

6/H-23 (xi) (Syllabus-2019)

2 0 2 3

(May/June)

CHEMISTRY

(Honours)

(**Physical Chemistry—VI**)

(Chem-H-603)

Marks : 38

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

1. (a) Derive the following Maxwell relations starting from relevant thermodynamic equations : 2×2=4
- (i) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$
- (ii) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$
- (b) Write notes on the following : 2×3=6
- (i) Partial molar quantities
- (ii) Residual entropy
- (iii) Thermodynamic scale of temperature

(2)

OR

2. (a) State the third law of thermodynamics and explain its application in determining the entropy. 2+3=5

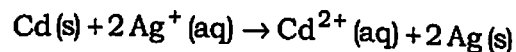
(b) What do you understand by chemical potential? Derive an expression, showing the variation of chemical potential with temperature and pressure. 1+2+2=5

3. (a) Explain the following phenomena in the presence of strong electrolytes : 3+2=5

(i) Relaxation effect

(ii) Electrophoretic effect

(b) For a cell reaction



the EMF of the cell is 0.6753 V at 25 °C and 0.6915 V at 0 °C. Calculate ΔG , ΔH and ΔS of the cell at 25 °C. (Given, $F = 96500 \text{ C mol}^{-1}$) 1+2+2=5

OR

4. (a) Define activity and activity coefficient. 1½+1½=3

(b) Discuss the application of quinhydrone electrode in the determination of pH of a solution. 4

D23/1037

(Continued)

(3)

(c) What do you understand by the ionic strength of a solution? Calculate the ionic strength of a solution containing equal volume of 0.1 M CaCl_2 solution and 0.01 M NaCl solution. 1+2=3

5. (a) Write down the mathematical expression of Planck's radiation law in terms of wavelength and show the conditions under which it reduces to Wein's relation and Rayleigh-Jeans relation. 2+2+2=6

(b) A particle is confined within a box of width $1.00 \times 10^{-14} \text{ m}$. Calculate its energy in the ground state and first-excited state in eV.

(1 eV = $1.602 \times 10^{-19} \text{ J}$)

3

OR

6. (a) Write a short note on Einstein's explanation of temperature variation of heat capacities of monatomic solids. 5

(b) Mention the physical significances of the quantum numbers n , l and m . 4

7. (a) Explain thermodynamic probability of a system. Give the condition for thermodynamic probability to be maximum. 3+2=5

D23/1037

(Turn Over)

- (b) Obtain the barometric distribution formula from the Boltzmann distribution expression. 2
- (c) Calculate the number density for oxygen molecule at an altitude of 8 km above sea level at 25 °C ($g = 9.8 \text{ m/s}^2$). 2

OR

8. (a) What do you understand by partition function? Show that the total molecular partition function (Q) is the product of individual partition functions. 5
- (b) Calculate the translational partition function of NO molecule at 300 K in a volume of 1000 m^3 , assuming the gas to behave ideally. Given

$$k = 1.38 \times 10^{-16} \text{ g cm}^2 \text{ s}^{-2}$$

$$h = 6.625 \times 10^{-27} \text{ g cm}^{-2} \text{ s}^{-1} \quad 4$$

★ ★ ★