

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, MARCH 2021

FIRST YEAR [BATCH 2020-23]

INDUSTRIAL CHEMISTRY (HONOURS)

Date : 26/03/2021

Time : 11 am - 1 pm

Paper : II [CC 2]

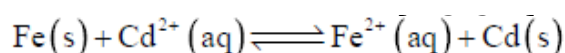
Full Marks : 50

Answer **any five** questions:

[10× 5]

Given Constants: $F = 96484.56 \text{ coul mole}^{-1}$, $T = (273.15 + 25) \text{ K}$, $R = 8.31441 \text{ joule mole}^{-1}\text{K}^{-1}$

1. a) What is rate of a reaction? What is its unit?
b) What is rate constant? What is the unit of rate constant for nth order reaction?
c) What is order of a reaction? Give an example of fractional order reaction.
d) What is molecularity of a reaction? [2+3+3+2]
2. a) What is pseudo unimolecular reaction?
b) Show that the specific reaction rate of a pseudo unimolecular reaction follows first order kinetics.
c) A reaction is found to be zero order. Will its molecularity be zero? Write down the Arrhenius equation. Explain the each term.
d) Is a first order or a second order reaction completed? [2+3+(1+2)+2]
3. a) At 25°C the half-life period for the decomposition of N_2O_5 is 5.7 hr. and is independent of the initial pressure of N_2O_5 . Calculate (i) the specific rate constant (ii) the time required to go to 90% completion.
b) Calculate the cell potential and free energy available for the following electrochemical systems:
i) $\text{Ag (s)} | \text{Ag}^+ (\text{aq } 1.0 \text{ M}) || \text{Cu}^{2+} (\text{aq } 1.0 \text{ M}) | \text{Cu (s)}$
Given: $E_{\text{anode}} = 0.7996 \text{ volt}$, $E_{\text{cathode}} = 0.3402 \text{ volt}$
ii) $\text{Cu (s)} | \text{Cu}^{2+} (\text{aq } 0.1 \text{ M}) || \text{Ag}^+ (\text{aq } 0.1 \text{ M}) | \text{Ag (s)}$
c) Explain with reason which of the above cells can act as Voltaic Cell and Electrolytic Cell. [5+(2+2)+1]
4. a) Briefly describe the principle of conductometric titration.
b) Illustrate with example how conductometric titration can be used to determine the end-point of titration of *Strong Acid with a Strong Base*, *Strong Acid with a Weak Base* and *Weak Acid with a Strong Base*
c) Define Molar conductivity of a substance and describe how weak and strong electrolytes' molar conductivity changes with concentration of solute. How is such change explained?
d) Calculate the Equilibrium constant for the reaction:



(Given : $E^\circ_{\text{Cd}^{2+}|\text{Cd}} = -0.40 \text{ V}$, $E^\circ_{\text{Fe}^{2+}|\text{Fe}} = -0.44 \text{ V}$).

[2+3+3+2]

5.
 - a) Write down four main differences between thermal and photochemical reactions.
 - b) State Lambert–Beer law and derive the expression between absorbance and concentration of the medium.
 - c) Define molar extinction coefficient.
 - d) Explain the Photochemical decomposition of Hydrogen Iodide and determine the quantum yield of the reaction.
 - e) Give an example of a naturally occurring Photo-sensitized reaction. [2+2+1+4+1]
6.
 - a) Distinguish between 'state function' and 'path function' with example. Explain why 'Adiabatic work' is a 'state function'.
 - b) Derive the expression for efficiency of a Carnot cycle. Involving ideal gas as the working substance.
 - c) Categorize the following properties of a thermodynamic system extensive or intensive? Specific heat capacity, internal energy, molar volume & chemical potential. [3+3+4]
7.
 - a) State “Zeroth law” of thermodynamics. From this derive the idea of “empirical temperature”.
 - b) Write down the operational principle of a “Carnot engine” with a schematic indicator diagram
 - c) Heat capacity at constant pressure is greater than heat capacity at constant volume. Why? [3+4+3]
8.
 - a) Entropy of a system cannot be negative, justify.
 - b) Prove that for an ideal gas adiabatic slope is steeper than isothermal for P vs. V diagram.
 - c) Isothermal reversible work of expansion for an ideal gas is greater than that for an irreversible process between the same initial and final state – Explain. [3+3+4]

_____ × _____