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B.Sc. RNLKWC(A)-/C8T/22

2022

CHEMISTRY

[Honours]

B.Sc. Fourth Semester End Examination - 2022

PAPER - C8T

Full Marks : 40

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.*

Illustrate the answers wherever necessary.

Physical Chemistry -III

Group - A

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

- (a) Density of monoclinic sulphur is less than that of rhombic sulphur. – Explain.
- (b) Why K_b values of a solvent is usually less than K_f value.
- (c) Prove that $\frac{d}{dx}$ is not Hermitian in nature.

(Turn Over)

(2)

- (d) I_2 usually sublimes. Why? How can it be melted?
- (e) An aqueous solution of Mohr salt becomes turbid – Why?
- (f) The dipole moment of Chlorobenzene is 1.55D. The bond distance $C_6H_5^+-Cl^-$ is 2.8Å. Estimate the ionic character of the bond.
- (g) Show that H atom wave function are n^2 fold degenerate.
- (h) Lowering of vapour pressure of a liquid does not occur when a volatile solute is dissolved in it – Justify or criticize.

Group - B

Answer any four questions from the following : 4×5

2. a) Show that the functions $\sin\frac{\pi x}{a}$ and $\cos\frac{\pi x}{a}$ are orthogonal over the interval $0 < x < a$. 3
- (b) What is the Zero point energy of a particle in a one dimensional box. 2
3. (a) Calculate the expectation value of the potential energy for a hydrogen atom in a ground state. 3
- (b) What do the expressions ψ , ψ^2 and $|\psi|^2 d\tau$ signify?

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(Continued)

(3)

4. Derive Duhem Margules equation with stating clearly the assumptions. Show that if Raoult's law is applicable to one of the constituents of a binary liquid mixture at all compositions, it must be equally applicable to the other constituent. 3+2
5. (a) The molality of dissolved gases in water at 0°C and 1atm is 1.29×10^{-3} . The decrease in volume during melting of ice is 0.0907 c.c./gm. The latent heat of fusion is 1436.3 cal/mol. The vapour pressure at triple point is 4.58 mm. Calculate the triple point temperature. 3
- (b) Show that the Van't Hoff factor i and the degree of dissociation α of an electrolyte A_xB_y in aqueous solution are related by the expression $\alpha = \frac{i-1}{n-1}$, where $n = x+y$.
6. (a) 50 ml of a 0.1(N) AcOH is titrated with 0.1(N) NaOH solution. Calculate pH of the solution at the start, at the half neutralisation point and at complete neutralisation point. (given $K_a = 1.75 \times 10^{-5}$)

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(Turn Over)

(4)

- (b) Find the Dimension of $\left(h \cdot \frac{\partial}{\partial x} \right)$.
- (c) What is the S.I. unit of dipole moment and molar polarisation. 1
7. (a) What is de-Broglie Wave length of an electron that has been accelerated through a potential differences of 100 Volt. 3
- (b) Justify the statement 'Eutectic is a mixture not a compound'. 2

Group- C

Answer any one question from the following > 1×10

8. (a) Derive thermodynamically the relation between the elevation of boiling point and the concentration of a dilute solution of non volatile, non electrolyte and non associated solute.
- (b) The osmotic pressure of an aqueous solution at 288K is 99.0 kPa. Calculate the freezing point of the solution.

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(Continued)

(5)

Given for water density = 0.98 gm cm^{-3} at 288K and $K_f = 1.86 \text{ K Kg mol}^{-1}$.

- (c) Draw the phase diagram of the phenol water system and calculate the number of degrees of freedom at different regions of the diagram with justification. 2+2
9. (a) For a particle in a one dimensional box, show that the average value of the momentum along the x axis is zero. 3
- (b) Deduce an expression for the fundamental frequency of a harmonic oscillator. 4
- (c) The solubility product of PbI_2 is 7.47×10^{-9} at 15°C and 1.39×10^{-8} at 25°C . Calculate molar heat of solution of PbI_2 .

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