

Total No. of Printed Pages—7

**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)  $n = 4, l = 3, m = +2$

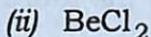
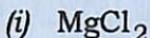
(ii)  $n = 3, l = 2, m = -2$

(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  $\text{Li}^{2+}$  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?



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  $1.0 \times 10^3 \text{ ms}^{-1}$ . [Mass of the proton =  $1.67 \times 10^{-27} \text{ kg}$  and  $h = 6.63 \times 10^{-34} \text{ J-s}$ ]

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

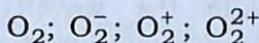
(d) What is Born-Haber cycle? Explain its applications and limitations.

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

- (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.

(ii) Explain why the dipole moment of  $\text{NF}_3$  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)  $\text{O}_3$

(ii)  $\text{NO}_3^-$

(iii)  $\text{CO}_3^{2-}$

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

Electronic charge =  $4.8 \times 10^{-10}$  esu

Born exponent = 9

Madelung constant for NaCl = 1.748

Ionic radius of  $\text{Na}^+$  = 0.95 Å

Ionic radius of  $\text{Cl}^-$  = 1.81 Å

Avogadro no. ( $N$ ) =  $6.023 \times 10^{23}$

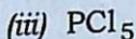
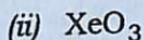
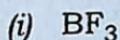
- (d) What do you mean by hydrogen bonding? Mention the electrostatic theory of hydrogen bonding and discuss its limitation. 1+1½+½=3

5. Answer any four of the following questions :

3×4=12

- (a) What is formal charge? Calculate the formal charge in  $\text{CO}_3^{2-}$  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  $\text{O}_2$  molecule. Explain the paramagnetic nature of  $\text{O}_2$  with MOT. 2+1=3

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



(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  $\text{KMnO}_4$ ? Why is  $\text{KMnO}_4$  a secondary standard?  $2+1=3$

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