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ICH 403

I Semester M.Sc. Degree Examination, May 2022
INDUSTRIAL CHEMISTRY
Physical Chemistry

Time : 3 Hours

Max. Marks : 70

- Instructions :** 1) Answer **any five** questions from Part – **A** and **any five** questions from Part – **B**.
2) Figures to the **right** indicate marks.

PART – A

1. Answer **any five** questions : **(5×2=10)**
- a) Calculate the de Broglie wavelength of an electron travelling at $1/10^{\text{th}}$ the speed of light. ($m_e = 9.1 \times 10^{-31}$ kg, $h = 6.626 \times 10^{-34}$ Js)
 - b) Normalize the wave function $\psi(x) = A \sin \frac{n\pi x}{L}$; $0 < x < L$.
 - c) The free energy change for a process at 25°C is -85.77 kJ and at 35°C is -83.68 kJ. Calculate the change in enthalpy for the process at 303 K.
 - d) Give any two comparisons of kinetics of hydrogen-halogen reaction.
 - e) Corrosion can be considered as the reverse process of metal extraction. Justify this statement.
 - f) Why are N- and S- containing organic compounds employed as organic corrosion inhibitors ?
 - g) What is Kolbe's electro-synthesis ?
 - h) Explain the principle of electro inorganic synthesis of chlorate.

P.T.O.



PART – B

Answer **any five full** questions :**(5×12=60)**

2. a) Obtain the expressions for energy levels and wavefunctions for a particle in one-dimensional Box.
- b) State the postulates of quantum mechanics.
- c) Discuss Einstein's explanation of photoelectric effect. **(5+4+3)**
3. a) Explain the concept of degeneracy using particle in a three-dimensional box problem.
- b) Discuss the application of Schrodinger equation to a harmonic oscillator.
- c) Set up operators for x, y and z components of angular momentum. **(4+5+3)**
4. a) Consider the two consecutive first-order reactions
- $$A \xrightarrow{k_1} B, \quad B \xrightarrow{k_2} C.$$
- Integrate the rate equations to obtain expressions for [A], [B] and [C] as functions of time. If $k_1 = 1 \text{ s}^{-1}$, sketch each of these functions for the cases $k_2/k_1 = 0.1, 1$ and 10 . Assume that only A is present initially with a concentration c_0 .
- b) What is chemical potential ? Give its physical significance.
- c) One mole of solid gold is raised from 25°C to 100°C at constant pressure. $C_p (\text{J/K mol}) = 23.7 + 0.00519T$. Calculate ΔS for the transformation. **(6+3+3)**
5. a) Derive the expression of Gibbs free energy of mixing.
- b) Explain the upper and lower explosion limits in branched chain reaction.
- c) Derive Kirchhoffs equation relating the variation of enthalpy of a reaction with temperature. **(4+4+4)**



6. a) Outline the principle involved in electrophoretic coating. What are its applications ?
- b) Give examples for pigments and drying oils. What are their functions ?
- c) Explain the importance of material selection and design in the control of corrosion. **(4+4+4)**
7. a) Explain cathodic and anodic protection. Mention two of their applications.
- b) Outline the importance of metal finishing and processing. **(6+6)**
8. a) Describe the mechanism of industrial production of potassium hydroxide.
- b) Explain the electrosynthesis of adiponitrile.
- c) Outline the electro-inorganic synthesis of fluorine. **(4+4+4)**
9. a) Discuss in detail the various costing parameters and electrolysis parameters employed in deciding the performance of an electrochemical cell.
- b) Explain with relevant reactions the electro-reduction and oxidation of hydrocarbons. **(6+6)**
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