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S 4022

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

First Semester

Civil Engineering

CY 1101 — CHEMISTRY — I

(Common to all branches Except Marine Engineering)

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

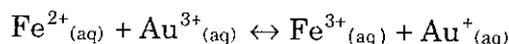
PART A — (10 × 2 = 20 marks)

1. What are the advantages and limitations of glass electrode?
2. The potential of the cell, $\text{Pt}/\text{H}_{2(\text{g})} // \text{HCl}_{(\text{aq})} / \text{AgCl}_{(\text{s})} / \text{Ag}$ is 0.322 V at 25°C. What is the pH of the electrolyte solution? ($E^\circ_{\text{Ag}-\text{AgCl}} = 0.22 \text{ V}$)
3. What is the criteria for thermodynamic reversibility?
4. Write down the mathematical statement for first and second law of thermodynamics. Write down the expression obtained when they are combined.
5. What is consecutive reaction? Give one example.
6. The rate constant for an isomerisation reaction $\text{A} \rightarrow \text{B}$, is $4.5 \times 10^{-3} \text{ min}^{-1}$. If the initial concentration of A is 1 M, calculate the rate of the reaction after one hour?
7. How is arsenic poisoning from the body removed by adsorption techniques?
8. What is elution and an eluent in chromatographic techniques?
9. What are the disadvantages of Beer-Lambert's law?
10. Differentiate o-nitrophenol and p-nitrophenol using IR-spectroscopy.

PART B — (5 × 16 = 80 marks)

11. (a) (i) How do the equivalent and specific conductances of an electrolyte vary with dilution? (4)

- (ii) Balance the equation and calculate the equilibrium constant for the reaction,



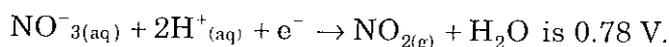
Given that $E^{\circ}_{\text{Au}^+/\text{Au}} = 1.69 \text{ V}$, $E^{\circ}_{\text{Au}^{3+}/\text{Au}} = 1.40 \text{ V}$ and $E^{\circ}_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ V}$. (6)

- (iii) How is calomel electrode constructed? Discuss how this electrode may be used for the determination of pH of a solution. (6)

Or

- (b) (i) Explain the types of conductometric titrations. (8)

- (ii) The standard reduction potential for half cell,



- (1) Calculate the reduction potential in 8 MH⁺.

- (2) What will be the reduction potential of the half cell in a neutral solution.

(Assume all the other species to be at unit concentration)

(4 + 4)

12. (a) (i) Derive an expression for the variation of equilibrium constant of a reaction with temperature. (10)

- (ii) Gibbs free energy of a reaction at 300 K and 310 K are -29 Kcal and -29.5 Kcal respectively. Determine ΔH and ΔS at 300 K. (6)

Or

- (b) (i) The standard enthalpy of combustion of solid phenol ($\text{C}_6\text{H}_5\text{OH}$) is -3054 KJ mol⁻¹ at 298 K and its standard molar entropy is 144.0 JK⁻¹ mol⁻¹. Calculate the standard Gibbs energy of formation of phenol at 298 K.

($\Delta_f H^{\circ}(\text{CO}_2) = -393.51 \text{ KJ mol}^{-1}$, $\Delta_f H^{\circ}(\text{H}_2\text{O}) = -285.83 \text{ KJ mol}^{-1}$,
 $S_m^{\circ}(\text{carbon}) = 5.740 \text{ JK}^{-1} \text{ mol}^{-1}$, $S_m^{\circ}(\text{H}_2) = 130.68 \text{ JK}^{-1} \text{ mol}^{-1}$,
 $S_m^{\circ}(\text{CO}_2) = 5.740 \text{ JK}^{-1} \text{ mol}^{-1}$).

- (ii) Derive Gibbs Helmholtz equation and mention its application. (8)

13. (a) (i) The rate constant of a second order reaction is $5.70 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ S}^{-1}$ at 25°C and $1.64 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ S}^{-1}$ at 40°C . Calculate the activation energy and the Arrhenius pre-exponential factor. (8)
- (ii) Explain the characteristics of second order reactions. (8)

Or

- (b) (i) What are opposing reactions? Give two examples. Derive an expression for the kinetics of opposing reaction in which both the forward and reverse reactions are first order. (12)
- (ii) The half-life of the homogeneous gaseous reaction, $\text{SO}_2\text{Cl}_2 \rightarrow \text{SO}_2 + \text{Cl}_2$, which obeys first order kinetics is 8.0 minutes. How long will it take for the concentration of SO_2Cl_2 to be reduced to 1% of the initial value? (4)
14. (a) (i) What are adsorption isotherms? Explain various types of adsorption isotherms. Give one example for each type. (12)
- (ii) Mention some important characteristics of adsorption. (4)

Or

- (b) Give the mechanism for enzyme catalyzed reaction as proposed by Michaelis and Menten. Write the rate equation for enzyme catalyzed reaction. What happens to the rate if (i) $[\text{S}] < K_m$ (ii) $[\text{S}] > K_m$? (16)
15. (a) What is colorimetry? Name the components of colorimeter and mention their functions. (16)

Or

- (b) What is IR spectroscopy? Explain the types of stretching and bending vibrations of linear and non-linear molecule with suitable examples. (16)