**Roll No: ----------**

# UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

**End Semester Examination – December, 2015**

**Program/course: B.Tech.** (CS-HealthCare; CS- Security & Cyber Forensic; CS-Manufacturing; CS-BAO; CS-BFSI; CS-E Com; CS-Game & Graphics; CS-IT Infra; PIE; ICE; Mechanical; Mechatronics; Mining; GSE, GIE, PSE; IFE, Electrical; Electronics)

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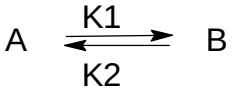
|---|---|
| **Subject: CHEMISTRY** | **Semester– I$^{st}$** |
| **Code : CHEM-107** | **Max. Marks : 100** |
| **No. of page/s: 3** | **Duration : 3 Hrs** |

**Instructions-**

1) **Mention Roll No. at the top of the question paper**
2) **Attempt all the parts of a question at one place**

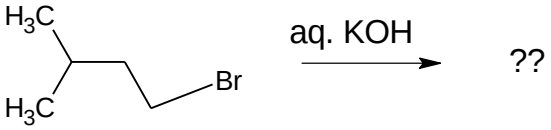
**SECTION-A (Attempt all the questions) (6 x 10= 60 Marks)**

1. (a) Explain a suitable polymerization technique that you will suggest for polymerization of water insoluble monomer.
   (b) Calculate the value of rate constant ($K_1$) for the following reaction, if initial concentration of A = a.




**(5+5)**

2. (a) Give the mechanism of following reaction with stereochemistry-



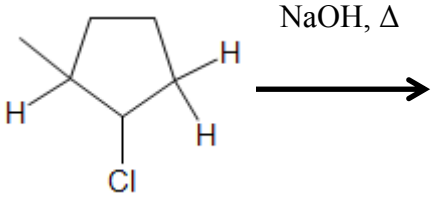

   (b) Write step 1 of the mechanism (generation of electrophile) for nitration, halogenation and sulphonation of benzene with proper reagents used and species formed. **(5+5)**

3. (a) For a given reaction A→B→C, what will be the amount of B left after time t?
   (b) Complete the following skeletal reaction with reagent required and names it: $CH_3COCH_3$ → $CH_3CH_2CH_3$; Apply the reaction for preparing n-butyl benzene from benzene. **(5+5)**

4. (a) W g. benzene was completely burnt in tube furnace using excess amount of dry oxygen and exhaust gas was allowed to absorb in excess amount of conc. KOH solution. After the experiment an increment of 2.0 g was observed in weight of KOH solution. Calculate weight of benzene that was subjected to combustion.
   (b) What is the potential of zinc half-cell constructed by dipping metallic zinc wire in 0.10 M $ZnCl_2$ solution at 25°C, provided standard reduction potential of zinc is -0.76V. Concentration of employed $ZnCl_2$ solution drops to 0.09 M after few days as this salt is hygroscopic in nature. Calculate the modified value of EMF and suggest whether $ZnCl_2$ is suitable salt for cell construction. **(5+5)**
5. (a) Explain:
   (i) Corrosion is a spontaneous process.
   (ii) Two different ways of coating a surface to protect it from corrosion.
   (b) One gram of polymer sample contains a mixture of three polymers having molecular weights of 2500; 8000; and 13,000 g/mol in a ratio of 0.25:0.25:0.50. Find out the Mn and Mw of the sample. **(5+5)**
6. (a) Write a short note of synthetic petrol.
   (b) Write short notes on tacticity of polymers and vulcanization. **(5+5)**

**SECTION-B (Attempt any two questions) (2 x 20= 40 Marks)**

7. (a) Explain the following: (i) Iron nails undergo corrosion at the portion inside the wall and (ii) Grills in the windows always corrode at the joints.
   (b) For the reaction: $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$; the value of K at 552 $^0$C is 0.137. If 5 moles of $CO_2$, 5 moles of $H_2$, 1 mole of CO and 1 mole of $H_2O$ are initially present, what are the actual concentrations of all reactants and products at equilibrium?
   (c) Discuss the product formation in the following compound with reasoning.




**(6+7+7)**

8. (a) In Bragg's reflection of x-ray, a reflection was found at $30^0$ with lattice plane of spacing 18.7 nm. If this is second order reflection, calculate the wavelength of the source.
   (b) Explain the synthesis of nanoparticles by microemulsion technique.
   (c) 0.8 g sample of benzene is combusted in bomb calorimeter. The heat of formation of benzene, water and carbon dioxide are +11.72 KCal, -68.32 Kcal/mole and -94.05 Kcal/mole respectively at 25 $^o$C. Calculate gross and net calorific value of benzene. **(6+6+8)**

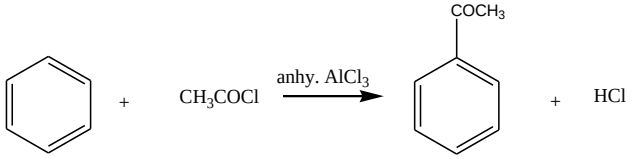
9. a) Derive a rate law expression for second order reaction of following type-

2A→Product

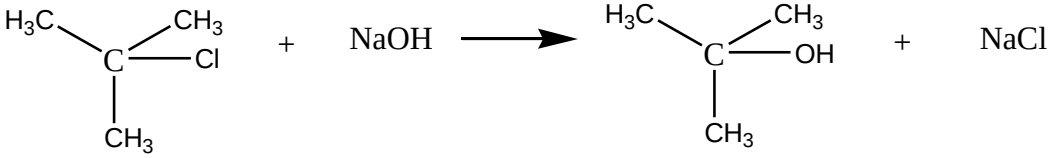
(b) A dilute solution of copper sulfate was electrolyzed between Pt electrodes. The amount of copper in the anodic solution was found to be 0.6350 g and 0.6236 g before and after electrolysis respectively. The weight of silver deposited in Ag-Coulometer, placed in series, was found to be 0.1351 g. Calculate transport number of copper and sulfate ions?

(c) Identify the type of following reactions and mention the type of mechanism (electrophilic/ nucleophilic).

a. $CH_3CH = CH_2 \quad + \quad Br_2 \xrightarrow{ccl_4} CH_3CHBr - CH_2Br$

b. 


c. $CH_3CHO \quad + \quad HCN \rightarrow CH_3CH(OH)CN$

d. 


**(6+6+8)**

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1) **Mention Roll No. at the top of the question paper**
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**SECTION-A (Attempt all the questions) (6 x 10= 60 Marks)**

1. (a) A polymer is obtained in the form of beads/pearls. Explain the technique, which according to you has been used for synthesis of the polymer.
   (b) Discuss any two methods of termination of growing chain in polymers. **(6+4)**
2. (a) Calculate $[B]_{max}$ for the following consecutive reaction, A→B→C having rate constants $K_1$ and $K_2$ respectively.
   (b) 2-Chloro-3-methyl butane reacts with sodium iodide in acetone to give a product. Explain the mechanism with stereochemistry. **(5+5)**
3. (a) Complete the following reaction with stereo chemistry-

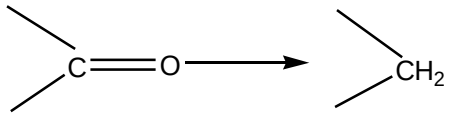

   (b) The value of Kp at 25 $^0$C for the reaction 2NO (g) +$Cl_2$ (g) ⇌ 2NOCl (g); is 1.9 × $10^3$ atm$^{-1}$. Calculate the value of Kc at the same temperature. **(5+5)**
4. (a) An unknown amount of D-glucose was completely burnt in tube furnace using excess amount of dry oxygen and exhaust gas was allowed to absorb in dry $CaCl_2$. After the experiment an increment of 2.0 g was observed in weight of dry $CaCl_2$. Calculate weight of D-glucose that was burnt.

(b) Calculate the electrode potential of the copper plate dipped in 0.1 M $Cu(NO_3)_2$ solution at standard temperature conditions provided standard reduction potential of copper is +0.34V. Will there be any change in the electrode potential if 0.1 M Cu $(NO_3)_2$ solution is replaced with 0.1 M $CuSO_4$ solution in the given half-cell. Explain. **(5+5)**

5. (a) A First order reflection for $d_{110} \rightarrow d_{110}$ plane, was occurred at 20.7°. If the Cu $K_\alpha$ radiation having $\lambda$ = 1.54 Å was the source of XRD, find out the inter-planner distance of $d_{110}$ plane.
   (b) Define the terms-
   (i) Standard enthalpy of vaporization and (ii) Standard enthalpy of combustion. **(5+5)**
6. (a) Explain:
   (i) Corrosion is a spontaneous process.
   (ii) Two different ways of coating a surface to protect it from corrosion.
   (b) Discuss the following-
   (i) Bolts and nuts are not made up of different metals.
   (ii) Chlorine environment leads to tremendous loss of articles made of tin, but not in case of silver. **(5+5)**

**<u>SECTION-B</u> (Attempt any two questions) (2 x 20= 40 Marks)**

7. (a) Complete the following skeletal reaction with reagent required and names it:



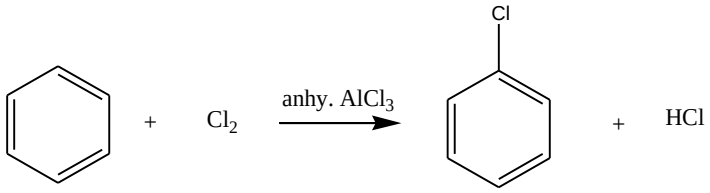

Apply above reaction for conversion of benzene to n-pentyl benzene.

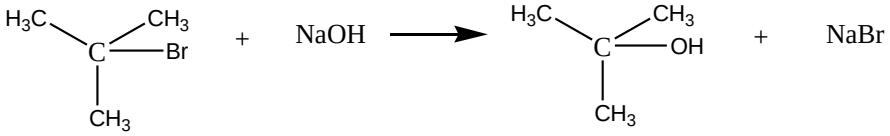
(b) Discuss the addition of alcohol on acetone in the presence of acid and base.
(c) In a second order reaction, the initial concentration of reactant is 0.1 mol/lit. The reaction was found to be 20% completed in 40 minutes. Calculate the rate constant, half-life and time required to complete 75% of the reaction? **(7+ 6+7)**

8. (a) In the electrolysis of copper sulfate between copper electrodes the total mass of copper deposited at the cathode was 0.153 g and the masses of copper per unit volume of the anodic liquid before and after electrolysis were 0.79 g and 0.91 g respectively. Calculate transport numbers of copper and sulfate ions?
   (b) 0.75 g of benzoic acid was burn in presence of oxygen in a bomb calorimeter and the gross calorific value was found to be 7205 cal/g. Calculate its enthalpy of formation if enthalpy of formation of water and carbon dioxide are -68.32 Kcal/mole and -94.05 Kcal/mole respectively at 25 °C.

(c) Identify the type of following reactions and mention the type of mechanism (electrophilic/ nucleophilic)

$$CH_3CH = CHCH_3 \quad + \quad Br_2 \xrightarrow{CCl_4} CH_3CHBr - CHBrCH_3$$




$$CH_2O \quad + \quad HCN \quad \rightarrow CH_2(OH)CN$$

**(6+ 6+8)**

9. (a) Explain different types of molecular weights of polymers. A sample contains equimolar amounts of polymer with molecular weights of 4500; 9000 and 13500 g/mol. Find out Mn and Mw of the sample.

(b) Discuss the effect of following on corrosion:

(i) Potential difference between two metals coupled.

(ii) Relative area of anode and cathode.

(c) Discuss how the following properties are changed when particle size is reduced from 1 micrometer to 1 nm.

(i) Optical property

(ii) Surface energy **(6+7+7)**