

Total Pages—5

B.Tech-2 (All)

Chem

Set-2

Full Marks : 70

Time : 3 hours

**Q. No. 1 is compulsory and answer
any five from the rest**

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2×10

- (a) Find the uncertainty in the velocity of an electron if the uncertainty in its position is 1pm.
- (b) Between super oxide and peroxide, which one has larger bond length ?
- (c) An object of mass 1.0 kg suspended from the end of a rubber band has a vibrational frequency of 2 Hz. Calculate the force constant of the rubber.

(Turn Over)

(d) For a reversible reaction, the value of standard free energy change is Zero. What is the value of its equilibrium constant ?

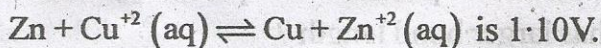
(e) If the dissociation constant of weak base is 1.6×10^{-5} at 25°C , what is the percentage of dissociation of the base in a 0.1 M solution ?

(f) Considering one mole of an ideal gas, prove

$$(\partial P / \partial T)_V (\partial T / \partial V)_P (\partial V / \partial P)_T = -1$$

(g) What are the value of pressure and temperature at which all the three phases of water are coexist in equilibrium ?

(h) The Standard EMF of the Daniell cell involving the cell reaction



Calculate the equilibrium constant of the cell reaction at 25°C .

(3)

- (i) Two particles A and B are in motion. The wavelength of A is 5×10^{-8} m. Calculate the wavelength of B , if its momentum is half of A .
- (j) If the ionic radii of M^+ and X^- are 147 and 195 pm respectively, what is the most probable coordination number of M^+ ion in MX ?
2. (a) Compare the relative stability of O_2^- and N_2^+ and predict their magnetic behaviour. 5
- (b) Derive the expression for the energy of a particle of mass m confined in an one dimensional box. 5
3. (a) Derive the relationship between moment of inertia and inter nuclear distance of a diatomic molecule consist of two atoms of mass M_1 and M_2 . 5
- (b) The spacing of the lines in a rotational spectrum of $C^{12}O$ molecule is 10.590 cm^{-1} . Calculate the energy (in cm^{-1}) of rotational state with $j = 2$ for $C^{13}O$ molecule. Assuming

(4)

the replacement of C^{12} by C^{13} leaves the bond length unchanged. 5

4. (a) Show that $C_p - C_v = R$ for a one mole of ideal gas. 5

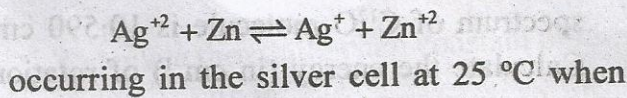
(b) Show that

$$\mu_{JT} = -1/C_p \left[\left(\frac{\partial U}{\partial P} \right)_T + \left(\frac{\partial(PV)}{\partial P} \right)_T \right] \quad 5$$

5. (a) Derive the expression for the rate constant of a first order reaction. 5

(b) The rate constant of a certain reaction is found to be doubled when temperature is raised from 27°C to 37°C . What is the activation energy? 5

6. (a) Calculate the equilibrium constant of the cell reaction



(5)

$[Zn^{+2}] = 0.1M$ and $[Ag^+] = 10M$. The EMF of the cell is found to be 1.62 V.

5

(b) What are the difference between Frenkel defect and Schottky defect ? Which of the two defect changes the density of the solid ?

5

7. (a) The degree of dissociation of acetic acid in a 0.1 M solution is 1.32×10^{-2} . Find out the dissociation constant of the acid and pK_a value.

5

(b) Derive Gibbs-Helmholtz equation for a process at constant volume and constant pressure.

5

8. (a) Draw and explain the phase diagram of sulphur system.

5

(b) NaCl is a face centered cubic lattice. Calculate its density if the edge of the cube is $5.62 \times 10^{-10}m$ long.

5