'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 2nd Semester Examination, 2023

GE1-P2-CHEMISTRY

NEW AND OLD SYLLABUS

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.

Use Separate Answer Scripts for each Section

SECTION-A (Marks: 22)

PHYSICAL CHEMISTRY

GROUP-A

1. Answer any ***two*** questions from the following: 1×2 = 2

   (a) What will be the mathematical form of the first Law of thermodynamics for adiabatic process?

   (b) Under what condition pK_a is equal to pH of a solution?

   (c) Write down the relation for K_p for the reaction:

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

GROUP-B

2. Answer any ***two*** questions from the following: 5×2 = 10

   (a) (i) State and explain Le-Chatelier's principle. $2\frac{1}{2}$

   (ii) Explain enthalpy of neutralization of strong acids vs strong bases. $2\frac{1}{2}$

   (b) (i) What are the conditions under which Q (heat) and W (work) become state functions? Discuss briefly. 2

   (ii) Derive the relationship between K_p, K_c and K_x. 3

   (c) (i) Prove that Joule-Thomson expansion is an iso-enthalpic process. 3

   (ii) Convert the equation:

   $C_p - C_v = nR$ for one mole of ideal gas. 1

   (iii) What do you mean by dynamic nature of chemical equilibrium? 1

GROUP-C

3. Answer any ***one*** question from the following: 10×1 = 10

(a) (i) What is meant by the efficiency of a heat engine? Derive the expression for the efficiency of a reversible Carnot engine working between two temperatures T_2 and T_1 $(T_2 > T_1)$. 1+3

(ii) Write down the thermochemical equation for the formation of liquid water from hydrogen and oxygen. 1

(iii) Derive the expression for pH due to hydrolysis of a salt of strong acid and weak base. 3

(iv) Why salt of strong acid and strong base does not undergo hydrolysis? 2

(b) (i) Derive the relation $T_1V_1^{\nu-1} = T_2V_2^{\nu-1}$, mentioning the assumptions used for the derivation. 3

(ii) Derive the relation between solubility and solubility product of a sparingly soluble salt. What is solubility product principle? 3+1

(iii) Given following thermochemical equations: 2

$S\ (rhombic) + O_2(g) \longrightarrow SO_2(g) \quad \Delta H = -297.5\ kJ$

$S\ (monoclinic) + O_2(g) \longrightarrow SO_2(g) \quad \Delta H = -300.0\ kJ$

Calculate ΔH for the process:

$S\ (rhombic) \longrightarrow S\ (monoclinic)$

(iv) What is the S. I. unit of entropy change? 1

SECTION-B (Marks: 18)

ORGANIC CHEMISTRY

GROUP-A

4. Answer any ***three*** questions from the following: 1×3 = 3

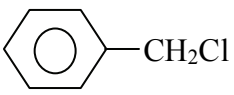
(a) *n*-butyl benzene on reaction with acidic $KMnO_4$ gives:

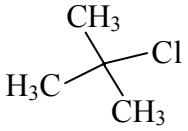
(i) Phthalic acid (ii) Benzoic acid (iii) Phenol (iv) Benzaldehyde

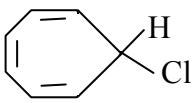
(b) Upon heating phenol with zinc dust which of the following compound is formed?

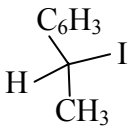
(i) Naphthalene (ii) Benzene (iii) Cumene (iv) Cresol

(c) Which of the following will exhibit S_N2 mechanism exclusively?

(i) 

(ii) 

(iii) 

(iv) 

(d) Over acylation is not observed in Friedel Crafts reaction because of

(i) deactivation through – *R* effect (ii) activation through + *R* effect

(iii) steric effect (iv) all of these

(e) Which of the following compound is more acidic?

(i) Phenol (ii) Ortho-Nitrophenol

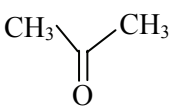
(iii) Meta Nitrophenol (iv) Para Nitrophenol

GROUP-B

5. Answer any ***one*** question from the following: 5×1 = 5

(a) (i) Explain the limitations of Friedel Crafts Reaction. 2

(ii) How do you distinguish following compounds by chemical test? 2



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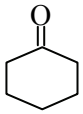


(iii) Write down the name and formula of an ambident Nucleophile. 1

(b) (i) Methyl chloride is inert to substitution by S_N1 mechanism. Explain. 2

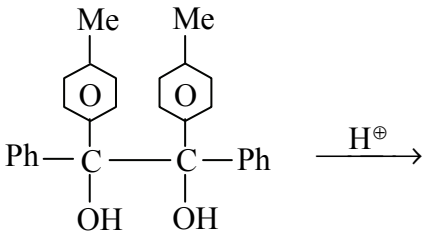
(ii) Discuss the mechanism involved in the following reaction of benzaldehyde with aq. ethanolic KCN under refluxing condition. 2

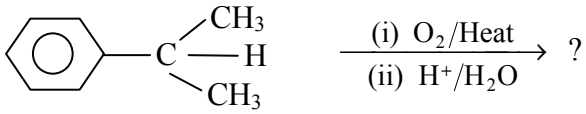
(iii) What reagents are used in Reimer-Tiemann's reaction? 1

GROUP-C

6. Answer any ***one*** question from the following: 10×1 = 10

(a) (i) Predict the products with suitable mechanism: 2×2 = 4





(ii) Nitration of benzene takes place more readily than nitrobenzene. Justify. 2

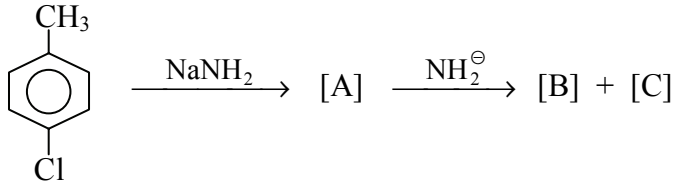
(iii) Outline the preparation of secondary alcohol by using Grignard Reagent. 2

(iv) Write one reaction in which alkaline $KMnO_4$ is used. 1

(v) Convert Cyclohexanol into Cyclohexanone. 1

(b) (i) Convert Isopropanol to *n*-propanol. 2

(ii) Predict the products $[A \rightarrow C]$: 3



(iii) What is intramolecular Cannizzaro reaction? Give example. 2

(iv) Explain why trimethylacetaldehyde does not give aldol condensation? 1

(v) Define esterification with example. 2

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