SPRING END SEMESTER EXAMINATION-2018

2ⁿᵈ Semester B.Tech

CHEMISTRY

CH-1003

(For 2017 Admitted Batch)

Time: 3 Hours   Full Marks: 50

Answer any SIX questions including question No.1 which is compulsory.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable
and all parts of a question should be answered at one place only.

1. (a) For the dissociation reaction of a metal oxide, $\Delta H = 35$ $[1 \times 10]$
         KJ/mol and $\Delta S = 0.08$ KJ/K at 1 atm pressure. Find the
         temperature up to which the reaction would not be
         spontaneous?

    (b) On the basis of molecular orbital theory, show that HF is
         diamagnetic.

    (c) $[Ni(CN)_6]^{2-}$ is colorless. Explain.

    (d) Explain sacrificial anodic protection.

    (e) Explain bathochromic shift with suitable example.

    (f) Explain the effect of concentration on molar conductance
         of NH_4OH.

    (g) CO_2 is non polar but IR active. Explain.

    (h) A reaction proceeds 3 times faster at 37 °C than it does
         at 27 °C. Find the activation energy.

    (i) For a solution of camphor in hexane in a 5 cm cell, the
         absorbance A was found to be 2.52 at 295nm with ϵ_{max}
         =14. What is the concentration of camphor?

(j) Predict whether the cell reaction

$2Ag(s) + Zn^{2+} (aq) \longrightarrow 2Ag^+ + Zn(s)$ is feasible or not.
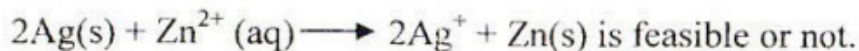
Given $E^0_{Ag/Ag^+} = -0.8V$ and $E^0_{Zn/Zn^{+2}} = 0.76V$.

2. (a) Calculate the vibrational absorption frequency of the -NH group while that of -CH group is 3023 cm^{-1}, keeping same value of force constant. [4]

(b) Deduce the structure of the isomeric compounds 'A' and 'B' having molecular formula C_3H_6O and the following IR spectral data. [4]

For 'A' a characteristic peak is at 1710 cm^{-1} whereas for 'B' two peaks at 3340 cm^{-1} and 1640 cm^{-1}.

3. (a) For the reaction $2O_3 \longrightarrow 3O_2$ the following mechanism has been proposed [4]

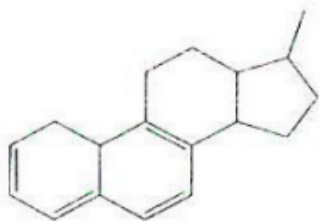$$O_3 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} O_2 + O$$

$$O_3 + O \overset{k_2}{\longrightarrow} 2O_2$$
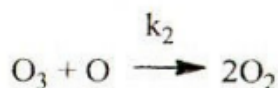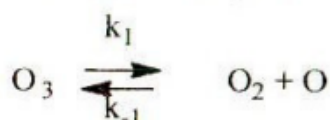
Show that, $-\dfrac{d[O_3]}{dt} = k \dfrac{[O_3]^2}{[O_2]}$

where $k = \dfrac{k_1 k_2}{k_{-1}}$ assuming that, $k_{-1}[O_2] \gg k_2[O_3]$

(b) What is time lag theory? On the basis of the same, develop the condition for a uni molecular reaction to follow 2nd order kinetics. [4]

4. (a) Calculate CFSE for the complex $[Co(NH_3)_6]^{3+}$. Given octahedral splitting energy is 21,400 cm^{-1} and the pairing energy is 27,800cm^{-1}. [4]

   (b) Find the pH of a solution placed in a quinhydrone half-cell which was coupled with standard calomel electrode. The EMF of the combined cell was found to be 0.123V at 25 ^{0}C. (Given, $E_{calomel} = 0.2415V$, $E^0 = 0.6996V$). [4]

5. (a) Discuss the scheme of hybridization and predict the shape for the complex $[Ni(CO)_4]$. The complex is found to be diamagnetic. [4]

   (b) The equivalent conductance of a very dilute solution of KNO_3 at 298K is 105.2 $ohm^{-1}. cm^2 equiv^{-1}$. If the ionic conductance of nitrate ion is 61.7 $ohm^{-1}. cm^2 equiv^{-1}$, then calculate the transport number and ionic mobility of potassium ion in this solution. [4]

6. (a) Predict the effect of increased pressure and temperature on the following reaction equilibria. [4]

   (i) $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3\,(g)} + 194.0\ KJ$

   (ii) $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)} - 361.0\ KJ$

   (b) Kp for a reaction is $1.6×10^{-4}$ at 400^0 C. What will be the Kp at 500^0 C? Heat of reaction in this temperature range is -25.0 kcal. [4]

7. (a) Calculate the number of binary collisions per cc of a nitrogen sample at STP. Given diameter of N_2 molecule is 3.7 A^0. [4]

   (b) Discuss the working principle of Ni-MH battery. Mention two advantages of the same. [4]

8. (a) Find the entropy change accompanying the mixing of [4]
4 g of H_2 and 4 g of He at STP.

(b) Calculate λ_{max} for the following compound by using [4]
Woodward-Fieser rule.

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