

**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034****M.Sc. DEGREE EXAMINATION – CHEMISTRY****FIRST SEMESTER – NOVEMBER 2022****PCH1MC02 – CONCEPTS IN INORGANIC CHEMISTRY**

Date: 25-11-2022

Dept. No. 

Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

**SECTION A****Answer ALL the questions**

| <b>1</b> | <b>Answer the following</b>   | <b>(5 x 1 = 5)</b> |     |
|----------|---|--------------------|-----|
| (a)      | How do you calculate the total number of lattices in an end centred lattice?  | K1                 | CO1 |
| (b)      | Which compound has high melting point, $\text{TiCl}$ or $\text{TiCl}_3$ ?   | K1                 | CO1 |
| (c)      | What is diffusion?  | K1                 | CO1 |
| (d)      | How is crown ether synthesised using a template method?   | K1                 | CO1 |
| (e)      | State Lux-Flood concept of acid-base theory.  | K1                 | CO1 |
| <b>2</b> | <b>Answer the following</b>   | <b>(5 x 1 = 5)</b> |     |
| (a)      | Represent the cell by coupling metal-metal ion electrodes, $\text{Cu}/\text{Cu}^{2+}$ and $\text{Ni}/\text{Ni}^{2+}$<br>( $E^\circ_{\text{Cu}/\text{Cu}^{2+}} = -0.76 \text{ V}$ and $E^\circ_{\text{Ni}/\text{Ni}^{2+}} = -0.25 \text{ V}$ ) | K2                 | CO1 |
| (b)      | What are the causes for the variation of bond angle in $\text{H}_2\text{O}$ and $\text{NH}_3$ though they are possessing same type of hybridisation?  | K2                 | CO1 |
| (c)      | How many microstates are possible for $d^8$ system?   | K2                 | CO1 |
| (d)      | Write the number of sigma and pi bonds in $\text{SO}_4^{2-}$ ion.   | K2                 | CO1 |
| (e)      | Mention any two examples for hard acids.  | K2                 | CO1 |

**SECTION B****Answer any THREE of the following in 500 words****(3 x 10 = 30)**

|          |   |    |     |
|----------|---|----|-----|
| <b>3</b> | (a) Construct the Frost diagram from the following Latimer diagram and comment on the tendency of any species to undergo disproportionation. <b>(5+5)</b><br>$\text{Hg}^{2+} \xrightarrow{+0.91 \text{ V}} \text{Hg}_2^{2+} \xrightarrow{+0.796 \text{ V}} \text{Hg}$<br>(b) Calculate the $E_0$ value for the reduction of $\text{HClO}$ to $\text{Cl}^-$ in aqueous acid medium.<br>$\text{HClO} \xrightarrow{+1.67 \text{ V}} \text{Cl}_2 \xrightarrow{+1.36 \text{ V}} \text{Cl}^-$ | K3 | CO2 |
| <b>4</b> | How is lattice energy determined using Born Lande equation? Explain.  | K3 | CO2 |
| <b>5</b> | Apply hybridisation concept to discuss the bonding and to predict the number of sigma and pi bonds in $\text{CO}_3^{2-}$ and $\text{XeO}_3$ .   | K3 | CO2 |
| <b>6</b> | Illustrate $\text{BrF}_3$ as non-aqueous solvent with suitable example.   | K3 | CO2 |
|          |   |    |     |

|   |  |    |     |
|---|--|----|-----|
| 7   | (a) Calculate EAN in $[\text{PtCl}_4]^{-2}$ and $[\text{Ru}(\text{bpy})_3]$ .<br>(b) Give the IUPAC nomenclature of i) $[\text{CoCl}(\text{ONO})(\text{en})_2]^+$ ii) $\text{K}_3[\text{Fe}(\text{CN})_5\text{NO}]$<br>(c) How are metal complexes synthesized by condensation method? | K3 | CO2 |
| <b>SECTION C</b>  |  |    |     |
| <b>Answer any TWO of the following in 500 words (2 x 12.5 = 25)</b> |  |    |     |
| 8   | Prove that the removal of electrons for the element Mn to $\text{Mn}^{2+}$ is from 4s orbital and not from 3d orbital by calculating effective nuclear charge.   | K4 | CO3 |
| 9   | Deduce the crystal structure of $\text{AB}_2$ and $\text{AB}_3$ type of crystal with a suitable example and a neat diagram.  | K4 | CO3 |
| 10  | Highlight the postulates of VSEPR theory and discuss the structure of (i) $\text{ClF}_3$ (ii) $\text{ICl}_4^-$ .   | K4 | CO3 |
| 11  | Illustrate any four types of interactions in supramolecular chemistry.   | K4 | CO3 |

### SECTION D

**Answer any ONE of the following in 1000 words**

**(1 x 15 = 15)**

|       |  |      |    |     |
|-------|--|------|----|-----|
| 12(a) | Derive the ground term of (i) $d^7$ system (ii) $\text{N}_2$ and $\text{He}_2$ molecule  | (8)  | K5 | CO4 |
| 12(b) | Discuss vacancy and interstitial diffusion with the mechanism.                           | (7)  | K5 | CO4 |
| 13(a) | Construct the MO diagram for $\text{CO}_2$ and HF molecules and predict the bond orders. | (10) | K5 | CO4 |
| 13(b) | Discuss the typical reactions and applications of acetic acid.                           | (5)  | K5 | CO4 |

### SECTION E

**Answer any ONE of the following in 1000 words**

**(1 x 20 = 20)**

|       |   |         |    |     |
|-------|---|---------|----|-----|
| 14(a) | (i) Explain the synergic effect of bonding present in CO molecule with metal in metal carbonyls using MO theory.<br>(ii) Predict EAN of Mn in $\text{Mn}_2(\text{CO})_{10}$ . | (7+3)   | K6 | CO5 |
| 14(b) | What are metal excess and metal deficiency defects? Write the consequences of the defects with examples.  | (10)    | K6 | CO5 |
| 15(a) | (i) List out the rules to be followed in naming chiral complexes with example.<br>(ii) How is optical activity of metal complexes determined by ORD method?                   | (10)    | K6 | CO5 |
| 15b)  | Write a note on the following:<br>(i) Relationship between a and r in bcc type of crystals<br>(ii) Limiting radius ratio and crystal structures<br>(iii) Molecular switches   | (3+3+4) | K6 | CO5 |

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