

**J-13/2110****PHYSICAL CHEMISTRY****Paper-103**

Time : Three Hours]

[Maximum Marks : 55

**Note** : Attempt *two* questions each from Section A and B.  
Section C will be compulsory.

**SECTION-A**

I. (a) Show that for an ideal gas  $\left(\frac{\partial V}{\partial S}\right)_P = \left(\frac{\partial T}{\partial P}\right)_S$ .

(b) How the absolute entropy of a substance can be estimated using third law of thermodynamics ? 4,4

II. (a) Show that

$$Q = q_{\text{trans}} \cdot q_{\text{vib}} \cdot q_{\text{rot}} q_{\text{elect}}$$

where are the terms have their usual meanings.

(b) Obtain relations between :

(i) Partition function and Enthalpy.

(ii) Partition function and Entropy. 2,3,3

- III. (a) Show that translational partition function,  $q_{\text{trans}}$  is expressed as  $q_{\text{trans}} = \frac{(2\pi mkT)^{3/2}}{h^3} V$ .
- (b) Briefly introduce Bose-Einstein statistics. State the conditions under which Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics become identical. 4,4
- IV. Write note on the following :
- (a) Partial molar volume and its determination.
- (b) Thermodynamics of living systems. 4,4

### SECTION-B

- V. (a) Give a brief account of Debye-Huckel theory of ion interactions. Highlight its applicability as well as limitations. 5½
- (b) Comment on “Activity coefficients at moderate and higher concentrations.” 3
- VI. (a) Discuss the concept on which Bjerrum's theory is based ? How does it help in the explanation of ion-association ? What are the limitations of this theory ? 5
- (b) Write an explanatory note on “Ion triplets in electrolytic solutions and their conductance.” 3½

VII. (a) Discuss in detail diffuse layer theory of double layer.  
Also discuss its applications and limitations.

(b) Write a note on "Fuel cells." 4½

VIII. Write note on the following :

(a) Electrochemical energy convertors. 4½

(b) Corrosion monitoring and methods of corrosion prevention. 4

### SECTION-C

#### (Compulsory Question)

IX. Explain in brief the following :

(a) Define Thermal Debroglie wave length. 2

(b) What is meant by Residual Entropy ? 2

(c) Explain the term "Excess function." 2

(d) Discuss the need of statistical mechanics. 2

(e) What is meant by Ensemble ? Also describe canonical and grand canonical ensembles. 2

(f) Define activity coefficients and mean activity coefficients. 2

- (g) Discuss the factors on which efficiency of electrochemical energy converts depends. 2
- (h) Differentiate between characteristic vibrational temperature and characteristic rotational temperature. 3
- (i) Explain the term Energy conduction. 3
- (j) State and explain coupled reactions. 2
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