RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, MARCH 2022

FIRST YEAR [BATCH 2021-24]

Date : 10/03/2022

Time : 11 am – 1 pm

INDUSTRIAL CHEMISTRY (HONOURS)

PAPER : II [CC2]

Full Marks : 50

Group A

Answer **any five** questions of the following: [5×5]

1. a) State the zeroth law of thermodynamics.

   b) Entropy of a system cannot be negative. Explain. (2+3)

2. a) State Kelvin-planck and Clausius statement of second law of thermodynamics.

   b) Distinguish between 'state function' and 'path function' with example. (2+3)

3. a) Explain why 'Adiabatic work' is a 'state function'

   b) Define degree of freedom and components in connection with Phase equilibrium. (2+3)

4. a) Prove that maximum work can be obtained from an isothermal reversible process.

   b) Prove that adiabatic PV–curve is steeper than isothermal PV–curve. (2.5+2.5)

5. a) State second law of thermodynamics.

   b) 10g of hydrogen gas at 27^0C are compressed isothermally to one-fifth of the original volume. Find the value of work done. (2+3)

6. a) Define triple point.

   b) Write and explain Gibbs phase rule. (2+3)

7. a) Prove that the maximum number of phases that can coexist in equilibrium is 3 for one component system.

   b) Define and explain the physical significances of the following terms:

   (i) Free energy

   (ii) Entropy. (3+2)

8. a) Identify the extensive and intensive properties from the among followings:

   free energy, molar enthalpy, temperature, density, entropy, Melting point.

   b) Calculate the value of C_p - C_v for any substance. All terms has their usual meaning. (2+3)

Group -B

Answer **any five** questions of the following: [5×5]

9. a) Consider a photochemical reaction A ⟶ B + C. when irradiated with light of wavelength 2500 A^0 during a certain period, the light energy absorbed = 2.628×10^8 Joule and the number of moles of B formed = 3.64×10^{-6} mole. Calculate the quantum yield.
   b) The quantum yield for the decomposition of HI is 2 but after sometime it comes down from 2. Explain with proper mechanism. (3+2)
10. a) In most of the electronic gadgets, Lithium ion battery is used. Explain with reason.
   b) Draw the Complete cell picture of the above battery, mark the electrodes, represent the complete cell with proper notation, write down the chemical reactions taking place in both of the electrodes & overall cell reaction, and write the Nernst equation for the cell. (2+3)
11. a) Draw the picture of the Calomel Electrode.
   b) Elucidate with proper reasoning: the situations when the boundary mark of the calomel expands or contracts. Write down the important reactions occurring at the electrodes in each of the two situations. (2+3)
12. Describe the method of determination of PH of an acidic solution and the end point of an acid-base titration by Potentiometric Measurement. (5)
13. a) At 478 nm, hydrogen and chlorine combine to give hydrogen chloride with a quantum efficiency of 1.00×10^6. If the absorbed intensity is 2.50×10^{-3} Js^{-1}, calculate the amount of hydrogen chloride formed in 10 minutes.
   b) The extinction coefficient **(ε)** value of a substance is 4.66 $m^2\,mol^{-1}$. Calculate the concentration of its solution (in molarity) which has $I/I_0 = 0.2$. The thickness of the cell is 1.00 cm. (3+2)
14. a) $2A+B \rightarrow 4C+D+E$, for this reaction rate constant (k) is $3.48*10^{-4}$ $mole^{-2}\,L^2\,s^{-1}$. Find out order of this reaction.
   b) Show that for a first order reaction concentration of the reactant decrease with time. (with diagram) (2+3)
15. a) For a first order reaction, concentration of the reactant changes from 0.3(M) to 0.12(M) in 1 hour. Find out rate of the reaction (in sec) when concentration of the reactant is 0.6(M).
   b) "The activation energy of an endothermic reaction must be greater than the heat change accompanying the reaction."- Explain. (3+2)
16. a) Point out the basic difference between Molecularity and Order.
   b) $C_6H_5N_2Cl \rightarrow C_6H_5Cl+N_2$ – for this reaction variation of rate constant with temperature is –

   t°c – 20 30

   k(min^{-1}) - 0.00166 0.00678

   Calculate Activation Energy and Frequency factor for this reaction. (2+3)

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