

Total number of printed pages – 7

B. Tech
BSCC 2101

Second Semester Examination – 2008

CHEMISTRY – I

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory
and any **five** from the rest.

The figures in the right-hand margin
indicate marks.

($h = 6.626 \times 10^{-34}$ Js, Mass of $e = 9.1 \times 10^{-31}$ kg,
 $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m/s, $N = 6.023 \times 10^{23}$,
 $R = 8.314$ JK⁻¹/mol)

1. Answer in brief : 2×10
- (a) Write the Schrödinger time independent wave equation. Explain the terms.
- (b) If the wavelength of an electron is one nm, what is the velocity of the electron ?

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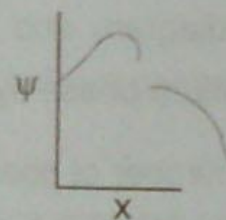
- (c) The triple point of one component system is invariant. Explain.
- (d) Why is AgCl less soluble in AgNO₃ than in pure water ?
- (e) Calculate the number of atoms per unit cell of hexagonal cell.
- (f) Explain why increase of temperature invariably increases the rate of reaction.
- (g) Why phenolphthalein is not a suitable indicator for titration of HCl against NH₄OH ?
- (h) Out of Zn, Ni, Zn²⁺, Ni²⁺ Which is
- strongest oxidizing agent and
 - strongest reducing agent ?
- (E° : Zn²⁺/Zn = -0.763V & Ni²⁺/Ni = -0.25V)
- (i) For the reaction 2 NaI (aq) + Br₂ (g) → 2NaBr (aq) + I₂(g), What is the effect on the reaction rate if some argon are mixed with bromine ?

- (j) Write down the cell reaction for
Pt | H₂(1 atm) | HCl(m) | AgCl | Ag.

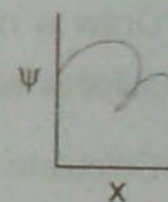
2. (a) Which of the following is/are acceptable wave function or not ? Explain with reasons.

(ψ vs x)

3



(i)



(ii)

- (b) Explain how black body radiation led to failure of classical mechanics. 4
- (c) Light of 350 nm strikes a metal surface with a work function of 3.2eV. Calculate
- the kinetic energy of most energetic electron and
 - the stopping potential. 3
3. (a) Which has more dissociation energy: O₂ or O₂⁺ ? Discuss on the basis of MO theory. 4

- (b) Explain the terms conductor, insulator and semiconductor on the basis of molecular orbital diagrams. 4
- (c) Why magnesium behaves as a metal even if it has filled orbitals? 2
4. (a) Draw a neat diagram and discuss the sulphur equilibrium phase system. 5
- (b) Calculate the number of phases, components and degrees of freedom for a mixture of N_2 , H_2 and ammonia at temperature at which equilibrium $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is readily established. 3
- (c) What are the characteristics of a good catalyst? 2
5. (a) A substance exists in two allotropic forms i.e. α (FCC, radius = 0.3nm) and β (BCC, radius = 0.37nm). Find out the ratio of their densities. (α/β). 3

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Contd.

- (b) Three uni-univalent ionic solids AB, AC and AD are composed of ions having following radii: $A^+ = 0.9nm$, $B^- = 0.9 nm$, $C^- = 1.8 nm$, $D^- = 2.7 nm$. Predict the structure and coordination of each solid. 3
- (c) Discuss about common defects found in solids. 4
6. (a) What is a storage cell? Write down the reactions taking place during charging of lead storage cell. 2
- (b) The emf of the cell $SCE || AgCl(satd) | Ag$ was 0.26V at 25°C. Find out the solubility of AgCl. ($E^\circ: SCE=0.2415, Ag^+/Ag=0.8V$) 3
- (c) What is quinhydrone? How can be pH of an unknown solution be found out using this electrode? A quinhydrone electrode was coupled with another electrode in a

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solution of pH 5.6. Find out the potential of the unknown electrode. (E: cell = 0.123V, quinhydrone = 0.699V) 5

7. (a) Derive an expression for rate constant of a second order reaction in which both the reactants are different. 4

(b) The decomposition of a gaseous substance $AB(g) \rightarrow A(g) + B(g)$ follows first order kinetics. Calculate 3

(i) the rate constant if pressure of AB falls from 0.62 atm to 0.44 atm in 50 seconds and

(ii) pressure of AB after 75 seconds at the same temperature.

(c) A first order reaction has rate constant equal to $1.5 \times 10^{-4} \text{ sec}^{-1}$ at 300 K and $7.5 \times 10^{-4} \text{ sec}^{-1}$ at 320 K. Calculate the activation energy and the frequency factor. 3

8. (a) Calculate the change of Gibbs and Helmholtz free energy when four moles of an ideal gas are expanded isothermally and reversibly from 5 atm to 1 atm at 300 K. 3

(b) The ionization constant for a certain acid HA is 4.5×10^{-4} at 298 K. What concentration of acid would be required to produce $[H_3O^+]$ of $3 \times 10^{-3} \text{ M}$? 3

(c) K_p for $SO_2(g) + \frac{1}{2} O_2(g) \rightarrow SO_3(g)$ is 1.7×10^{21} at 300 K. Calculate K_p and K_c for $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$. 4