

3 Yr. Degree/4 Yr. Honours 3rd Semester Examination, 2024 (CCFUP)

Subject : Chemistry

Course: CHEM3011 (MAJOR)

Time: 3 Hours

Full Marks: 60

*The figures in the right hand margin indicate full marks.**Candidates are required to give their answers in their own words
as far as practicable.*

1. Answer any ten questions from the following: $2 \times 10 = 20$
- (a) The bond energies in H_2^+ and He_2^+ are almost identical.— Justify.
 - (b) A polydentate ligand may not use all its donor centers for complexation.— Comment.
 - (c) What are the basic differences between conductor and semiconductor?
 - (d) Why is the molecular nitrogen chemically inert?
 - (e) What are π -acidic and π -complexing ligands?
 - (f) ZnO is white when cold but yellow when hot.— Explain.
 - (g) 'SF₆ is unreactive towards water but TeF₆ is readily hydrolyzed'.— Comment.
 - (h) What is linkage isomerism? Give an example.
 - (i) What is pseudohalogen? How does pseudohalogen act as an ambidentate ligand?
 - (j) Draw the structures of P₄O₆ and P₄O₁₀.
 - (k) HF₂⁻ exists while the other halogens cannot form such stable species.— Explain.
 - (l) 'The I₃⁻ is linear but I₃⁺ is bent'.— Justify.
 - (m) Diamond looks transparent but silicon or germanium looks opaque.— Explain.
 - (n) Why has SiCl₄ a lower boiling point than CCl₄?
 - (o) What is clathrate compound? Give its example.

1+1

2. Answer *any four* questions from the following:**5×4=20**

- (a) (i) Discuss the characteristic features of primary and secondary valence of Werner's coordination theory. 3+2
- (b) (i) Write down the differences between Schottky and Frenkel defects. What effects do they have on the density of crystals? 2+1
- (ii) How NiO crystal is showing electrical conductivity after doping with Li_2O ? 2
- (c) (i) Give a brief account on interhalogen compounds. 3
- (ii) Why is helium used for artificial respiration of deep sea divers? 2
- (d) (i) Polythiazyl compounds show electrical conductivity.— Explain. 2
- (ii) What do you mean by dithionic acid and polythionic acid? State the differences in structural features. 2+1
- (e) What are silicones? How are they prepared? Draw the structures of two different varieties of silicones. 1+2+2
- (f) (i) In the crystal structure of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, the four water molecules are loosely held but the fifth water molecule is somewhat difficult to remove upon heating — Explain. 3
- (ii) How will you detect hydrogen bond that is present in compounds experimentally? 2

3. Answer *any two* questions from the following:**10×2=20**

- (a) (i) Hydrazine can act as a monodentate and as a didentate bridging ligand but not as a didentate chelating ligand.— Justify the statement. 3
- (ii) Three compounds, P, Q and R have molecular formula $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$. When 1g of each of P and R is dehydrated in presence of a dehydrating agent, a constant weight of 0.865 g and 0.932 g respectively is obtained. Compound Q shows no loss of water. Find the composition of P, Q and R. What kind of isomerism P, Q and R show? $[\text{Cr}=52, \text{Cl}=35.5, \text{O}=16, \text{H}=1]$ 3+1
- (iii) Draw the structures of possible isomers of $[\text{RuCl}_3(\text{OH}_2)_3]$. Write down the IUPAC name of Prussian blue. 2+1

- (b) Write down the short account on (*any four*): 2.5×4
- (i) Inorganic benzene
 - (ii) Zyolith or Sorel's cement
 - (iii) Buckyballs
 - (iv) Phosphazenes
 - (v) n-type semiconductor
 - (vi) Linear Combination of Atomic Orbital (LCAO).
- (c) (i) How XeF_2 , XeF_4 and XeF_6 are prepared? Mention their chemical properties and structures (VSEPR theory). 6
- (ii) Draw the structure of pyrosulphurous acid, pyrosulphuric acid, peroxodisulphuric acid and thiosulphuric acid. 2
- (iii) Why does $\text{N}(\text{CH}_3)_3$ and $\text{N}(\text{SiH}_3)_3$ give different products on the reaction with HCl ? 2
- (d) (i) The colours of halogen are: F_2 (pale yellow), Cl_2 (yellow), Br_2 (reddish brown), I_2 (Violet).— Justify the statement. 3
- (ii) The O–O bond length varies in the species as: $\text{O}_2^+ < \text{O}_2 < \text{O}_2^- < \text{O}_2^{2-}$ — Explain in terms of MOT. 3
- (iii) Why is hydrogen bridge bond a 3c–2e bonding system while hydrogen bond is a 3c–4e bonding system? 2
- (iv) TiO shows the metallic conduction while FeO shows the properties of semiconductors. —Explain. 2
-