B.E. METALLURGICAL AND MATERIAL ENGINEERING

SECOND YEAR FIRST SEMESTER - 2023

CHEMISTRY - II

Time : 3 h   Full Marks : 100

PART I (

(Environmental Chemistry)

Attempt five questions   *5 x 8 = 40*

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(c) For a given chemical reaction, the magnitude of equilibrium constant, K_p is found to be 1.64×10^{-4} and 1.44×10^{-5} at 673K and 773K temperature respectively. Calculate the value of standard molar enthalpy change of the reaction.   3+4+3

2. (
4. (a) Derive the expression for equilibrium constant, K_p in terms of the degree of dissociation for the following dissociation reaction of N_2O_4.
$$N_2O_4 (g) = 2 NO_2 (g)$$
(b) Deduce the expression of integrated form of rate expression for first order chemical reaction.
(c) Show that for a first order chemical reaction, the time required for the 99.9 % completion is almost 10 times of the half-life of the reaction.   4+3+3

3.
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5. (a) Consider the following reaction,
$$N_2 (g) + 3H_2 (g) = 2NH_3 (g)$$
Express the rate of the reaction in terms of rate of change of H_2 concentration and NH_3 concentration.
(b) Show that for a second order chemical reaction, the half-life of the reaction is inversely proportional to the initial concentration of the reactant.
(c) Rate constants of certain chemical reaction are 0.02 s^{-1} and 0.07 s^{-1} at 400K and 600K temperature respectively. Calculate the activation energy and pre-exponential factor of the
4.   reaction.   2+4+0

6. (a) What do you mean by absorption and adsorption?
(b) 'Adsorption is generally an exothermic process'- explain.
(c) How can you determine the value of K and n graphically for Freundlich adsorption isotherm.   3+3+4

7. (a) Write down the differences between physisorption and chemisorption.
(b) Derive the expression for fraction of surface covered (θ) for an adsorption of a gas on
5.   solid surface according to Langmuir isotherm.
po   (c) How can you obtain Freundlich isotherm starting from expression of Langmuir adsorption isotherm applying high- and low-pressure condition.   3+4+3

(ii) Write experimental details of DO (Dissolved Oxygen) measurement with all possible chemical reactions.   4

Marks)   [Turn over

6. (i) What are the reasons for toxicity of F^- in water? How it impacts on human health ?   3

 (ii) Write down the qualities (at least four) of drinking water for human health.   2

(iii)Account on the effect of Cigarette smoking and Tobacco chewing on human health.   3

7. (i) Which chemical(s) involved in Bhopal Gas Tragedy? Write down their effect on human health.   4

(ii) What is the end product of Union Carbide Co. in Bhopal? Draw its structure. Where it is used?   4

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Name of the Examination: B.E. METALLURGICAL AND METERIAL ENGINEERING SECOND YEAR FIRST SEMESTER – 2023

Subject: CHEMISTRY – II   **Time:** Three hours   **Full Marks:100**

PART II (60 Marks)

1. **Answer any ten questions from the following.**   1 x 10=10
   (a) Give an example of reversible reaction.
   (b) What is the value of Gibbs free energy change for a chemical reaction at equilibrium?
   (c) In which direction a reversible reaction moves when the magnitude of reaction quotient is higher than the value of equilibrium constant?
   (d) The unit of rate constant of a particular chemical reaction is $L^2 mol^{-2} s^{-1}$. What is the order of the reaction?
   (e) Give an example of adsorption of a gas on solid surface.
   (f) What is the sign of enthalpy change for an exothermic chemical reaction?
   (g) What is the relation between rate constant and half-life of a first order chemical reaction?
   (h) What is the nature of the curve of lnk vs 1/T?
   (i) At which temperature condition chemisorption is favoured?
   (j) When does a first order chemical reaction undergo completion?
   (k) What is the unit of activation energy (E_a) of a chemical reaction?
   (l) What do you mean by adsorbent?
   (m) Give an example of fraction order chemical reaction?

Answer any five questions from the following.

2. (a) Explain mass action law considering the following chemical reaction-
$$aA + bB = cC + dD$$
   and derive the expression of equilibrium constant using the mass action law.

   (b) Consider the following reactions

$$N_2 (g) + 3H_2 (g) = 2NH_3 (g);$$

$$\tfrac{1}{2} N_2 (g) + 3/2\ H_2 (g) = NH_3 (g);$$

   What is the relation between K_1 and K_2?

   (c) Consider the following reaction,

$$SO_2 (g) + NO_2 (g) = SO_3 (g) + NO (g)$$
   The equilibrium constant, K_c is found to be 16 at a particular temperature. If we take one mole of each reactant at the beginning in a 1 Litre container, what would be the concentration of the reactants at equilibrium?   3+3+4

3. (a) "Chemical equilibrium is dynamic in nature"– explain.

   (b) Establish the relation between K_P and K_C.

[Turn over

(c) For a given chemical reaction, the magnitude of equilibrium constant, K_p is found to be 1.64×10^{-4} and 1.44×10^{-5} at 673K and 773K temperature respectively. Calculate the value of standard molar enthalpy change of the reaction.   3+4+3

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