BI/D/TY

Final Assessment Test – April 2025

VIT
Vellore Institute of Technology

Course: **BCHY101L - Engineering Chemistry**

Class NBR(s): **5005 / 5012 / 5028 / 5029 / 5031 / 5039 / 5042**

Slot: **D1+TD1**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer ALL Questions

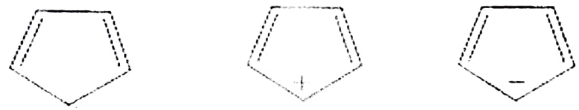
(10 X 10 = 100 Marks)

1. Derive the appropriate equations for the work done for a reversible and irreversible isothermal expansion processes. Interpret the maximum work done between the two processes through a graphical sketch and justify why mechanical work is a path function and not a state function.

2. Illustrate the crystal field splitting diagram for the (Group 6) octahedral complexes of (i) $Cr(CO)_6$ and (ii) $[Cr(H_2O)_6]^{3+}$. Calculate their CFSE and magnetic moment values based on their ligand field strength.

3. a) Exemplify the influence of resonance and inductive effects on the stability of carbocations and carbanions with suitable examples. **[5]**

   b) Interpret whether the given compounds are aromatic, non-aromatic, or anti-aromatic, with appropriate justifications. **[5]**



(i) (ii) (iii)

4. a) Identify a rechargeable energy device that works on ion intercalation-deintercalation mechanism. Subsequently, describe the cell components and associated-cell reactions. **[5]**

   b) Identify a ceramic-based high-temperature operated flow cell device for powering trains, ships, etc. Discuss the various cell components and electrochemical processes associated with it. **[5]**

5. Summarize the types of conducting polymers and the factors that affect their conductivity. Explain the working mechanism of doped conducting polymers with suitable examples.

6. Illustrate the working principle, instrumentation, and applications of powder X-ray diffraction technique with a neat sketch.

7. Demonstrate the hardness removal procedure using ion-exchanger resins with suitable diagram and appropriate chemical reactions. Discuss the pros and cons of the process.

8. a) A heat engine absorbs 1000 J of heat from a reservoir at 150°C and rejects 200 J to the sink at 25°C. Calculate the efficiency of the heat engine and the amount of work done. **[5]**

b) The half-life for an H_2O_2 decomposition reaction that follows a first-order kinetics is 32 seconds. Calculate the initial concentration of H_2O_2 if its concentration after 120 seconds is 0.062 M. **[5]**

9.a) Illustrate the syntheses of (i) ABS and (ii) Bakelite polymers. State two important properties and applications associated with the above-mentioned polymers.

[OR]

9.b) Explain the procedures involved in the synthesis of nanoparticles using sol-gel and ball milling methods. Based on your understanding, state the pros and cons of sol-gel method.

10.a) Explicate an appropriate corrosion protection technique for the following cases.

(i) A home appliance company interested in protecting the water heaters from corrosion.

(ii) A power generation company interested in protecting its power transmission towers in remote areas from corrosion.

[OR]

10.b) The combustion of a coal sample (0.59 g) in a bomb calorimeter produced the following data: (i) water equivalent of the calorimeter was 400 g; (ii) water taken in the calorimeter was 1600 g; (iii) Initial temperature and final temperatures were 20.5°C and 21.8°C; (iv) cooling correction was 0.04°C; (v) acid correction was 36 calories, and (vi) fuse wire correction was 12 calories. Besides, the fuel contained 4.0% hydrogen, and the latent heat of condensation of steam was 587 cal/g. Calculate the coal sample's gross and net calorific values (in terms of J/g).

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