2022

(May/June)

CHEMISTRY

(Honours)

(Part—A : Physical Chemistry–II)

(Chem–H–603)

Marks : 38

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Derive the phase rule from the concept of chemical potential. 5

(b) Derive the expression for the chemical potential of a component in an ideal mixture. 5

OR

2. *(a)* Define chemical potential. Derive the variation of chemical potential with temperature and pressure. 1+2+2=5

(b) Explain Nernst heat theorem. How does it lead to the enunciation of the third law of thermodynamics? 2+3=5

3. *(a)* Discuss the Debye-Hückel theory for strong electrolytes and write the relevant Onsager equation. 6

(b) Derive the expressions for ΔG and ΔH in terms of EMF of a cell. 2+2=4

OR

4. *(a)* Explain potentiometric titrations taking the example of an acid-base titration. 3

(b) Write notes on the following : 2×2=4

(i) Liquid junction potential

(ii) Concentration cells

(c) Define mean ionic activity coefficient. Calculate the mean ionic activity coefficient of 0·01 molal NaCl solution. 1+2=3

5. *(a)* Discuss briefly the spectral distributions of blackbody radiation and mention the interpretations therein. 2½+2½=5

(b) Explain Compton effect and its physical significance. What is Compton shift? 1½+1½+1=4

OR

6. *(a)* Solve the Schrödinger equation for a particle in a one-dimensional box of length *a*. 5

(b) Discuss photoelectric effect and Einstein's equation for this effect. 2+2=4

7. *(a)* Define molecular partition function. Show that the total molecular partition function (Q) is the product of individual partition functions. 1+3=4

(b) Define entropy and probability. Derive the relationship between them. 2+3=5

OR

8. *(a)* Write the mathematical expression for Boltzmann distribution for degenerate and non-degenerate states and define the terms involved. 1½+1½=3

(b) Write the expressions for translational, rotational and vibrational partition functions in one dimension and give the meaning of the terms involved. 1+1+1=3

(c) 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,

$k = 1 \cdot 38 \times 10^{-16}\ gcm^2 s^{-2}$,
$h = 6 \cdot 625 \times 10^{-27}\ gcm^2 s^{-1}$ 3

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