

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<sup>-1</sup>/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 ?

P.T.O.

- (c) The triple point of one component system is invariant. Explain.
- (d) Why is AgCl less soluble in AgNO<sub>3</sub> 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 NH<sub>4</sub>OH ?
- (h) Out of Zn, Ni, Zn<sup>2+</sup>, Ni<sup>2+</sup> Which is
  - (i) strongest oxidizing agent and
  - (ii) strongest reducing agent ?
 (E° : Zn<sup>2+</sup>/Zn = -0.763V & Ni<sup>2+</sup>/Ni = -0.25V)
- (i) For the reaction 2 NaI (aq) + Br<sub>2</sub> (g) → 2NaBr (aq) + I<sub>2</sub>(g), What is the effect on the reaction rate if some argon are mixed with bromine ?

BSCC 2101

2

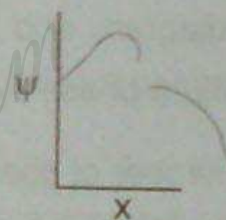
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(j) Write down the cell reaction for  
Pt | H<sub>2</sub>(1 atm) | HCl(m) | AgCl | Ag.

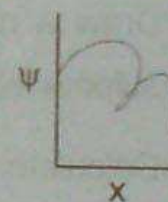
- 2. (a) Which of the following is/are acceptable wave function or not ? Explain with reasons.

(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
  - (i) the kinetic energy of most energetic electron and
  - (ii) the stopping potential. 3

- 3. (a) Which has more dissociation energy: O<sub>2</sub> or O<sub>2</sub><sup>+</sup> ? Discuss on the basis of MO theory. 4

BSCC 2101

3

P.T.O.

(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.  $\alpha$  (FCC, radius = 0.3nm) and  $\beta$  (BCC, radius = 0.37nm). Find out the ratio of their densities. ( $\alpha/\beta$ ). 3

BSCC 2101

4

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(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

BSCC 2101

5

P.T.O.

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  $4.5 \times 10^{-4}$  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  $1.7 \times 10^{21}$  at 300 K. Calculate  $K_p$  and  $K_c$  for  $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$ . 4