

## Second Semester Examination – 2011

## 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.

1. Answer the following questions : 2 × 10
- (a) Why the fusion curve of ice in phase diagram is slightly inclined toward pressure axis.
- (b) Write the time – independent Schrödinger equation for particle of mass  $M$  with potential  $V$ .
- (c) Identify the crystal system in following cases :
- (i) if  $a = 4 \text{ nm}$ ,  $b = 7 \text{ nm}$ ,  $c = 9 \text{ nm}$  and  $\alpha = \beta = \gamma = 90^\circ$
- (ii)  $a = 6 \text{ nm}$ ,  $b = 6 \text{ nm}$ ,  $c = 6 \text{ nm}$  and  $\alpha = \beta = \gamma = 90^\circ$
- (d) In an ionic crystal of general formula  $AX$ . The co-ordination number is six and value of radius ratio is in the range.
- (i) 0.155–0.215 (ii) 0.215–0.414
- (iii) 0.732–1 (iv) 0.414–0.732
- (e) Why it is essential to remove the arsenic in contact process for manufacture of  $H_2SO_4$ ?
- (f) Write down electrode reaction of calomel electrode and oxygen gas electrode.
- (g) Calculate the entropy change in melting 5 gm of ice at  $0^\circ C$ . Given that molar heat of fusion of ice 1440 cal.
- (h) What do you mean by heat of hydration? Give an example.
- (i) What do you mean by fuel cell? Write down the fuel cell reaction of  $H_2-O_2$  fuel cell.
- (j) What do you mean by intensive properties? Justify emf of the electrochemical cell is a intensive properties.

2. (a) Explain with suitable example with diagram the following terms used in the phase rule study of heterogeneous equilibrium. 6
- (i) Triple point
  - (ii) Eutectic point
  - (iii) Univariant system.
- (b) If  $\partial U = T\partial S - P\partial V$  then show that  $[\partial T/\partial V]_S = -[\partial P/\partial S]_V$ . 4
3. (a) What do you mean by gas electrode? How you determined  $P^H$  of solution with help of hydrogen electrode? Write down the construction of S.H.E. 6
- (b) Heat of reaction for combustion of glucose at constant pressure is  $-651$  kcal at  $17^\circ\text{C}$ . Calculate the heat of reaction for same at constant volume. 4
4. (a) Calculate EMF cell 4
- $\text{Pt}, \text{H}_2(1\text{atm})/\text{HCl}(0.2\text{M})/\text{Cl}_2(1.0\text{atm})/\text{Pt}$   $E^\circ \text{Cl}_2/\text{Cl} = 1.36\text{V}$ .
- (b) Justify the order stability in  $\text{O}_2^+, \text{O}_2^0, \text{O}_2^-, \text{O}_2^{2-}$  by molecular orbital theory. Compare their bond orders, bond lengths and magnetic properties using their molecular orbital electronic configuration. 6
5. (a) What is the effect of temperature on reaction rate? Give Arrhenius equation. Plot the graph showing variation of  $K$  with temperature. What can you calculate from slope. 5
- (b) What do you mean by body centered unit cell? At room temperature, sodium metal crystallize in body centered cubic cell with  $a = 4.24 \text{ \AA}$ . Calculate the theoretical density of sodium. Molar mass of sodium is  $23.0 \text{ gmol}^{-1}$ . 5
6. (a) Define term (i) molecularity, (ii) order (iii) half life period of reaction with example. Describe any one method for determination of order of reaction. 6
- (b) Calculate the voltage required to accelerate an electron to have velocity  $1.42 \times 10^8 \text{ ms}^{-1}$ . What will be de Broglie wave length? 4



7. (a) State and explain Hess's law. The molar heat of combustion of  $C_2H_2(g)$ , C (graphite) and  $H_2(g)$  are 310.62, 94.05 and 68.32 KJ/mol respectively. Calculate heat of combustion of  $C_2H_2(g)$ . 6
- (b) Calculate the standard potential of  $Ni^{+2}/Ni$  electrode. If the cell potential of the cell  $Ni/Ni^{+2}(0.01M)//Cu^{+2}(0.1M)/Cu$  is 0.59 V,  $E^\ominus_{(Cu^{+2}/Cu)} = 0.34V$ . 4
8. (a) Derive Gibb's Helmholtz equation in term of free energy change and enthalpy change. With help of above equation explain how emf of the cell is calculated. 6
- (b) What do you mean by eigen value and eigene function? Write down the some application of Schrodinger's equation. 4