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**SARDAR PATEL UNIVERSITY**
**B.Sc. (III SEM. (CBCS)) EXAMINATION**
**2012**
**Friday, 28th December**
**2.30 pm to 5.30 pm**
**US03CCHE02: Physical Chemistry**

**Total Marks: 70**

**Note:** Figures to the right indicate full marks to the questions.

Q.1 Choose the correct answer for the following: [10]

(1) A particular reaction will occur spontaneously or not is determined by which law of thermodynamics? _____
(a) First law (b) Second law
(c) Third law (d) None of these

(2) The unit of molal boiling point elevation constant $\langle \boldsymbol{kb} \rangle$ is; _____
(a) $Jk^{-1}$ (b) $KkgMol^{-1}$ (c) Mole $lit^{-1}$ (d) None of these

(3) Which one is a colligative property; _____
(a) Temperature (b) Pressure
(c) Volume (d) Molality

(4) For the weak electrolyte, the degree of dissociation, $\propto$ = _____
(a) $\boldsymbol{\Lambda / \Lambda}$ (b) $\boldsymbol{\Lambda^0 / \Lambda^0}$ (c) $\boldsymbol{\Lambda / \Lambda^0}$ (d) $\boldsymbol{\Lambda^0 / \Lambda}$

(5) The unit of cell constant ($\boldsymbol{\theta}$) is; _____
(a) Meter (b) $Meter^{-1}$ (c) $Meter^2$ (d) None of these

(6) The ionic strength is a property of the; _____
(a) Ions (b) Solute (c) Solution (d) Activity

(7) The activity (a) of a weak electrolyte in an aqueous solution can be obtained by; _____
(a) $\gamma.c$ (b) $\gamma^2.c^2$ (c) $\gamma^2$ (d) $c^2$

(8) A galvanic cell is a device in which the free energy of a chemical process is converted into; _____
(a) Potential Energy (b) Mechanical Energy
(c) Electrical Energy (d) Chemical Enegy

(9) Quinhydrone electrode can not be used to pH-range more than; _____
(a) 4 (b) 8 (c) 12 (d) None of these

(10) Which electrolyte is used to prepare the salt-bridge for the cell; _____
(a) KCl (b) KOH (c) $HNO_3$ (d) None of these

Q.2 Answer in short. **(Any Six)** [12]

(1) Write the statements of the second law of thermodynamics given by Lord Kelvin and Clausius.
(2) What are colligative properties? Write the names of colligative properties.
(3) Define molar conductance and specific conductance with unit.
(4) Discuss precipitation titration followed by conductance

measurements.

(5) Write the limitations of quinhydrone electrode.

(6) Explain the terms: (1) Osomosis (2) Osmotic pressure

(7) State and explain "Kohlrausch law" of independent migration of ions.

(8) Define the terms: (1) Standard electrode potential
(2) Electrol chemical series

Q.3

(1) Discuss Trouton's rule with its limitations. [04]

(2) What is the difference in the entropy of a liquid-water sample that contains one mole of water molecules at $0^0$ and 100 $^0$C? The measured heat capacity Cp in this temperature range can be taken as equal to the 25 $^0$C value of 75.5 $JK^{-1}$ $Mol^{-1}$. [04]

**OR**

Q.3

(1) State Third law of Thermodynamics. Explain absolute zero is unattainable. [04]

(2) Determine the entropy change for the isothermal expansion of n mole of an ideal gas at temperature T from a volume $V_1$ to a volume $V_2$. [04]

Q.4

(1) Explain the term vapour-pressure lowering. Describe Static and Dynamic methods for the measurement of vapour-pressure lowering. [05]

(2) Calculate the molar mass of a nonvolatile solute if, at 25 $^0$C, its solution containing 1.6 gm per $dm^3$ has an osmotic pressure of 83 torr. [Given: 0.08214 $dm^3$.a+m.$K^{-1}$ $Mol^{-1}$.] [03]

**OR**

Q.4

(1) What is elevation in boiling point? Derive an expression correlating molal elevation constant and elevation in boiling point when non-volatile solute is added to pure solvent. [05]

(2) Calculate the molal freezing point depression constant of water. The molar heat of fusion of ice at 0 $^0$C is 6024.6 $JMol^{-1}$. [03]
[Given: R = 8.314 $JK^{-1}$ $Mol^{-1}$]

Q.5

(1) Define Van't Hoff Factor (i). Derive the relation between Van't Hoff factor (i) and degree of dissociation ($\propto$) of an electrolyte in solution. [04]

(2) Calculate the molar conductance of a 0.01M aqueous solution of an electrolyte, if its resistance at room temperature is 220 ohm and cell constant is 88 $m^{-1}$. [04]

**OR**

Q.5

(1) What is electrolysis? Explain the electrolysis of HCl solution with electrode reaction. [04]

(2) A conductivity cell has a resistance of 747.5 ohm, when it is filled with 0.01M KCl solution and a resistance of 876 ohm when it is filled with an 0.005M $CaCl_2$ solution, both at 25 $^0$C. Calculate the specific conductance of the $CaCl_2$ solution. The specific conductance of KCl [04]

solution is at 25 $^0$C given 0.14114 ohm$^{-1}$ m$^{-1}$.

Q.6

(1) What is ionic mobility? Derive an expression for the determination of ionic mobility through measurement of conductance of solution. [05]

(2) Calculate the ionic strength of the solution which is 0.1M in KCl and 0.2 M in $K_2SO_4$. [03]

**OR**

(1) Write a note on: Debye-Huckel theory. [04]

(2) Calculate the mean activity coefficient ($\gamma_{\pm}$) for the $H^+$ and $Ac^-$ ions of acetic acid concentration of 0.01M, the degree of dissociation ($\propto$) from the conductance data is 0.0417 and $K_{th}$ is 1.752 x $10^{-5}$. [04]

Q.7

(1) Discuss the different types of reversible electrodes giving suitable example and reaction. [05]

(2) For the Daniel cell involving the cell reaction, [03]
$\boldsymbol{Zn_{(s)} + Cu^{+2}_{(aq)} \rightleftharpoons Zn^{+2}_{(aq)} + Cu_{(s)}}$, the standard free energy change of the reaction is -218.4 kJ. Calculate the standard EMF of the cell.
[Given: 1F = 96500 coulombs].

**OR**

Q.7

(1) Derive the Nernst's equation for the reaction: aA + bB $\rightleftharpoons$ cC + dD. [04]

(2) A zinc rod is placed in 0.1M solution of $ZnSO_4$ at 25 $^0$C. Assuming that the salt is dissociated to the extent of 95 percent at this dilution, calculate the potential of the electrode at this temperature. [04]
[Given: $E^0_{(Zn^{+2}/Zn)}$= -0.76 Volt.]3

Q.8

(1) What is concentration cell? Derive an expression for the EMF of concentration cell without transference. [04]

(2) Give brief account on: Liquid Junction Potential. [04]

**OR**

Q.8

(1) How will you determine the pH of the solution by using glass and Calomel electrodes? [04]

(2) Calculate the solubility product of AgBr in water at 25 $^0$C from the cell, [04]
$Ag, Ag^+Br^-_{(sat.sol.^n)}/AgBr_{(s)}, Ag.$
Given: $E^0_{AgBr\,/Br^-} = 0.071\ Volt.$
$E^0_{Ag^+/Ag} = 0.799\ Volt.$

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