TDC (CBCS) Even Semester Exam., 2024

CHEMISTRY

(2nd Semester)

Course No. : CHMHCC–202T

(Physical Chemistry)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* questions : 2×2=4

(a) Define state and path function and give one example of each.

(b) State the first law of thermodynamics. Why is it also called the law of conservation of energy?

(c) Define standard state of formation. Give one example.

2. Answer any *one* question : 6

(a) *(i)* Distinguish between isothermal and adiabatic process. Derive a relation between temperature and volume in reversible adiabatic expression. 1+3=4

(ii) One mole of an ideal gas expands against a constant external pressure of 1 atm from a volume of 10 dm^3 to a volume of 30 dm^3. Calculate the work done by the gas in Joules. 2

(b) *(i)* Derive the expression for the work done in reversible isothermal work. 4

(ii) The enthalpy of combustion of glucose $C_6H_{12}O_6$ (s) is $-2816\ kJ\ mol^{-1}$ at 25 °C. Calculate $\Delta H_f^\circ (C_6H_{12}O_6)$. The ΔH_f° values for CO_2(g) and H_2O(l) are $-393{\cdot}5\ kJ\ mol^{-1}$ and $-285{\cdot}9\ kJ\ mol^{-1}$ respectively. 2

UNIT—II

3. Answer any *two* questions : 2×2=4

(a) Explain the limitation of first law of thermodynamics.

(Continued)

(b) Show that $\left(\frac{\delta T}{\delta V}\right)_S = -\left(\frac{\delta P}{\delta S}\right)_V$.

(c) State and explain Joule-Thomson coefficient.

4. Answer any *one* question : 6

(a) (i) Derive an expression for second law of thermodynamics. 3

(ii) Obtain an expression for change in entropy of an ideal gas with change in pressure and temperature. 3

(b) (i) State third law of thermodynamics and explain its significance. 3

(ii) Define the following terms : 1½×2=3

(1) Residual entropy

(2) Inversion temperature

UNIT—III

5. Answer any *two* questions : 2×2=4

(a) Define partial molar entropy and partial molar enthalpy.

(b) Explain the importance of chemical potential.

(c) Derive an expression for Gibbs-Duhem equation.

6. Answer any *one* question : 6

(a) Derive an expression for chemical potential of ideal gas mixture in terms of pressure, concentration and mole-fraction.

(b) (i) Discuss the variation of free energy change with temperature and pressure. 4

(ii) Show that $\left(\frac{\delta \mu_i}{\delta T}\right)_{P,\, N} = -\overline{S}_i$. 2

UNIT—IV

7. Answer any *two* questions : 2×2=4

(a) Explain the term 'fugacity'.

(b) Explain the thermodynamic condition for spontaneity of a reaction.

(c) What will be the effect of temperature on the following reaction?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$
$$\Delta H = -92{\cdot}38 \text{ kJ}$$

8. Answer any *one* question : 6

(a) (i) Explain coupling of exoergic and endoergic reactions with suitable example. 4

(ii) Explain Le Chatelier's principle with a suitable example. 2

(b) (i) Derive a relation among K_p, K_x and K_c. 4

(ii) Derive van't Hoff reaction isotherm. 2

UNIT—V

9. Answer any *two* questions : 2×2=4

(a) State and explain Raoult's law.

(b) Explain depression of freezing point with an example.

(c) Explain reverse osmosis.

10. Answer any *one* question : 6

(a) Derive an expression for osmotic pressure and explain how it can be used for determining molar mass of non-volatile solute. 4+2=6

(b) Derive a relation between the depression of freezing point of a solution and the mole fraction of dissolve solute. What is molal freezing point constant of a solvent? 4+2=6

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