

(i) sp^3d

(ii) sp^3d^2

(iii) dsp^2

(iv) d^4s

(f) Which compound has maximum covalent character?

(i) $MgCl_2$

(ii) $BeCl_2$

(iii) $BaCl_2$

(iv) $CaCl_2$

2. Answer the following questions : 2×9=18

(a) State Heisenberg's uncertainty principle. Write the mathematical statement of the principle in terms of energy and time.

(b) Calculate the wavelength (in nano-meter) associated with a proton moving at $1{\cdot}0\times10^{3}$ ms^{-1}. [Mass of the proton = $1{\cdot}67\times10^{-27}$ kg and $h = 6{\cdot}63\times10^{-34}$ J-s]

(c) Write down the Schrödinger's wave equation and give the significance of ψ and ψ^2.

(d) What is Born-Haber cycle? Explain its applications and limitations.

(e) What is radial probability distribution function? Draw the radial distribution curve for 2*p*-orbital.

(f) What do you mean by polarization? Discuss Fajan's rules.

(g) Draw different shapes of the *d*-orbitals.

(h) What is the relation between solvation energy and lattice energy of an ionic crystal? Justify with suitable example.

(i) 4*s*-orbital filled first followed by 3*d*-orbital, but removal of electron initially take place from 4s. Why, give reason.

Or

Arrange the following in order of increasing bond order or bond length :

O_2; O_2^-; O_2^+; O_2^{2+}

3. Answer any *two* of the following questions : 4×2=8

(a) How can lattice energy of an ionic crystal be calculated theoretically? Deduce the equation. Give the limitation of Born-Landé equation. 3+1=4

(b) (i) The first ionization energy of Be is higher than that of B, while the second ionization energy of B is higher than that of Be. Explain giving reason.

(ii) Explain why the dipole moment of NF_3 is nearly zero. 2+2=4

(c) Discuss the metallic bonding in terms of band theory. Explain the following properties of metals in terms of Band theory : 2+1+1=4

(i) Semi-conductor and conductor

(ii) Insulator

4. Answer any *two* of the following questions : 3×2=6

(a) Define Pauling scale of electro-negativity. The ionic resonance energy of C—H bond is 5·75 kcal. The electro-negativity of H is 2·1. Find the electro-negativity of carbon. 3

(b) Draw the resonating structures of the following molecules and ions : 1×3=3

(i) O_3

(ii) $NO_3^{=}$

(iii) $CO_3^{=}$

(c) What is lattice energy? Calculate the lattice energy of NaCl with the help of the following data : 1+2=3

Electronic charge = $4{\cdot}8\times10^{-10}$ esu
Born exponent = 9
Madelung constant for NaCl = 1·748

Ionic radius of Na^+ = 0·95 Å
Ionic radius of Cl^- = 1·81 Å
Avogadro no. (N) = $6{\cdot}023\times10^{23}$

(d) What do you mean by hydrogen bonding? Mention the electrostatic theory of hydrogen bonding and discuss its limitation. 1+1½+½=3

5. Answer any *four* of the following questions : 3×4=12

(a) What is formal charge? Calculate the formal charge in CO_3^{2-} ion. 1½+1½=3

(b) Define Slater's rule. Calculate the effective nuclear charge for valence electron of K atom. 1+2=3

(c) Draw the molecular orbital energy level diagram for O_2 molecule. Explain the paramagnetic nature of O_2 with MOT. 2+1=3

(Continued)

(d) Using VSEPR theory, predict the structure of the following : 1×3=3

(i) BF_3

(ii) XeO_3

(iii) PCl_5

(e) What are weak intermolecular forces? Outline the role of induced dipole interaction in inter-molecular bonding. 1½+1½=3

(f) Explain the following : 1½×2=3

(i) *o*-Nitrophenol is more volatile than *p*-nitrophenol.

(ii) Boiling point of $H_2O > HF > NH_3$ although electronegativity of $F > O > N$.

6. How is standard electrode potential used in the volumetric estimation of oxalate using $KMnO_4$? Why is $KMnO_4$ a secondary standard? 2+1=3

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