

*Full Marks : 70*

*Time : 3 hours*

Answer any **six** questions including  
**Q. No. 1** which is compulsory

*The figures in the right-hand margin indicate marks*

1. Answer the following questions : 2 × 10

(i) What are the conditions, a wave function must satisfy ?

(ii) Write down two applications of Schrödinger's equation.

(iii) What is the difference between Pearlite and Ledeburite ? -2

(iv) Arrange the following in ascending order in terms of their energy. IR, UV-vis, microwave, radiowave.

(v) What is triple point of water ?



( Turn Over )



(Cvtr)

(2)  
 $\Delta S = \ln \frac{P_2}{P_1} \times C_p + R \ln \frac{P_2}{P_1}$

(vi) AB forms a simple cubic lattice in which  $A^+$  ions are at the corners and  $B^-$  at the center of the unit cell. Calculate the radius of  $A^+$ , if the radius of  $B^-$  is 0.8 nm and length of the unit cell is 0.4 nm. (Assume that cation/anion contact takes place along the body diagonal).

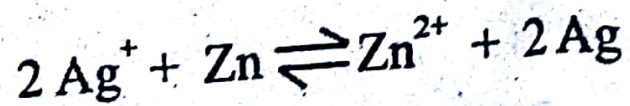


(vii) What are the disadvantages of Collision theory?

(viii) Write down electrode reaction of calomel electrode.

(ix) Calculate the entropy change in melting of 10 gm of ice at  $0^\circ\text{C}$ . Given that molar heat of fusion of ice is 1.5 Kcal. -2

(x) Calculate the equilibrium constant for the following reaction at  $27^\circ\text{C}$ .

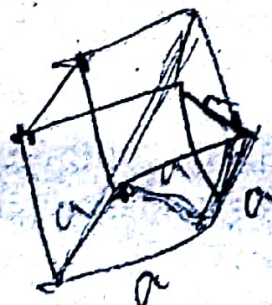


where the standard emf of the cell is 1.5 V.



B.Tech-2/Chem (Set-1)

$\Delta S = C_p$

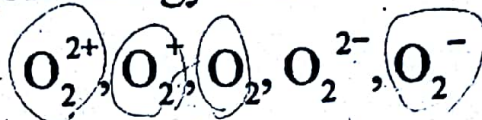


(Continued)

$\Delta S = C_p$



2. (a) Arrange the following species in order of their increasing bond length, bond dissociation energy and relative stability. 4



- (b) An electron is moving with a K.E. of  $4.5 \times 10^{-25}$  J. Calculate the wavelength and frequency of the particle wave. 3

- (c) What is eigenvalues and eigenfunctions? 3

3. (a) State the phase diagram of Bi-Cd system; Labelling all the phases, curves and points. 7

- (b) What do you mean by peritectic point and eutectic point? 3

4. (a) Consider a gaseous decomposition reaction  $A \rightarrow$  products at  $500^\circ\text{C}$  and at initial pressure of 350 torr. The rate of the reaction is  $1.07 \text{ torr sec}^{-1}$  when 5% of the decomposition was over and  $0.76 \text{ torr sec}^{-1}$  when 20% decomposition was over. Determine order of the reaction. 4



(b) 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 frequency factor.

4

(c) Explain the function of a catalytic promoters and poison with example.

2

5. (a) Discuss about Frenkel and Schottky defects.

4

(b) Three univalent ionic solids AB, AC, AD are composed of ions having the following radii.

$A^+ = 0.9 \text{ nm}$ ,  $B^- = 0.9 \text{ nm}$ ,  $D^- = 2.7 \text{ nm}$ ,  
 $C^- = 1.8 \text{ nm}$ . Predict the structure and co-ordination number of each solid.

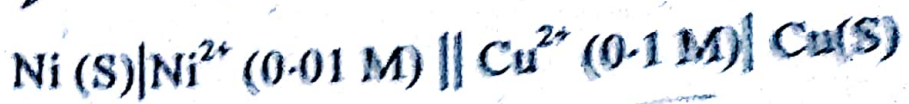
3

(c) How do the spacing of the planes (110), (100) and (111) vary in the cubic lattice.

3

6. (a) Calculate the maximum work that can be accomplished by the operation of the

following cell at 25°C.



Given that

$$E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V and}$$

$$E^\circ_{\text{Cu}/\text{Cu}^{2+}} = -0.34 \text{ V.}$$

(b) What is quinhydrone? How can the pH of an unknown solution be found out using this electrode. A quinhydrone electrode was coupled with another electrode in a solution of pH = 5. Find out the potential of the unknown electrode. ( $E_{\text{cell}} = 0.12 \text{ V}$ ,  $E_{\text{quinhydrone}} = 0.699 \text{ V}$ .)

7. (a) Show that

$$\left( \frac{\partial V}{\partial T} \right)_P = - \left( \frac{\partial S}{\partial P} \right)_T$$

B.Tech - 2/Chem (Set-1)

(Turn Over)



(b) Given the following standard heats of reaction.

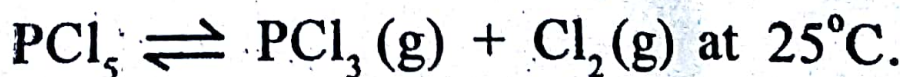
(i) Heat of formation of water =  $-68.3 \text{ Kcal.}$

(ii) Heat of combustion of  $\text{C}_2\text{H}_2 = -310.6 \text{ Kcal.}$

(iii) Heat of combustion of ethylene =  $-337.5 \text{ Kcal.}$

Calculate the heat of the reaction for the hydrogenation of acetylene at constant volume at  $25^\circ\text{C}$  temperature. 4

(c) For the equilibrium



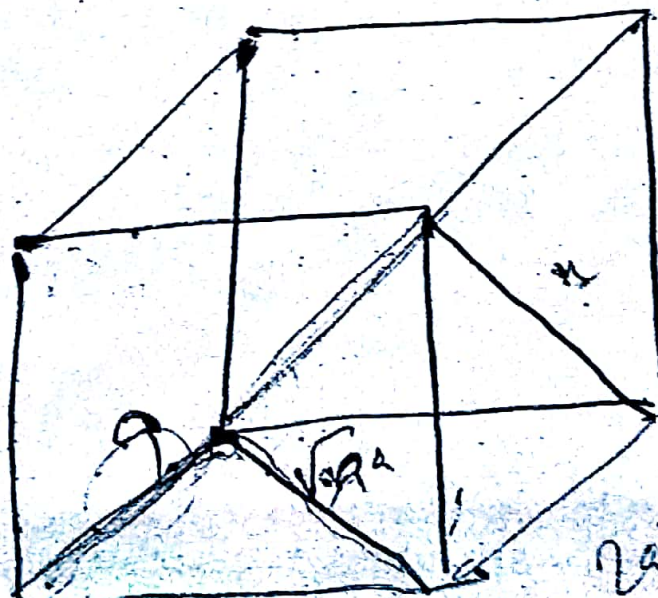
$$K_c = 1.8 \times 10^7$$

Calculate  $\Delta G^\circ$  for the reaction. 2

8. (a) Discuss the basic principle of UV-visible spectroscopy. 4

(b) If the molar absorption coefficient of a coloured complex is  $3.5 \times 10^4 \text{ dm}^3/\text{mole}/\text{cm}$  at 300 nm. Calculate the absorbance of a  $4.5 \times 10^{-6} \text{ M}$  solution in 70 nm cell when measured at this wavelength. 3

(c) Discuss the selection rules in which emission or absorption in microwave region takes place. 3



$$a = \frac{4}{\sqrt{3}} r$$

$$2a^2 \quad a^2 + a^2 = a^2$$