

This question paper contains 4 printed pages]

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S. No. of Question Paper : 97

Unique Paper Code : 217586

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Name of the Paper : CHCT-501 : Chemistry—I

Name of the Course : B.Sc. (Prog.) Physical Sciences, Part III (Concurrent Course)

Semester : V

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory.

Both Section A and Section B are compulsory.

Attempt *three* questions from Section A and *three* questions from Section B.

1. Attempt any *five* parts from the following :

- (a) Write down the Schrodinger wave equation of Hydrogen atom. Describe the various terms involved. 3
- (b) What do you understand by Aufbau's principle. State the $(n+1)$ rule. 3
- (c) Explain why melting point of NaCl is higher than that of $AlCl_3$. 3
- (d) State the second law of thermodynamics and justify the statement qualitatively. 3
- (e) Explain why C_p is always greater than C_v . 3
- (f) What is Common Ion Effect ? Explain with the help of an example. 3

Section A

Attempt any *three* questions.

2. (a) Show the Born-Haber Cycle for the formulation of ionic KF. Give the meaning of each and every term used in the cycle.

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P.T.O.

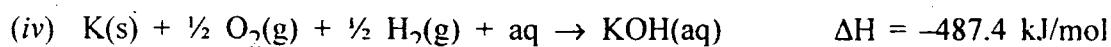
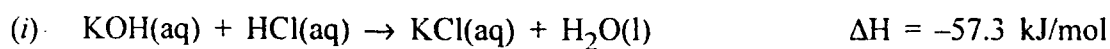
- (b) Calculate the lattice energy of NaCl crystal from the following data by the use of Born-Haber Cycle. Sublimation energy = 108.7 kJ/mol, Dissociation Energy for $\text{Cl}_2 = 225.9$ kJ/mol, Ionization Energy for $\text{Na(g)} = 489.5$ kJ/mol, Electron affinity for $\text{Cl(g)} = -351.4$ kJ/mol, Heat of formation of NaCl = -414.2 kJ/mol. 3
- (c) What is the physical significance of the Madelung's constant in the Born-Landé equation ? 2
3. Give reasons for any *four* of the following : $4 \times 2.5 = 10$
- (a) BaSO_4 is insoluble in water
- (b) Noble gases do not form ionic halides
- (c) LiCl has a higher boiling point than HCl
- (d) AgF, AgCl and AgBr have similar structures but the order of hardness differs.
- (e) Silver halides have lattice energies similar to alkali halides but still insoluble in water.
4. (a) Give the quantum mechanical expression and the physical significance of normalization principle. 3
- (b) Explain the importance of the radial probability distribution curves and plot the same for $1s$, $2s$ and $2p$ orbitals of H atom. 5
- (c) Why are $2d$ and $3f$ orbitals not possible ? 2
5. (a) Predict the shape and the type of hybridization in each of the following molecules : 5
- BeF_2 , H_2O , SF_6 , ClF_3 , XeF_4 .
- (b) Draw the MO diagram for CO molecule and calculate its bond order. 3
- (c) State the limitations of the Valence Bond Theory. 2

Section B

Attempt any *three* questions.

6. (a) Calculate q , w , ΔU and ΔH for an isothermal reversible and isothermal irreversible expansion of an ideal gas. 6

- (b) Calculate the heat of formation of KCl from the following data : 4



7. (a) Derive the following relation for a salt of strong acid and weak base : 6

$$\text{pH} = \frac{1}{2} [\text{pK}_a + \text{pK}_w - \text{pK}_b]$$

- (b) Calculate the solubility in grams per litre of Al(OH)_3 in water at 25°C if the value of $K_{\text{sp}} = 8.5 \times 10^{-32}$. 4

8. (a) Derive the following Thermodynamic expression :

$$\Delta G = \Delta H + T \left[\frac{\partial \Delta G}{\partial T} \right] P$$

and give the name of this equation.

- (b) Calculate the entropy change for the fusion of 1 mole of a solid which melts at 300K.

The latent heat of fusion is 2.51 kJ/mol.

2

- (c) Show that :

3

$$\left(\frac{\partial P}{\partial S}\right)_V = \left(\frac{\partial T}{\partial V}\right)_S$$

9. Write short notes on any *four* :

4×2.5=10

- (i) Carnot cycle for an ideal gas
- (ii) Ostwald's dilution law
- (iii) Arrhenius Theory of Electrolytic Dissociation
- (iv) Buffer Action of Acidic Buffer (qualitative explanation)
- (v) Henderson-Hasselbalch equation for Basic Buffer.