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B.Sc./4th Sem (H)/CHEM/24(CBCS)

2024

4th Semester Examination

CHEMISTRY (Honours)

Paper : C 8-T

[Physical Chemistry-III]

[CBCS]

Full Marks : 40

Time : Two Hours

*The figures in the margin indicate full marks.*

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

Group - A

Answer any *five* questions from the following :

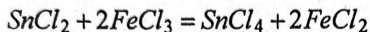
2×5=10

1. Osmotic pressure of 1% glucose solution is identical to that of 1% sucrose solution. Justify or criticize the statement.
2. Define upper critical solution temperature with example.
3. An azeotrope is a mixture, not a compound. Explain.
4. Why potentiometer instead of voltmeter is used to measure emf of a galvanic cell?

P.T.O.

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5. Construct a cell where following reaction occurs.



6. How will you know whether a molecule is polar or nonpolar by molar polarisation measurement?

7. What is radial distribution function?

8. Write down the eigen value equation of  $L^2$  operator and hence obtained the energy expression of a rigid rotator.

### Group - B

Answer any *four* questions from the following :

5×4=20

9. (a) Explain eutectic mixture and eutectic temperature with an example. 3

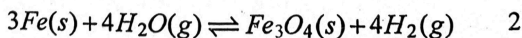
(b) What is Van't Hoff Factor? How is it related with degree of dissociation of an electrolyte? 2

10. (a) Explain reversible and irreversible cell with example. 3

(b) What molality of  $\text{CuSO}_4$  solution has the same ionic strength with 1 molal solution of  $\text{KCl}$ ? 2

11. (a) How pH of a solution can be measured using quinhydrone electrode? 3

(b) Write no. of phase, component and degree of freedom for the following equilibrium.



12. (a) How electrode potential of calomel electrode depends on concentration of chloride ion? 2
- (b) The molar polarisation of a substance is  $46 \text{ cm}^3 \text{ mol}^{-1}$  at  $25^\circ \text{C}$ . Calculate dipole moment of the molecule if the distortion polarisability be  $1.808 \times 10^{-24} \text{ cm}^3$ . 3
13. (a) Show that  $E_n$  of hydrogen atom is  $n^2$  fold degenerate. 3
- (b) Mixture of benzene and toluene behaves almost ideally at  $30^\circ \text{C}$ . The vapour pressure of pure benzene is 118.2 mm and that of toluene is 36.7 mm. Calculate the total vapour pressure of the mixture considering of equal weights of two components. 2
14. (a) Give example of an electrode and an electrolyte concentration cell. 2
- (b) The 1s wave function for H atom is  $\Psi = (\pi a_0^3)^{-1/2} e^{-r/a_0}$ . Calculate the probability of the electron being within a distance of  $a_0$  (Bohr radius) from the nucleus. 3

$$\int_0^{a_0} (\pi a_0^3)^{-1/2} e^{-r/a_0} 4\pi r^2 dr$$

$$= \frac{4\pi}{\pi a_0^3} \int_0^{a_0} r^2 e^{-r/a_0} dr$$

$$= \frac{4}{a_0^3} \int_0^{a_0} r^2 e^{-r/a_0} dr$$

P.T.O.

( 4 )

Group - C

Answer any *one* question from the following :

10×1=10

15. (a) Derive thermodynamically Raoult's law of relative lowering of vapour pressure. 4
- (b) During heating at normal pressure ice melts but dry ice sublimates. Explain. 3
- (c) Determine activity of 10(M) *HCl* solution and hence calculate pH of this solution. 3
16. (a) Evaluate the commutator  $[x^2, \hat{p}_x]$ . 3
- (b) Eigen function of  $\hat{L}_z$  operator is given by  $Ae^{-im\phi}$ . Normalize the eigen function. 3
- (c) The e.m.f. of Weston cadmium cell is 1.01530 V at 20°C and 1.01807 V at 25°C. Calculate  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  for the reaction at 25°C. 4