



VIT

Vellore Institute of Technology

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## Continuous Assessment Test I (CAT II) – April 2024

Program	: B. Tech	Semester	: Winter 2023-24
Course	: Engineering Chemistry	Code	: BCHY101L
Faculty	: G. Ramachandran	Slot	: AI Slot (CH2023240500574)
Time	: 1 ½ Hours	Class Nbr	: 50
		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
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1. a. 2 moles of an ideal gas at 30°C expand isothermally from 20 dm<sup>3</sup> to 50 dm<sup>3</sup>. Calculate the values of q, w, ΔU and ΔS. Given, R = 8.314 Jmol<sup>-1</sup>K<sup>-1</sup>. 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<sup>-1</sup> and activation energy is 1.8 kJ mol<sup>-1</sup>, 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 ¼ th. 5  
 Which one of them is preferable & why? Provided the catalyst cannot work beyond 0 °C.

- 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.

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

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

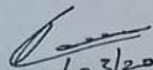
- b. unpaired electrons, how many unpaired electron is expected for the other complex? Also, justify the colour differences for the complexes in terms of crystal field theory (CFT). 5
4. Based on the 18-electron rules, predict which of the following will be stable. Show electron count using any one of 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)  $(\eta^5 - C_5H_5)_2 Cr(CO)$

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

As per the crystal field theory (CFT), among the d orbitals,

- b.  $d_{z^2}$ ,  $d_{x^2-y^2}$ ,  $d_{xy}$ ,  $d_{xz}$ , &  $d_{yz}$  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