

**2024/TDC (CBCS)/EVEN/SEM/  
CHMHCC-202T/300**

**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.

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*( Turn Over )*



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  $10 \text{ dm}^3$  to a volume of  $30 \text{ dm}^3$ . 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  $\text{C}_6\text{H}_{12}\text{O}_6$  (s) is  $-2816 \text{ kJ mol}^{-1}$  at  $25^\circ\text{C}$ . Calculate  $\Delta H_f^\circ$  ( $\text{C}_6\text{H}_{12}\text{O}_6$ ). The  $\Delta H_f^\circ$  values for  $\text{CO}_2$ (g) and  $\text{H}_2\text{O}$ (l) are  $-393.5 \text{ kJ mol}^{-1}$  and  $-285.9 \text{ kJ mol}^{-1}$  respectively. 2

UNIT—II

3. Answer any *two* questions :

$2 \times 2 = 4$

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

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( 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 :  $1\frac{1}{2}\times 2=3$

(1) Residual entropy

(2) Inversion temperature

UNIT—III

5. Answer any *two* questions :  $2\times 2=4$

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

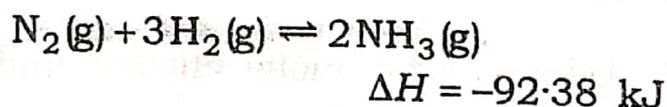
#### UNIT—IV

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?



8. Answer any *one* question : 6

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

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- (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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