*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 × 10$^{-34}$ Js, Mass of e = 9.1 × 10$^{-31}$ kg,

e = 1.6 × 10$^{-19}$ C, c = 3×10$^8$ m/s, N = 6.023 × 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 ?

   (c)   The triple point of one component system
         is invariant. Explain.

   (d)   Why is AgCl less soluble in AgNO$_3$ 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$_4$OH ?

   (h)   Out of Zn, Ni, Zn+$^2$, Ni$^{+2}$ Which is

         (i)   strongest oxidizing agent and

         (ii)  strongest reducing agent ?

               (E° : Zn+$^2$/Zn = – 0.763V & Ni+$^2$/Ni

               = – 0.25V)

   (i)   For the reaction 2 NaI (aq) + Br$_2$ (g) →
         2NaBr (aq) + I$_2$(g), What is the effect on
         the reaction rate if some argon are mixed
         with bromine ?

(j)   Write down the cell reaction for

Pt | $H_2$(1 atm) | HCl(m) | AgCl | Ag.

2.   (a) Which of the following is/are acceptable wavefunction or not ? Explain with reasons. ($\psi$ vs x)          3
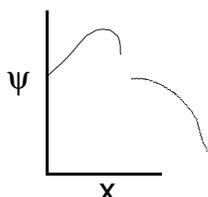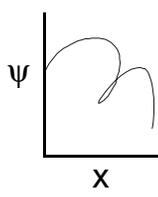


(i)                    (ii)

(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: $O_2$ or $O_2^+$ ? 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.$\alpha$ (FCC, radius = 0.3nm) and $\beta$(BCC, radius = 0.37nm). Find out the ratio of their densities.($\alpha$ /$\beta$).          3

(b) Three uni-univalent ionic solids $AB$, $AC$ and $AD$ are composed of ions having following radii : $A^+ = 0.9$nm, $B^- = 0.9$ 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.($E°$: 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 solution of pH5.6. 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 0.44atm 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 $1.5 \times 10^{-4}$ sec$^{-1}$ at 300 K and $7.5 \times 10^{-4}$ 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 $3 \times 10^{-3}$ M ?      3

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

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