

CHE-4

BACHELOR OF SCIENCE (B.Sc.)

Term-End Examination

December, 2005

CHEMISTRY

CHE-4 : PHYSICAL CHEMISTRY

Time : 2 hours

Maximum Marks : 50

Note : Attempt all the parts. Answer **five** questions from each of the three parts, A, B and C. From Part D, answer any **four** questions.

$(R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1})$

PART A

Answer any **five** questions.

1. Define the term, mean free path. 1
2. What are nematic liquid crystals ? 1
3. Define the terms, critical temperature and critical pressure. 1
4. What are n-type semiconductors ? 1

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P.T.O.

PART B

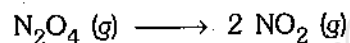
Answer any **five** questions.

9. At room temperature, among water, methyl cyanide and methanol, which is expected to have the highest surface tension ? State the reason. 2
10. Derive an expression relating hydrolysis constant of a salt of a weak acid and weak base to the dissociation constants of the latter two. 2
11. State the criteria for spontaneity in terms of Helmholtz free energy change and Gibbs free energy change. 2
12. State the factors which affect the solubility of a gas in a liquid. State Henry's law. 2
13. Define, critical solution temperature. Give an example for each of the following : 2
- (i) liquid pair having lower CST
 - (ii) liquid pair having upper CST
14. For the reaction, $N_2O_4 (g) \rightleftharpoons 2 NO_2 (g)$, K_p is 1.4×10^4 Pa at 303 K. Calculate K_c at this temperature. 2
15. Explain the principle of working of a storage battery. 2
16. Discuss briefly the heterogeneous catalysis. 2

PART C

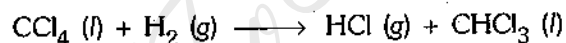
Answer any **five** questions.

- 17.** At 298 K, the standard enthalpies of formation of NO_2 (g) and N_2O_4 (g) are 33.2 kJ mol^{-1} and 9.2 kJ mol^{-1} . Calculate the standard enthalpy change of the following reaction : 3



- 18.** A Carnot engine works between $3.00 \times 10^2 \text{ K}$ and $4.00 \times 10^2 \text{ K}$. Calculate its efficiency. 3

- 19.** Predict whether the process



is spontaneous at 298 K under standard state conditions.

At 298 K $\Delta_r H^\circ = -91.35 \text{ kJ}$ and $\Delta_r S^\circ = 41.50 \text{ J K}^{-1}$

for this reaction. 3

- 20.** Describe any one method for the study of fast reactions. 3

- 21.** Discuss any one method for the purification of colloidal solution. 3

- 22.** Define the term, order of a chemical reaction. Explain any one method for the experimental determination of order of reaction. 3
- 23.** State the meaning of the terms, fluorescence and phosphorescence. State two applications of fluorescence. 3
- 24.** Derive van der Waals equation for a real gas. 3

PART D

Answer any **four** questions.

- 25.** State the principle of equipartition of energy. Apply it to calculate the ratio of molar heat capacity of a diatomic gas at constant pressure to its value at constant volume at 298 K. 5
- 26.** (a) Discuss, with the help of examples, effect of molecular interactions on viscosity and vapour pressure of liquids. 3
- (b) Define the term, azeotrope. State the difference between fractional distillation and azeotropic distillation. 2
- 27.** (a) State any one method for the determination of molar mass of a nonvolatile solute using the principle of boiling point elevation. 3
- (b) Discuss powder method for the determination of crystal structure. 2
- 28.** Describe Hittorf method for the determination of transport number of an ion. 5

29. (a) Using the following data on the distribution of succinic acid between water and benzene, show that succinic acid exists as a dimer in benzene : 3

C_1 (concentration of undissociated succinic acid in water) / (kg dm^{-3})	1.10×10^{-3}	1.95×10^{-3}	2.90×10^{-3}
C_2 (total concentration of succinic acid in benzene) / (kg dm^{-3})	14.2×10^{-3}	41.2×10^{-3}	96.5×10^{-3}

- (b) Derive the relationship,
$$C_p - C_v = nR$$
 2

30. (a) Draw the phase diagram of sulphur and explain its salient features. 3
- (b) Discuss any one application of eutectic system. 2