U.G. 3rd Semester Examination - 2020

CHEMISTRY

Course Code: BCEMCCHC301

Course Title: Physical Chemistry II

Full Marks : 30 Time : 2 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **ten** questions: 1×10=10

   a) Write down Fick's law of diffusion.

   b) What is the relationship between specific conductance and equivalent conductance?

   c) How does viscosity of gases vary with temperature?

   d) Limiting equivalent conductance of aluminium sulphate is 150.0 S $cm^2 equi^{-1}$. What would be its molar conductance?

   e) Normalise the function $\psi = \frac{1}{x}$ over the range, $a \le x \le b$.

   f) Evaluate : $\left[x, \frac{d}{dx}\right]$

   g) How conductivity water is prepared?

   h) Write down the condition of spontaneity in terms of internal energy change of a system.

   i) 'f' is an eigen function of operator $x\frac{d}{dx}$ with eigenvalue 'n'. Express 'f' in terms of x.

   j) Write down Nernst distribution law.

   k) State Carnot's theorem.

   l) How entropy is related to unavailable work?

   m) Adiabatic process should be isoentropic—Justify/Criticise.

   n) State Le Chatelier's principle.

   o) Define chemical potential.

2. Answer any **five** questions from the following: 2×5=10

   a) Show that the function $f(x) = 3x^2 - 1$ is an eigen function of the operator:

   $$B = -(1-x^2)\left(\frac{d^2}{dx^2}\right) + 2x\left(\frac{d}{dx}\right)$$

   Find the eiginvalue.

b) Show that the lowest two states of particle in 1-D box are orthogonal in nature.

c) Calculate the Kinetic energy of photoelectrons emitted from surface of potassium (W=2.26ev) when illuminated by the radiation of 4000 Å.

d) Sketch and explain the conductometric titration curve for the titration of $AgNO_3$ solution by KCl solution.

e) Explain briefly why capillary rising occurs in case of water.

f) Find the dimension of $\left[\dfrac{\partial(G/T)}{\partial(1/T)}\right]_p$

g) Draw carnot cycle in T-S diagram with clearly stating the steps involved therein.

h) For this equilibrium $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$, arrive at the expression for K_p in terms of degree of dissociation.

3. Answer any **two** questions from the following: 5×2=10

a) Find out the values of <x> and <p_x> for a free particle moving in one dimensional box of length L. Given that

$$\psi_n(x) = \sqrt{\frac{2}{L}}\sin\left(\frac{n\Pi x}{L}\right);\ n = 1, 2, 3, ...$$

$2\frac{1}{2}+2\frac{1}{2}$

b) Establish the following Maxwell's thermodynamic relation:

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$$

Hence show that $\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_V - p$. What will be the value of $\left(\frac{\partial U}{\partial V}\right)_T$ for ideal gas.

2+2+1

c) i) At 25°C a conductance cell filled with a weak acid (0.3N) HA has specific conductance $6.15\times10^{-4} ohm^{-1}cm^{-1}$. Calculate Ka. ($\wedge^0$=390.7CGS unit.)

ii) Write down Gibbs-Duhem equation and explain the terms. 3+2

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