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 thermodynamics. 2

2. Write the mathematical statement for the first law of thermodynamics. 2

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

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

$$P_{adia} < P_{iso}$$

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

(Continued)

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

(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

(Continued)

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 intraveinous injection that is to have the same osmotic pressure as blood? 2

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