NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa 403 401

Programme Name: B.Tech
End Semester Examination, April-2021

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Course Name: Chemistry	**Course Code: CY150**
Date: 06/04/20201	**Time:** 9.30 AM
Duration: 3 hrs	**Max. Marks:** 100

1. Answer all the questions

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1. The following cell has been constructed and standard reduction potential at 298 K has been measures as 0.73V. Write the proper cell equation for the given cell and calculate the solubility product constant for Silver bromide in water at 298K — **4 Marks**

    $Ag(s)|Br^-(aq)|AgBr(s)||Ag^+(aq)|Ag(s)$

2. A cell was constructed with a copper and iron as an electrode dipped into the solution containing their own divalent ions, produces a voltage of 1.6V. — **4 Marks**
    (a) Estimate the relative concentration of Cu^{2+} and Fe^{2+} ions in the solution.
    (b) Represent this cell properly and identify the cathode and anode (c) identify the direction of flow of current.
    Given that $E^o{}_{Cu^{2+}/Cu} = 0.34V$; $E^o{}_{Fe^{2+}/Fe} = -0.44V$

3. A 40 m long pipe having 1.8 m diameter has been electroplated with Zinc to prevent corrosion. A successful electroplating has been carried out by passing 3.26V between a graphite anode and the pipe dipped in Zn^{2+} solution. Calculate the amount spent on electricity to achieve the plating thickness of 200 micro meters. Note that the government supply electricity at the rate of Rs. 5/KWh. Give that $A_{Zn} = 65.4$, density of zinc is 7.14 g/cm^3 — **5 Marks**

4. A cell was constructed using magnesium and copper rod dipped in to a solution containing its own ions. Each of the half-cell contains 230 ml of 0.5 M solutions. (a) How many grams of copper is deposited if the cell delivers a current of 0.18 Amp continuously for 29.6 hrs. (b) Calculate the leftover concentration of copper ion in the electrolyte solution after 29.6 hrs. — **4 Marks**

5. A galvanic cell is constructed by connecting two half-cells through a salt bridge, each of the half cells have a silver rod immersed in a 25 ml of solution containing 0.15 M silver nitrate. A 25 ml of 0.15 M sodium chloride solution is mixed in the electrolyte of left-hand side compartment and measured the cell voltage of 0.241 V. Write the half and complete cell reaction and calculate the solubility product constant of AgCl — **4 Marks**

6. The following cell is constructed and started working at the temperature of 25° C. (a) Calculate the EMF produced by this cell at the given concentrations and temperature. (b) The cell continued to work until the concentration of copper reaches 0.45 M and stops working. What is the concertation of I$^-$ when the cell got exhausted. — **4 Marks**
    $Cu(s)|Cu^+(aq, 0.25M)||I(s)|I^-(aq, 3.5M)$
    Given that $E^o{}_{Cu+/Cu} = 0.52$; $E^o{}_{I/I^-} = 0.54$

7. A solution containing 7.49×10^{-5} M of compound X in a 1.5 cm cell measured absorbance of 0.160 and 0.760 at 465nm and 687 nm respectively. Under — **5 Marks**

the same condition, a solution containing 4.245×10^{-5} M of compound Y measured absorbance of 0.710 and 0.100. A solution containing a mixture of compound X and Y in 2.0 cm cell measured absorbance of 0.439 and 1.025 at the wavelength mentioned above. Calculate the concentration compound X and Y in the mixture.

8   Specify whether the vibrational modes indicated on the hypothetical molecule will be observed in IR spectrum and justify your answer. Note that molecule a, b and c are planar.   5 Marks

(a)   (b)   (c)

(d)   (e)
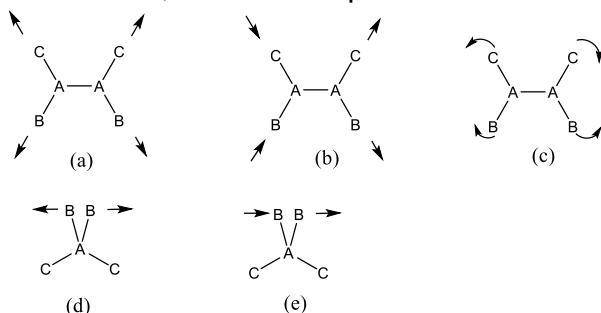
9   The O-H stretching frequency of alcohol is observed at 3400 cm^{-1} in the IR spectrum. Calculate the force constant of the O-H bond and calculate the wavenumber at which ^{18}O-H stretching vibration will appear   5 Marks

10 A hypothetical organic free radical show four EPR transitions at 3052, 3252, 3452, 3652 Gauss respectively at a frequency of 9452 MHz. (a) Calculate hyperfine coupling constant, and g value for the radical. (b) Calculate the resonance position of this same molecule at a frequency of 35325 MHz   5 Marks

11 A hypothetical molecule show a single EPR transition at g = 2.1234. The spectrum was recorded at 32° C with three different microwave frequency; 9.4321, 34.3210 and 95.6789 GHz respectively. Also, the EPR spectrum was recorded at -102° C and -152° C with a microwave frequency 9.4321 GHz. Calculate the population ratio between the spin states at the given temperature and frequency. Given that Boltzmann constant is 1.380649×10^{-23} J.K^{-1}; Planck constant: 6.62607×10^{-34} J.s; Bohr magneton: 9.274×10^{-24} J.T^{-1} 5 Marks

12 Draw the molecular orbital diagram for the given hypothetical molecules and comment on its bond order and magnetic property: a) BO b) MgF   5 Marks

13 a) Define BOD   1+1+1+1+1
    b) What is meant by caustic embrittlement and how it is prevented?   =
    c) Why sewage is warm in anaerobic condition?   5 Marks
    d) Define resonance energy.
    e) State the variation principle used in quantum mechanics.

14 a) What is the limitation (or drawback) of electron sea model of metallic   1+1+1+1 =
       bond?   4 Marks
    b) What is meant by semi synthetic polymer? Give one example.
    c) Why base of some iron boxes are made with Teflon?
    d) Why thermal behaviour of polymer is discussed using T_g mainly.

15 a) Describe the principle involved in Winkler's method of estimation of   3+2=
       dissolved oxygen content of water.   5 Marks
    b) Compare soap titration method with EDTA method of determination of
       hardness of water by at least four points.

16 a) State and explain Fajan's rules.   2+2+2 =
    b) Write the rules which are used in predicting the proper resonating 6 Marks
       structures of molecule or ion or radical.
    c) Justify that density of ice is less than that of liquid water.

17 a) Justify that hybrid orbitals have higher energy but hybrid orbital bonded 1+2+4=
       molecule has lower energy and higher stability.   7 Marks
    b) Write the salient features of hybridisation.
    c) Write the mechanism of Ziegler – Natta Catalysis using ring
       intermediate?

18 a) Calculate number average and weight average molecular weight of a   3+2=
       poly dispersed polymer composed of the following mixture of fractions 5 Marks
       (mass % and molecular weight of each of the fractions are given):

Mass %	10	30	60
Mol. Weight	10000	100000	200000

    b) 20 ml of sewage water sample for COD is reacted with 25 ml of $K_2Cr_2O_7$
       solution and the unreacted $K_2Cr_2O_7$ requires 10.3 ml of 0.231 N FAS
       solution. Under similar conditions, in blank titration 14.7 ml of that FAS
       is used up. Calculate the COD of the sample.

19 Draw and explain the d-orbital splittings for trigonal planar geometry, 6 Marks
    square pyramidal geometry and square antiprism geometry.

20 Deduce and explain the geometries of IF_5, IF_7, and ClF_3 molecules.   7 Marks

****ALL THE BEST****