

Total number of printed pages – 7

B. Tech  
BSCC 2101

First Semester Examination – 2007

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,  $m_e = 9.1 \times 10^{-31}$  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 the following in brief : 2×10
- (a) What happens to the sign or magnitude of  $\psi_g$  of homonuclear diatomic molecule when inverted through mid point ?

P.T.O.

- (b) What is a black body ?
- (c) What is the maximum number of phases that can be present in one component system at constant temperature and pressure ?
- (d) Will Fe reduce  $\text{Fe}^{3+}$  to  $\text{Fe}^{2+}$ ? ( $E^{\ominus} : \text{Fe}^{2+} / \text{Fe} = -0.441 \text{ V}$ ,  $\text{Fe}^{3+} / \text{Fe}^{2+} = 0.771 \text{ V}$ )
- (e) What is the most possible structure for AB if radius ratio is 0.863 ?
- (f) What is the order of a reaction if half-life period and units of k depend inversely on concentration ?
- (g) Calculate the solubility of  $\text{Ag}_2\text{CrO}_4$  if solubility product is  $8 \times 10^{-12}$ .
- (h) Identify the crystal system if  $a = 6.5$ ,  $b = 6.5$ ,  $c = 6$ ,  $\alpha = \beta = 90^\circ$  and  $\gamma = 120^\circ$ .

- (i) What is the value of  $\Delta G$  for liquid water vapourising at 373 K and 1 atm. pressure ?
- (j) Write down the cell reaction for  $\text{Pt} | \text{Ce}^{3+} (a = 1), \text{Ce}^{4+} (a = 1) || \text{Cl}^- (a = 1), |\text{Cl}_2| \text{Pt}$ .
2. (a) Calculate the wavelength associated with a photon having energy of one electron volt. 3
- (b) Compare the wavelength associated with an object with mass  $6 \times 10^{27} \text{ kg}$  and a velocity  $3 \times 10^4 \text{ m/s}$  with that of an electron moving with a velocity of  $6 \times 10^5 \text{ m/s}$ . 4
- (c) Calculate the uncertainty in velocity of a bullet weighing 10 gram whose position is known with  $\pm 0.01 \text{ mm}$ . 3
3. (a) Write down the M.O. configurations of  $\text{O}_2$ ,  $\text{N}_2$ ,  $\text{F}_2$  and compare their bond dissociation energies and magnetic properties. 4

(b) What do you mean by an eutectic? Draw and discuss the phase diagram of two components eutectic system. 4

(c) Why cannot all the phases of sulphur system co-exist at the same temperature and pressure? 2

4. (a) A buried piece of wood has 25.6% as much  $C^{14}$  as ordinary wood today. When did the piece get buried if the decay follows first order kinetics? (half-life = 5760 years) 3

(b) Differentiate between order and molecularity. 2

(c) The rate of reaction (i)  $A \rightarrow Pr$  is doubled when the temperature is raised from 300 K to 310 K. The half-life period at 310 K for the reaction is 30 minutes. At the same temperature B decomposes twice as fast

as A in another reaction (ii)  $B \rightarrow Pr$ . Calculate the rate constant of reaction (ii) at 300 K if the activation energy of reaction (ii) is half that of reaction (i). Both reactions follow first order kinetics. 5

5. (a) The pH of HCN solution is 5.2. What is the value of  $K_a$ ? 3

(b) Calculate the composition of an acetic acid buffer of total molarity of 0.29 and having a pH of 4.4. ( $K_a = 1.8 \times 10^{-5}$ ) 4

(c) What is common ion effect? Explain it with a suitable example. 3

6. (a) Differentiate between a galvanic cell and an electrolytic cell. 2

(b) Zinc granules are added in excess to a 500 ml solution of 1 M nickel nitrate at 298 K until equilibrium is reached. Find out

the concentration of  $\text{Ni}^{2+}$  in solution at equilibrium. ( $E^\circ: \text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$ ,  $\text{Ni}^{2+}/\text{Ni} = -0.24 \text{ V}$ ) 4

(c) The standard free energy change for the reaction  $\text{H}_2(\text{g}, 1 \text{ atm}) + \frac{1}{2} \text{O}_2(\text{g}, 1 \text{ atm}) \rightarrow \text{H}_2\text{O}(\text{l})$  is  $-237.19 \text{ kJ/mol}$  at  $298 \text{ K}$ .

(i) Write the electrode reactions if it occurs in a galvanic cell, (ii) Calculate the standard electrode potentials of the following electrodes:  $\text{Pt} | \text{O}_2 | \text{OH}^- (a=1)$ ,  $\text{Pt} | \text{O}_2 | \text{H}^+ (a=1)$ ,  $\text{Pt} | \text{H}_2 | \text{OH}^- (a=1)$  ( $\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$ ,  $E^\circ = -0.8277 \text{ V}$ ). 4

7. (a) Describe the use of standard hydrogen electrode in pH measurement. A hydrogen electrode and a SCE has a voltage of  $0.4 \text{ V}$  when placed in a solution at  $298 \text{ K}$ . Calculate the pH of the solution. ( $E^\circ$  of SCE =  $0.2415 \text{ V}$ ) 5

(b) How is fuel cell different from battery? What are the advantages? 3

(c) Explain (i) active center, (ii) catalytic poison with respect to heterogeneous catalysis. 2

8. (a) Calculate and compare the atomic packing factor of FCC and BCC structures. 4

(b) Differentiate between Schottky and Frenkel defects. 3

(c) Calculate  $\Delta G$  for isothermal reversible compression of a mole of ideal gas from  $1 \text{ atm}$  to  $50 \text{ atm}$  at  $303 \text{ K}$ . 3