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SARDAR PATEL UNIVERSITY, VALLABH VIDYANAGAR
Bachelor of Science (Semester-6) Examination – 2026
US06MACHE02: PHYSICAL CHEMISTRY

DATE : 02/04/2026, Thursday
TIME : 10:00 AM to 12:30 PM

Total marks : 50

NOTE: 1. Figure to the right indicate full marks of the questions.
2. All the questions are attempt to be compulsory.

Q.-1. Multiple Choice Questions.

[10]

1. A particular reaction will occur spontaneously or not is determined by which law of thermodynamics?
(a) First (b) Second (c) Third (d) None of these
2. Which of the following is true for a cyclic process?
(a) $\Delta E = 0$ (b) $\Delta E = q - w$ (c) $q = w$ (d) All of these
3. The free energy function (G) is defined as, _____.
(a) $G = H + TS$ (b) $G = H - TS$ (c) $G = TS - H$ (d) None of these
4. Which of the following are called Arrhenius parameters? _____.
(a) k and A (b) E_a and A (c) k and T (d) E_a and T
5. The reaction coordinate, which has maximum potential energy, is called _____.
(a) Simple complex (b) Ionic complex (c) Activated complex (d) All of these
6. Choose the correct statement for the catalyst, _____.
(a) Which increase the rate of reaction
(b) Which provided lower energy barrier
(c) Which does not alter the position of an equilibrium.
(d) All of these
7. A phase is always, _____.
(a) Homogeneous (b) Heterogeneous (c) Both a and b (d) None of these
8. Which of the following exist in four different phases?
(a) Water (b) Alcohol (c) Sulphur (d) All of these
9. A device used to convert chemical energy of a action into electrical energy is called, _____.
(a) Electrochemical cell (b) Galvanic cell (c) Voltaic cell (d) All of these
10. The effective concentration of an anion or the electrolyte in an aqueous solution is called.
(a) Mobility (b) Velocity (c) Molality (d) Activity



[P.T.O.]

Q.-2. Answer the following:

- (A) What is a cyclic process? Discuss in detail the Carnot cycle. [06]
- (B) Calculate the entropy change accompanying the freezing of one mole of water at 25°C to ice at -10°C, given the heat of fusion of ice at its fusion point (0°C) is 6.0 KJ/mol, the heat capacity of ice is 36.82 J/Kmol and the heat capacity of liquid water is 75.31 J/Kmol. [04]

OR

Q.-2. Answer the following:

- (A) Calculate the Entropy Change of an Ideal Gas with Change in P, V and T. [06]
- (B) Calculate the entropy of mixing of one mole of oxygen gas and two moles of hydrogen gas; assuming that no chemical reaction occurs and the gas mixture behaves ideally. [Given that $R = 8.314 \text{ J/mole K}$]. [04]

Q.-3. Answer the following:

- (A) Discuss the activated complex theory of bimolecular gaseous reaction. [06]
- (B) Using the Rice-Herzfeld mechanism for the reaction : $\text{H}_2 + \text{Br}_2 \longrightarrow 2\text{HBr}$, using steady state approximation for $[\text{H}]$ and $[\text{Br}]$, derive the rate law expression for the formation of HBr. Given : $r = d[\text{HBr}]/dt = k [\text{H}_2] [\text{Br}_2]^{1/2}$. [04]

OR

Q.-3. Answer the following:

- (A) Explain the effect of temperature and catalyst on the reaction rates. [06]
- (B) Calculate the activation energy of a reaction whose rate constant is tripled by a 10 °C rise in temperature in the vicinity of 27 °C. [$R = 8.314 \text{ J/mole K}$]. [04]

Q.-4. Answer the following:

- (A) State and explain the important conditions for equilibrium between various phases in a heterogeneous system. [06]
- (B) Draw and discuss the phase diagram of the water system. [04]

OR

Q.-4. Answer the following:

- (A) Draw the labelled phase diagram of the sulphur system and discuss its salient features. [06]
- (B) Deduce Gibbs phase rule equation viz, $F = C - P + 2$. [04]

Q.-5. Answer the following:

- (A) Define activity and activity coefficient. Using the relation between free energy and activity, derive the Nernst equation. [06]
- (B) Show that using the standard emf of the cell is consistent with the fact that the iron(III), Fe^{+3} , can be reduced to iron(II), Fe^{+2} , by the action of zinc in an acid solution. [Given: $E^\circ \text{Fe}^{+2}, \text{Fe}^{+3} = +0.771 \text{ V}$ and $E^\circ \text{Zn}/\text{Zn}^{+2} = -0.7626 \text{ V}$] [04]

OR

Q.-5. Answer the following:

- (A) Discuss different types of reversible electrodes giving electrode reactions. [06]
- (B) Derive an expression for ΔG , ΔH and ΔS in terms of the emf of the cell and the temperature coefficient of the cell. [04]

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