

2021

BIOCHEMISTRY — HONOURS

Paper : CC - 3

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer **any five** questions : 2×5
- What do you understand by ionic product of water? How is it affected by increase in temperature?
 - What is buffer capacity? Under what conditions will its value be at a maximum for any given buffer?
 - Why does specific conductance decrease but molar conductance increases on dilution of an aqueous solution of strong electrolyte?
 - The solubility of AgCl in water is 10^{-5} M at 300K. What is its solubility product? If 0.1M KCl solution is added what will be its solubility? [Neglect the effect of ionic strength]
 - Why is gelatin mostly used in making of ice-creams?
 - What is cryoscopic constant? State its unit.
 - Graphically represent the variation of surface tension(γ) of a liquid with temperature(T). Explain significance of the point on the graph at critical temperature.
 - By using the efficiency of a Carnot cycle show that the attainment of absolute zero of temperature is not possible.
 - For the reaction $\text{NH}_4\text{HS(s)} \rightleftharpoons \text{NH}_3\text{(g)} + \text{H}_2\text{S(g)}$, the equilibrium pressure at 298 K was found to be 0.67 bar. Calculate K_p^0 .
 - Write the expressions of activity and mean ionic activity for an electrolyte A_xB_y .
2. Answer **any two** questions :
- What is Kohlrausch's law of independent migration of ions? Mention its utility. The specific conductance of pure water at 25°C is $5.55 \times 10^{-8} \text{ ohm}^{-1} \text{ cm}^{-1}$. Find the pH of the water at that temperature. [Given $\lambda_{\text{H}^+}^0 = 350 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ and $\lambda_{\text{OH}^-}^0 = 200 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$] 1+1+3
 - The emf of a cell involving one electron transfer reaction was found to be 0.2699 V at 20°C and 0.2669 at 30°C. Calculate the molar entropy of the reaction.
 - Calculate the ionic strength of 0.3M Na_3PO_4 . Also calculate the activity coefficient of the salt if the mean ionic activity coefficient of Na_3PO_4 in a certain solution is 0.887. 2+3
 - What do you mean by contact angle θ_c ? Give diagrams of each of $\theta_c < 90^\circ$ and $\theta_c > 90^\circ$ with example of systems which exhibit them.

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- (ii) The coagulation values in moles/litre of some electrolytes to coagulate As_2S_3 are given below :
 (I) $NaCl = 52$; (II) $BaCl_2 = 0.69$; (III) $MgSO_4 = 0.22$. Write down the correct order of their coagulating power with proper explanation. 3+2
- (d) (i) On the basis of Le Chatelier's principle, give the effect of temperature, pressure on the following kinds of gaseous reactions where (i) $\Delta v = +ve$, exothermic and (ii) $\Delta v = -ve$, endothermic.
- (ii) Calculate the degree of dissociation, $[H^+]$, pH and pOH of acetic acid of 1.6×10^{-4} M at $25^\circ C$. [Given K_a of acid = 1.8×10^{-5}]. 2+3

3. Answer **any three** questions :

- (a) (i) What do you mean by ideal solution? Lowering of vapour pressure is not due to solvent solute interaction alone because ideal solutions also show lowering of vapour pressure-explain.
- (ii) At 1 atm pressure an aqueous solution freezes at $-1.5^\circ C$. Calculate the osmotic pressure of the solution at $27^\circ C$. [Given $K_f = 1.85$ and density of the solution 1 gm/ml]
- (iii) Calculate the equivalent conductance of $0.001M H_2SO_4$ at 298 K. The specific conductance of the solution was found to be $8 \times 10^{-4} S cm^{-1}$.
- (iv) What are surface active agents? Give examples. 3+3+2+2
- (b) (i) 10 cc of $0.1 M NaOH$ solution is added to 50cc $1.1 M CH_3COOH$ solution. What will be the pH of resulting solution? ($K_a = 1.8 \times 10^{-5}$)
- (ii) For the cell $Zn(s) | Zn^{2+}(0.1M) || H^+(aq) | H_2(1 atm)$ the emf is 0.28 Volt at $25^\circ C$. Calculate the pH of the hydrogen electrode. [Given $E_{Zn^{2+}/Zn}^\circ = -0.76$ Volt]
- (iii) How would you prepare 100 ml of a phosphate buffer at pH 7.40 using $0.1M Na_2HPO_4$ and $0.1M NaH_2PO_4$ solutions? Given $pK_a = 7.21$ for the following :
 $H_2PO_4^-(aq) \rightleftharpoons H^+(aq) + HPO_4^{2-}(aq)$ 3+4+3
- (c) (i) Write a short note on electrophoresis. Why it is an electrokinetic phenomenon?
- (ii) State Clausius inequality explaining the terms involved therein. How does this inequality lead to the criteria of spontaneity in terms of enthalpy change (ΔH) of a system?
- (iii) For a biochemical reaction like metabolic breakdown of glucose with inorganic phosphate group (Pi) to glucose-6-phosphate(G6P) : $Glucose(aq) + Pi(aq) = G6P(aq)$; the standard reaction Gibbs free energy $+14KJmol^{-1}$ at $37^\circ C$. Calculate the equilibrium constant of such reaction and hence comment on the spontaneity of the reaction. 3+4+3
- (d) (i) What is the change in entropy of 100 g of water when it is heated from room temperature ($20^\circ C$) to body temperature($37^\circ C$)? Use $C_p = 75.5 JK^{-1}mol^{-1}$.
- (ii) One mole of ideal gas is allowed to expand reversibly and adiabatically from a temperature of $27^\circ C$. If the work done by the gas is 3 kJ, what will be the final temperature? Use $C_v = 20 JK^{-1}mol^{-1}$.
- (iii) Show that $\delta(\Delta G/T) / \delta(1/T) = \Delta H$.
- (iv) Plot $\log K$ vs $1/T$ ($K =$ equilibrium constant of a reaction) with proper explanation. 3+2+3+2