B. Tech

BSCC2101/BS1102

First 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, Mass of $p = 1.67 \times 10^{-27}$ 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, k)

1. Answer in brief : 2×10

   (a) When would the wavelength associated with an electron be equal to that of a proton ?

(b) Write the Schrodinger time independent wave equation.

(c) The equilibrium constant for a reaction is 2.5×10^6. Calculate free energy change at 27°C.

(d) What is Hess's law ? Or What is a black body ?

(e) For the reaction $2A + B_2 \rightarrow 2AB$, the rate increases by 8 times when the concentrations of both are doubled and rate doubles when only concentration of B is doubled. Write down the rate equation

(f) Give one example each of solid where Frenkel and Schottky defect occur.

(g) What changes occur to quinhydrone electrode when pH is greater than 7 during determination of pH of an unknown solution ?

(i) How much ammonium chloride required to be added to one litre of 0.1 M ammonium hydroxide to make a solution of pH10 ? ($k_b = 1.8 \times 10^{-5}$)

(j) Calculate ΔG when one mole of an ideal gas expands isothermally and reversibly from 3 atm to 1 atm at 300 K ?

2. (a) A laser used to read CD emits light of wavelength 600 nm.Calculate the number of photons emitted by it in each second if its power is 0.1 W. 3

(b) Calculate the K.E. and the velocity of the photo electron when a light of wavelength 190 nm falls on a metal surface. The work function is 2.05 eV. Also calculate the stopping potential. 4

(c) The speed of a projectile of mass 1 gram is known to within 1 μm/sec. Calculate minimum uncertainty in its position. 3

3. (a) What are the rules for linear combination of atomic orbitals. Draw the plot of Δ^2 *vs.* internuclear distance for bonding molecular orbital for a diatomic molecule. 4

(b) Write down the MO configuration of N_2 and N_2^+. Compare their bond length, stability and magnetic characteristics. 4

(c) What will be consequences if ψ is infinite? 2

4. (a) Draw a neat diagram for a one component system from the following data. A exists in two solids A_1 and A_2. Both are denser than liquid. The transition temperature of A_1 and A_2 increases with increase of pressure. A_1 is stable at low pressure and temperature. Label the diagram. 5

(b) Is it possible to observe four distinct phases for a binary alloy ? Give reasons to your answer. 3

Contd.

(c) Calculate the ionization constant of a 0.1 M weak acid HA if pH is found to be 5.37 at 298 K. 2

5. (a) Show that $(\delta T/\delta P)_S = (\delta V/\delta S)_P$. 4

Or

The peak of sun's emission occurs at 480 nm. Calculate the temperature of its surface.

(b) The enthalpy of vapourisation of water at 373 K and 1 atm is 40.6 kJ/mol. Calculate its value at 400K under constant pressure. The sp. heat capacities of liquid water and steam are 75.3J/K/mol and 36J/K/mol respectively. 4

Or

Explain how Einstein's introduction of quantization accounted for the properties of black body radiation. 4

(c) Which of the following is spontaneous ?

$X(1, 1\text{ atm}, 270\text{K}) \leftrightarrow X(s, 1\text{ atm}, 270\text{K})$

P.T.O.

or (1, 1 atm, 280K) ↔ X(s, 1 atm, 280K)
If fusion temperature = 280K. 2

6. (a) Differentiate between primary and secondary battery. Discuss about a dry battery. 4

(b) What are the disadvantages of use of hydrogen electrode for pH determination? 2

(c) Calculate ΔE° and ΔG° for $Cr^{3+} + 2e^- \rightarrow Cr^{2+}$ at 298 K.
Given $Cr^{3+} + 3e^- \rightarrow Cr$, $E^\circ = 0.5V$
$Cr^{3+} + e^- \rightarrow Cr^{2+}$, $E^\circ = -0.41V$. 4

7. (a) Differentiate between order and molecularity. 2

(b) In a first order reaction, the concentrations of reactant after 10 and 20 minutes from the start were found to be 14 and 8.5 units respectively. Calculate the initial concentration and the rate constant. 4

(c) A first order reaction has rate constant equal to $7 \times 10^{-7} sec^{-1}$ at 7°C and $9 \times 10^{-1} sec^{-1}$ at 77°C. Calculate the activation energy. Calculate the rate constant at 400 K. 4

8. (a) Calculate the solubility product of lead iodide at 25 °C. Its solubility at this temperature is 0.7gm/ltr. (mol.wt.= 461 gm) 4

(b) N_2O_4 is 25% dissociated at 37°C and one atm. pressure. Calculate
(i) kp and
(ii) the percent dissociation at 0.1 atm at 37 °C. 4

(c) What do you mean by homogenous and heterogeneous catalysis? Give one example for each type. 2