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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) $n = 4, l = 3, m = -2$

(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

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(3)

(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 nanometer) associated with a proton moving at $1.0 \times 10^3 \text{ ms}^{-1}$. [Mass of the proton = 1.67×10^{-27} kg and $h = 6.63 \times 10^{-34}$ 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 $2p$ -orbital.

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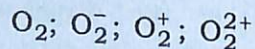
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(4)

- (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) $4s$ -orbital filled first followed by $3d$ -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 :



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.

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(5)

(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 electronegativity. The ionic resonance energy of C—H bond is 5.75 kcal. The electronegativity of H is 2.1. Find the electronegativity 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^{2-}

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(6)

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

Electronic charge = 4.8×10^{-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) = 6.023×10^{23}

- (d) What do you mean by hydrogen bonding? Mention the electrostatic theory of hydrogen bonding and discuss its limitation. $1+1\frac{1}{2}+\frac{1}{2}=3$

5. Answer any four of the following questions : $3 \times 4 = 12$

- (a) What is formal charge? Calculate the formal charge in CO_3^{2-} ion. $1\frac{1}{2}+1\frac{1}{2}=3$

- (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. $2+1=3$

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(7)

- (d) Using VSEPR theory, predict the structure of the following : $1 \times 3 = 3$

(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. $1\frac{1}{2}+1\frac{1}{2}=3$

- (f) Explain the following : $1\frac{1}{2} \times 2 = 3$

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

(ii) Boiling point of $\text{H}_2\text{O} > \text{HF} > \text{NH}_3$ although electronegativity of $\text{F} > \text{O} > \text{N}$.

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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