

TDC (CBCS) Even Semester Exam., 2019

CHEMISTRY

(2nd Semester)

Course No. : CHMHCC-202 T

(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

(Marks : 20)

Answer **ten** questions, taking **two** from each Unit

UNIT—I

1. What are exact and inexact differentials?
Give one example each from thermo-
dynamics. 2
2. Write the mathematical statement for the
first law of thermodynamics. 2

J9/2192

(Turn Over)

3. Define adiabatic flame temperature and explosion temperature. 2

UNIT—II

4. Give the statement of the second law of thermodynamics in terms of entropy. 2
5. Define inversion temperature. What is its significance? 1+1=2

6. Show that

$$\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P \quad 2$$

UNIT—III

7. Explain the term 'partial molar property'. 2
8. Show that

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

where the terms have their usual meanings. 2

9. Show the variation of chemical potential with temperature, graphically. 2

UNIT—IV

10. Fugacity is a sort of 'fictitious pressure'. Explain. 2
11. Define the degree of advancement of a chemical reaction. 2
12. What is reaction potential? Complete the following sentence : 1+1=2
The decrease of reaction potential is defined as the _____.

UNIT—V

13. State Raoult's law. Define ideal solutions. 1+1=2
14. Mention two differences between osmosis and diffusion. 2
15. Define ebullioscopic constant and cryoscopic constant. 1+1=2

SECTION—B

(Marks : 30)

Answer **five** questions, taking **one** from each Unit

UNIT—I

16. (a) Prove thermodynamically

$$C_P - C_V = R$$

for one mole of an ideal gas.

4

- (b) Compare isothermal and adiabatic expansions of an ideal gas and show that

$$P_{\text{adia}} < P_{\text{iso}}$$

where P indicates pressure of the ideal gas after expansion.

2

17. (a) Deduce Kirchhoff's equations.

3

- (b) Calculate the bond enthalpy of C—H bond in methane from the following thermodynamic data :

3

(i) Heat of formation of methane is -75 kJ

(ii) Heat of sublimation of carbon is 720 kJ

(iii) Bond enthalpy of hydrogen gas is 435 kJ

UNIT—II

18. (a) State Lewis and Randall's statement for the third law of thermodynamics. 1
- (b) Explain the concept of residual entropy. 2
- (c) Show that Joule-Thomson effect is isoenthalpic. 3
19. (a) Derive the first thermodynamic equation of state using Maxwell relations. 2
- (b) Show that
- $$-\Delta A_T = w_{\max}$$
- where the terms have their usual meanings. 2
- (c) In the solid state at 0 K, nitric oxide, NO, is capable of existing in two orientations, viz., NONO and NOON, which have practically equal probabilities. Calculate the molar entropy of NO at 0 K. 2

UNIT—III

20. Define chemical potential. What is its significance? Derive an expression to show the variation of chemical potential with pressure. 2+1+3=6
21. Deduce Gibbs-Duhem equations. Mention one important conclusion that can be drawn from Gibbs-Duhem equations. 4+2=6
- J9/2192 (Turn Over)

UNIT—IV

22. (a) Derive thermodynamically the relation between Gibbs free energy of reaction and reaction quotient. 4
- (b) The extent of dissociation of PCl_5 at a certain temperature is 20% at 1 atm pressure. Calculate the pressure at which this substance is half dissociated at the same temperature. 2
23. (a) Derive the integrated van't Hoff equation. 2
- (b) The equilibrium constant of a reaction doubles on raising the temperature from 25°C to 35°C . Calculate ΔH° for the reaction. 2
- (c) Explain coupling of exoergic and endoergic reactions. 2

UNIT—V

24. (a) State and explain the law which explains the effect of pressure on the solubility of a gas. 3
- (b) Define van't Hoff factor. Find a relation between van't Hoff factor and degree of dissociation, taking one mole of a uni-univalent electrolyte as an example. 1+2=3

25. (a) Apply thermodynamics to derive a relationship between osmotic pressure and vapour pressure lowering of an ideal solution. 4
- (b) At 37 °C, osmotic pressure of blood is 7.65 atm. How much glucose should be used per litre for an intravenous injection that is to have the same osmotic pressure as blood? 2
