



# VIT<sup>®</sup>

Vellore Institute of Technology  
(Deemed to be University under section 3 of UGC Act, 1956)  
CHENNAI

Name of Examination		Continuous Assessment Test - 1, Fall Semester 2023-24, (Sept. 2023)		
Slot: B1+TB1		Course Mode: Classroom Based	Class Number(s): CH2023241700733	
Course Code:	BCHY101L	Course Title:	Engineering Chemistry	
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Answer Any FIVE Questions

Total Marks: 5 X 10 Marks = 50

Q. No.	Question Text	Marks
1.	(a) 2 moles of an ideal monoatomic gas ( $C_V=3/2R$ ) at 30°C expand adiabatically from 20 dm <sup>3</sup> to 50 dm <sup>3</sup> . Calculate the values of q, w, $\Delta U$ and $\Delta H$ . Given, $R = 8.314 \text{ Jmol}^{-1}\text{K}^{-1}$ . (5M)  (b) Identify if the heat exchanged (q), work done (W) and internal energy (U) and enthalpy (H) are state functions or path Functions. Calculate the efficiency of a heat engine if it operates between 25°C and 125°C. (5M)	10
2.	(a) Which of the following processes will have $\Delta S > 0$ ? Justify your answer. (i) Isothermal reversible expansion of an ideal gas. (ii) Adiabatic reversible expansion of an ideal gas. (5M)  (b) Decomposition of $\text{SO}_2\text{Cl}_2$ follows a first order kinetics. 50% of that reaction completes in 100 minutes. How long will it take for 90% of the reaction to be completed? (5M)	10
3.	(a) What is a catalyst? Explain homogeneous and heterogeneous catalysis with an example of each type. (5M)  (b) The values of rate constants for a reaction are $10 \times 10^{-4} \text{ L/mol.s}$ and $10 \times 10^{-2} \text{ L/mol.s}$ at temperatures 300K and 400 K respectively. Calculate the activation energy of the reaction. ( $R=8.314 \text{ JK}^{-1}\text{mol}^{-1}$ ). (5M)	10
4.	(a) Applying VB theory explain the hybridization, geometry and magnetic behavior of $[\text{FeF}_6]^{4-}$ and $[\text{Fe}(\text{CN})_6]^{4-}$ (At. No. of Fe= 26). (5M)  (b) With proper example describe the role of coordination complexes in (i) metal extraction and (ii) metal purification process. (5M)	10
5.	(a) Draw the crystal field splitting diagram for low spin and high spin complexes with $d^6$ configuration in octahedral field. Calculate CFSE and spin only magnetic moment in each case. (5M)  (b) Identify the compounds which will have higher extent of d orbital splitting in each of the following set. Justify your choice. Set 1 : $[\text{CoF}_6]^{3-}$ & $[\text{Co}(\text{CN})_6]^{3-}$ Set 2: $[\text{Fe}(\text{NH}_3)_6]^{3+}$ & $[\text{Ru}(\text{NH}_3)_6]^{3+}$ (Atomic Number of Co: 27, Fe:26, Ru:44). (5M)	10
6.	(a) Applying 18 electron rule predict the thermodynamic stability of the following organometallic complexes. (At. No. of Co=27; At. No. of Mn=25) (5M) (i) $(\eta^5\text{-C}_5\text{H}_5)_2\text{Co}$ (ii) $\text{Mn}(\text{CO})_5$  (b) Explain in detail how the presence of Magnesium metal ion in chlorophyll favors the utilization of light energy in photosynthesis. (5M)	10