

**1 SEM TDC CHMH (CBCS) C 1**

**2 0 2 1**

( March )

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. Find out the correct answer from the following : 1×6=6

(a) The de Broglie wavelength of a tennis ball of mass 66 g moving with a velocity  $10 \text{ m s}^{-1}$  is approximately

(i)  $10^{-31} \text{ m}$

(ii)  $10^{-35} \text{ m}$

(iii)  $10^{-34} \text{ m}$

(iv)  $10^{-33} \text{ m}$

(b) The correct order of increasing electron affinity of elements F, Cl, O and S is

(i)  $F < S < O < Cl$

(ii)  $S < O < Cl < F$

(iii)  $O < S < F < Cl$

(iv)  $Cl < F < O < S$

(c) Which of the following has the minimum melting point?

(i)  $\text{CaF}_2$

(ii)  $\text{CaCl}_2$

(iii)  $\text{CaBr}_2$

(iv)  $\text{CaI}_2$

(d) The shape of  $\text{XeO}_2\text{F}_2$  molecule is

(i) trigonal bipyramidal

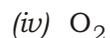
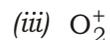
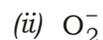
(ii) square planar

(iii) seesaw

(iv) tetrahedral

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(e) Which of the following has the maximum bond length?



(f) Standard reduction potentials ( $E^\circ$ ) of  $Cd^{2+}$ ,  $Ag^+$ ,  $Fe^{2+}$  and  $Cu^{2+}$  are  $-0.40$  V,  $+0.80$  V,  $-0.44$  V and  $+0.34$  V respectively. Which is the strongest reducing agent?



2. Answer the following questions :  $2 \times 9 = 18$

(a) Discuss the physical significances of  $\psi$  and  $\psi^2$ .

(b) Give all the possible values of quantum numbers  $l$ ,  $m_l$  and  $m_s$  for electron when  $n = 3$ .

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( Turn Over )

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(c) The second ionization energy of sulphur is higher than that of phosphorous. Explain.

(d) Arrange  $O_2^{2-}$ ,  $F^-$ ,  $Na^+$  and  $Mg^{2+}$  ions in the increasing order of size giving the proper explanation for the trend.

(e) Write the favourable factors for the formation of ionic bond.

(f) Using VSEPR theory, give the structure of the following molecules :  $1+1=2$



(g) Write a short note on shielding effect.

(h) What is resonance? Draw the resonating structure of  $NO_3^-$  ion.  $1+1=2$

(i) What do you mean by polarizing power of a cation? Explain.

3. Answer any two questions from the following :  $4 \times 2 = 8$

(a) (i) State Heisenberg's uncertainty principle. Give the mathematical expression for the same and explain.

(ii) State and explain Pauli's exclusion principle.  $2+2=4$

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(b) What are quantum numbers? What permitted values can these have? Give the significance of each quantum number.  $1+1+2=4$

(c) Draw the radial probability distribution curve for the orbitals with quantum numbers  $n = 1, 2$  and  $3$  indicating the nodes. 4

4. Answer any *two* questions from the following :  $3 \times 2 = 6$

(a) What is effective nuclear charge? Calculate the effective nuclear charge at the periphery of a Cu atom.  $1+2=3$

(b) Define electronegativity of an element. Calculate the electronegativity of oxygen atom using Allred-Rochow equation (covalent radius of O =  $0.74 \text{ \AA}$ ).  $1+2=3$

(c) Give reasons for the following:  $1\frac{1}{2}+1\frac{1}{2}=3$

(i) Size of  $\text{Cl}^-$  ion is greater than Cl atom while that of  $\text{Na}^+$  ion is smaller than that of Na atom.

(ii) Electron affinity of fluorine is less than that of chlorine.

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

(a) What is lattice energy of a crystal? Calculate the lattice energy of  $\text{MgF}_2$  from the following data :  $1+2=3$

Sublimation energy of magnesium  
 $= 146.4 \text{ kJ mol}^{-1}$

Dissociation energy of fluorine  
 $= 158.8 \text{ kJ mol}^{-1}$

Ionization energy of magnesium ( $\text{IE}_2$ )  
 $= 2186.0 \text{ kJ mol}^{-1}$

Electron affinity of fluorine  
 $= -327.9 \text{ kJ mol}^{-1}$

Enthalpy of formation of  $\text{MgF}_2$   
 $= -1096.5 \text{ kJ mol}^{-1}$

(b) Draw the molecular orbital energy level diagram for CO molecule and calculate the bond order.  $2+1=3$

(c) What is dipole moment of a molecule? How does it affect the polarity of the molecule? Each C—O bond in  $\text{CO}_2$  molecule is polar but  $\text{CO}_2$  molecule is non-polar. Explain.  $1+2=3$

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(d) Explain the following :  $1\frac{1}{2}+1\frac{1}{2}=3$

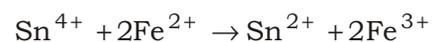
(i) *p*-nitrophenol has high-boiling point than *o*-nitrophenol.

(ii) Schottky defect lowers the density of ionic crystal while Frenkel defect does not.

(e) What is hybridization? On the basis of hybridization, discuss the formation of  $\text{NH}_3$  and  $\text{NH}_4^+$ .  $1+2=3$

6. Answer the following questions :  $1\frac{1}{2}+1\frac{1}{2}=3$

(a) Predict whether the reaction



will occur or not?

Given :

$$E_{\text{Sn}^{4+}/\text{Sn}}^{\circ} = 0.1 \text{ V and } E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^{\circ} = 0.77 \text{ V}$$

(b) Discuss the principle involved in quantitative estimation of Fe (II) by  $\text{KMnO}_4$ .

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