TDC (CBCS) Even Semester Exam., 2023

CHEMISTRY

(Honours)

(2nd Semester)

Course No. : CHMHCC-202T

(Physical Chemistry—II)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *ten* questions : 2×10=20

1. What do you mean by intensive properties? Explain with examples.

2. Show that in an isothermal expansion of an ideal gas *(a)* $\Delta U = 0$ and *(b)* $\Delta H = 0$.

3. State and explain the zeroth law of thermodynamics.

4. What is residual entropy?

5. What is inversion temperature?

6. Define Helmholtz free energy.

7. What do you mean by partial molar quantities?

8. What is chemical potential?

9. Write the Gibbs-Duhem equation.

10. Explain the term fugacity.

11. State the law of mass action.

12. Explain Le Chatelier's principle with an example.

13. What are osmosis and osmotic pressure?

14. Define isotonic solutions.

15. What is van't Hoff factor?

SECTION—B

Answer any *five* questions : 6×5=30

16. *(a)* Derive the expression for the work done in reversible isothermal expansion. 3

(b) Show that work done in the expansion of an ideal gas is numerically greater than the work done in the expansion of real gas. 3

17. *(a)* Derive Kirchhoff's equation relating the variation of enthalpy of a reaction with temperature. 3

(b) Discuss the three limitations of the first law of thermodynamics. 3

18. *(a)* Derive Gibbs-Helmholtz equation for a process at constant pressure. 3

(b) Show that Joule-Thomson coefficient for an ideal gas is zero. 3

19. *(a)* Discuss the variation of free energy change with temperature and pressure. 4

(b) What is Gibbs free energy? 2

20. Discuss the variation of chemical potential with temperature and pressure. 3+3=6

21. Show that for a mixture of ideal gases, the chemical potential of any constituent is given by the expression

$$\mu_i = \mu^0_{i(p)} + RT \ln P_i$$

$$or \quad \mu_i = \mu^0_{i(c)} + RT \ln C_i$$

where P_i and C_i are the partial pressure and concentration of the constituents, respectively. 6

22. *(a)* What are the roles of high and low temperatures in controlling the spontaneity of a chemical reaction? 3

(b) Explain the coupling of exoergic and endoergic reactions. 3

23. *(a)* Derive the relation among the equilibrium constants K_p, K_c and K_x, where p, c and x stand for partial pressure, molar concentration and mole fraction, respectively. 4

(b) Calculate K_c and K_x for the reaction

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

for which $K_p = 0{\cdot}157$ atm at 27 °C and 1 atm pressure. 2

24. State and derive Raoult's law for vapour pressure lowering. 1+5=6

25. Derive the relation between the boiling point elevation of a solution and mole fraction of the dissolved solute. 6

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