Reg. No.:

Name :

VIT

Vellore Institute of Technology

Continuous Assessment Test I (CAT II) – April 2024

Programme	: B. Tech	Semester	: Winter 2023-24
Course	: Engineering Chemistry	Code	: BCHY101L
Faculty	: G. Ramachandran	Slot Class Nbr	: A1 Slot (CH2023240500574) :
Time	1 ½ Hours	Max. Marks	: 50

Answer ALL Questions **5 x 10 = 50 Marks**

N.B: *Answers need to be scientific, logical and to the point*

Q.No.	Sub. Div.	Questions	Marks
1.	a.	2 moles of an ideal gas at 30°C expand isothermally from 20 dm^3 to 50 dm^3. Calculate the values of q, w, ΔU and ΔS. Given, R = 8.314 $Jmol^{-1}K^{-1}$.	5
	b.	If a Carnot Engine's low temperature heat sink is the ambient temperature and high temperature source is at 100 °C, calculate the efficiencies of the engine in the month of January and June, provided the average temperature of the place during the months 10 & 30 °C, respectively.	5
2.	a.	For a reaction if the pre-exponential factor is 0.04 min^{-1} and activation energy is 1.8 kJ mol^{-1}, for faster reaction between the options: i.) Refluxing the reaction mixture at 150 °C, and ii.) Performing the reaction mixture in presence of a catalyst that reduces the reaction's activation energy making ¾ th. Which one of them is preferable & why? Provided the catalyst cannot work beyond 0 °C.	5
	b	When one mole of gas raised by its temperature by 1K, the microstates of them is enhanced 2 times. Calculate the molar ΔS for the process.	

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3. a. Decomposition of H_2O_2 follows a first order kinetics. 50% of that reaction completes in 17 minutes at 25 °C. At the same temperature how long will it take for 70% of decomposition? 5

b. Identify the inorganic complexes $[M(H_2O)_6]^{2+}$ and $[M(H_2O)_6]^{3+}$ having the colours yellow and purple/pink, when the lower cationic charged complex is having 3 unpaired electrons, how many unpaired electron is expected for the other complex? Also, justify the colour differences for the complexes in terms of crystal field theory (CFT). 5

4. Based on the 18-electron rules, predict which of the following will be stable. Show electron count using any one of the counting methods

(a) $(\eta^5 - C_5H_5)_2\ Co$ (b) $Ti(\eta^2 - C_2H_4)_2(\eta^5 - C_5H_5)_2$ 10

(c) $Ni(NH_3)_3(\eta^2 - C_2H_4)$ (d) $(\eta^5 - C_5H_5)_2Cr(CO)$

5. a. Though chlorin ring is able to absorb both the spectra of blue and red, explain the reasons chlorin ring must form a complex with Mg to form chlorophyll for photosynthesis. 5

b As per the crystal field theory (CFT), among the d orbitals, d_{z^2}, $d_{x^2-y^2}$, d_{xy}, d_{xz}, & d_{yz} which are the orbitals, stabilized when central metal is surrounded by ligands in a shape of octahedral geometry and which are not? Justify your answer with proper drawing orbitals and their interaction with the ligands. 5

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27/03/2024