

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

FIRST YEAR [2017-20]

B.A. /B.Sc. SECOND SEMESTER (January – June) 2018

Mid-Semester Examination, March 2018

INDUSTRIAL CHEMISTRY (Honours)

Date : 14/03/2018

Time : 11am – 1pm

Paper: II

Full Marks: 50

(Use a separate Answer Book for each group)

Group A

(20 marks)

Answer **any four** questions of the following:

[4 × 5]

1. a) Define standard electrode potential and formal potential of a redox couple.
b) Calculate the standard EMF of a cell (E_{cell}^0) for the reaction: $\text{Cu} + 2\text{Ag}^+ = \text{Cu}^{2+} + 2\text{Ag}$
 $\left[E_{\text{Cu}^{2+}/\text{Cu}}^0 = +0.34 \text{ V}; E_{\text{Ag}^+/\text{Ag}}^0 = +0.80 \text{ V at } 25^\circ \text{C} \right]$; Calculate the standard free energy change (ΔG^0) of the above cell reaction using the calculated E_{cell}^0 . ($F = 96,500 \text{ C}$). (2 + 3)
2. a) State the characteristic features of 'Hard Acids' and 'Hard Bases' with suitable examples.
b) Predict the direction of the following equilibria with explanation:
i) $\text{BF}_3\text{H}^- + \text{BF}_3\text{F}^- \rightleftharpoons \text{BF}_4^- + \text{BH}_4^-$
ii) $2\text{CH}_3\text{MgF} + \text{HgF}_2 \rightleftharpoons (\text{CH}_3)_2\text{Hg} + 2 \text{MgF}_2$ (3 + 2)
3. a) Balance the following reaction by ion-electron method in both acidic and basic medium:
 $\text{ClO}_4^- \rightarrow \text{Cl}^-$
b) Give the order of acid strength of the following compounds with proper explanation: H_3PO_4 , H_3PO_3 , H_3PO_2 .
c) PhCOOH is weak acid in water but strong acid in liquid NH_3 - justify or criticise. (1 + 2 + 2)
4. a) Which among the following bidentate ligands would be expected to give hexaco – ordinated non – electrolytic complex? $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$, $\text{HOOC}-\text{COOH}$, $\text{H}_3\text{C}-\text{CO}-\text{CH}_2-\text{CO}-\text{CH}_3$ in which class they belong to? (2 + 1)
b) Write the IUPAC name with formula of your suggested complexes. (2)
5. a) The compound $\text{Co}(\text{en})_2(\text{NO}_2)_2\text{Cl}$ (en = ethylene diamine) has been prepared in a number of isomeric forms. One form undergoes no reaction with either silver nitrate or ethylene diamine. A second form reacts with silver nitrate but not with ethylene diamine. A third form reacts with both silver nitrate and ethylene diamine. Identify each of the three forms by their IUPAC names and discuss the above reactions in the light of Werner's theory. (5)
6. a) Write the formula of sodium tetrahydridoborate (III) and bis – $\{\mu - \text{hydroxidotetraaminecobalt(III)}\}$. (2)
b) Draw the possible geometrical isomers of $[\text{Co}(\text{en})(\text{NH}_3)_2\text{BrCl}]^+$ and hence predict which of them would be optically active. (3)

Group B

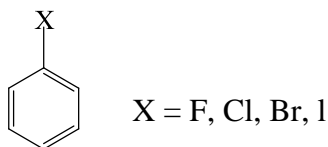
(15 marks)

Answer **any three** questions of the following:

[3 × 5]

7. Explain the relative rate of aromatic electrophilic and nucleophilic substitution of the following halobenzenes.

(2.5 × 2)

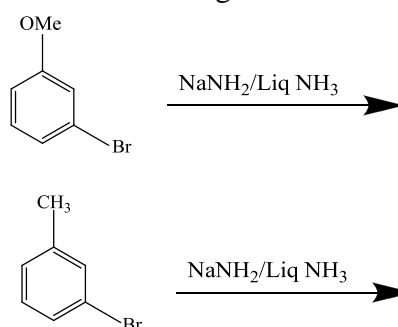


8. a) Comment on the structure of benzyne.

(2)

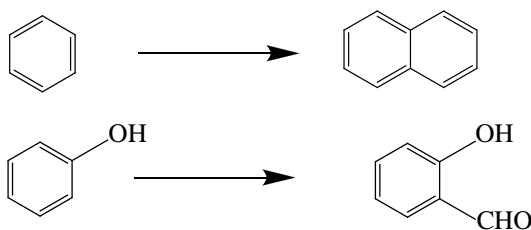
- b) Write the major product of the following reaction with proper explanation.

(3)



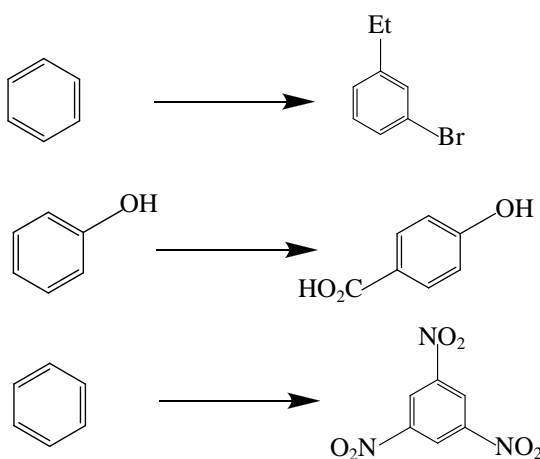
9. Carry out the following conversions with detailed mechanism.

(2.5 × 2)



10. How do you carry out the following transformations?

(2 + 1 + 2)



11. a) Write the disadvantages of Friedel – Crafts alkylation?

- b) Write the difference between aromatic and aliphatic bimolecular substitution reaction.

- c) Why nitrobenzene used as a solvent in Friedel – Crafts reaction?

(2 + 1.5 + 1.5)

Group C

(15 marks)

Answer **any three** questions of the following:

[3 × 5]

12. a) Explain why the variation of molar conductivity on dilution of a strong electrolyte differ from that of a weak electrolyte. Sketch a diagram indicating the typical variation of molar conductivities for these two types of electrolytes upon dilution. (2 + 1)
- b) The reaction ($A + B \rightarrow \text{Product}$) is first order with respect to A and zero order with respect to B. Write down its differential rate law and deduce the integrated rate law. (2)
13. a) What is equivalent conductance of an electrolyte? Express equivalent conductance in terms of conductivity. (2)
- b) The specific conductance of 0.01 N KCl solution is $1.41 \times 10^{-3} \text{ S cm}^{-1}$ at 25°C . When a conductivity cell was filled with 0.01 N KCL, it offered a resistance of 484 ohms at 25°C . The same cell was filled with 0.001 N solution of NaCl at the same temperature, which gave a resistance of 5194 ohm. Calculate the equivalent conductance of 0.001N NaCl solution. (3)
14. a) Distinguish between order and molecularity of a reaction. (1)
- b) Following Michaelis- Menten mechanism of enzyme catalyst, show that enzyme reaction is first order and zero order with respect to substrate at low and high concentration of substrate, respectively. (4)
15. a) A catalyst does not change the position of the equilibrium. Justify or criticize. (1)
- b) State the significance of Lineweaver – Burk plot in enzyme catalysis. (2)
- c) A sea creature Daphnia performs a constant heartbeats and then dies. It lives twice as long at 15°C than at 25° . Calculate the activation energy for the reaction that controls the rate of its heartbeat. (2)
16. a) Define the term half – life. Show that for a first order reaction, half – life is independent of initial concentration of the reactant. (1 + 2)
- b) In the thermal decomposition of a gaseous substance, the time taken for the decomposition of half of the reactants was 105 minutes when the initial pressure was 750 mm and 950 minutes when the initial pressure was 250 mm. Find the order of the reaction. (2)

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