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Sr. No. of Question Paper : 8443

C

Roll No.....

Unique Paper Code : 217151

Name of the Paper : CHCT-301 : Chemistry – I

Name of the Course : B.Sc. (H) Microbiology/Botany/Zoology/Bio-chemistry/
Bio-Medical

Semester : I

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Use separate answer-sheets for Section A and Section B.

SECTION – A

Attempt Three questions in all.

Q. No. 1 is compulsory.

1. Answer the following briefly

- (a) Explain why orbitals like 1p, 2d and 3s are not permissible. (2)
- (b) What is the total Number of orbitals in 5g and 6h. (2)
- (c) What is the relation between polar co-ordinates and Cartesian co-ordinates ? (2)
- (d) On what factors the radial part of a wave function $R_{(r)}$ depends. What is the nodal point ? (2)
- (e) Highly charged ions are rare. Why ? (2)
- (f) Which is more covalent LiCl or KCl. (2)
- (g) The bond angle in CH_4 is 109° while in NH_3 is 107° . Why ? (1½)

2. (a) What is the significance of ψ and ψ^2 . (4)

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- (b) What do you mean by dipole moment? Calculate the ionic character of HF if its dipole moment is 1.92 D and bond distance 1.2 \AA . (4)
- (c) What is resonance? Write the resonating structure for CO, NH_3 and N_2O . (4)
3. (a) Define with example Hund's rule of maximum spin multiplicity. Account for the $\pm \frac{1}{2}$ value assigned to spin quantum number. (4)
- (b) Taking the example of MgCl_2 , explain Born-Haber cycle. What is its significance? (4)
- (c) Born-Landé equation comprises of two energy terms, one term is attractive in nature and the other repulsive in nature. What are these terms? Find lattice energy for NaCl crystal from the following data
 $A = 1.75$, $r_0 = 2.8 \text{ \AA}$, $n = 9$, $N = 6.02 \times 10^{23}$, $e = 4.8 \times 10^{-10} \text{ esu}$. (4)
4. (a) What is hybridization? Predict the shape of following molecules on the basis of hybridization
 (i) SnCl_2 (ii) SF_4 (iii) XeF_2 (4)
- (b) Draw radial probability distribution curve for:
 (a) $n = 4, l = 0$ and (b) $n = 3, l = 2$ (2)
- (c) What are conditions that ψ must obey as a wave function. (2)
- (d) ZnCl_2 is soluble in organic solvents but MgCl_2 is insoluble. Why? (2)
- (e) The dipole moment of NH_3 is more than NF_3 . Why? (2)

SECTION B

Scientific calculator is allowed.

Attempt three Questions in all.

Question No. 1 is compulsory.

1. Explain (Answer any five): (2½×5)
- (a) What are extensive properties? State which of the following properties are extensive:
 Density, volume, heat capacity and temperature.

- (b) Why is the value of C_p always greater than C_v ? How are they related?
- (c) What is buffer solution. Give one example each of acidic buffer and basic buffer?
- (d) Explain Degree of hydrolysis and hydrolytic constant. Give the mathematical expression which relates them.
- (e) Why phenolphthalein is suitable indicator for titration of strong acid against strong base?
- (f) Explain Hess's law of constant heat summation and its importance in thermochemistry.
2. (a) Show that pH of solution of a salt of weak acid and strong base is given by

$$\text{pH} = \frac{1}{2} (\text{p}K_w + \text{p}K_a + \log_{10} C) \quad (3\frac{1}{2})$$

- (b) Derive Henderson equation for pH of a basic buffer solution. (3)

- (c) Define solubility and solubility product of sparingly soluble salt (AX_2 type). If 20 cm^3 each of 0.01 M AgNO_3 and 0.0004 M NaCl are mixed, will precipitation of AgCl occur? Given ($K_{sp}(\text{AgCl}) = 1.7 \times 10^{-10}$). (3,3)

3. (a) Derive (any three):

$$(i) (\partial V / \partial S)_T = (\partial T / \partial P)_V$$

$$(ii) (\partial T / \partial P)_S = -(\partial V / \partial S)_P$$

$$(iii) H = G - T(\partial G / \partial T)_P$$

$$(iv) TV^{\gamma-1} = \text{constant}$$

All the symbols have their usual meanings. (2×3)

- (b) Distinguish between bond enthalpy and bond dissociation enthalpy.

Calculate $\Delta H_{\text{N-H}}$ bond using the following data:

$$\Delta H_f^\circ(\text{NH}_3) = -46 \text{ KJmol}^{-1}$$

$$\Delta H_{\text{diss}}^\circ \text{H}_2(\text{g}) = 436 \text{ KJmol}^{-1}$$

$$\Delta H_{\text{diss}}^\circ \text{N}_2(\text{g}) = 941.3 \text{ KJmol}^{-1} \quad (4\frac{1}{2})$$

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- (c) Derive the expression of work done during reversible adiabatic expansion for one mole of ideal gas. (2)

4. (a) Write short note :- (any three) (3×3)

(i) Common-ion effect.

(ii) Kirchhoff's law

(iii) Efficiency of Carnot engine

(iv) Second law of thermodynamics

(v) Ionic product of water.

- (b) Four moles of an ideal gas are compressed isothermally at 300K from $2.02 \times 10^5 \text{ Nm}^{-2}$ to $4.04 \times 10^5 \text{ Nm}^{-2}$ pressure. Calculate the free energy change for the process involved. (3½)