'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 2nd Semester Examination, 2022

GE1-P2-CHEMISTRY

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
All symbols are of usual significance.

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) Write an example of a reaction for which $K_p = K_c$.

   (b) Among the quantities which one is state function?

   Q , W , Q_{rev}/T

   (c) Mention the thermodynamic processes when (i) $Q = 0$ and (ii) T = constant.

GROUP-B

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

   (a) (i) State and explain Hess's law of constant heat summation. Mention one application of this law. (2+1)+2

   (ii) Explain common ion effect with suitable example.

   (b) (i) Distinguish between chemical equilibrium and thermodynamic equilibrium. 2+3

   (ii) Derive Kirchhoff's equation.

   (c) (i) State the second and third law of thermodynamics. 2+3

   (ii) Derive thermodynamically the relationship between C_P and C_V for n mole of ideal gas.

GROUP-C

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

   (a) (i) Derive the relation PV^{γ} = constant, mentioning the assumption for the derivation. 3+2+3+2

   (ii) Draw the indicator diagram for a reversible Carnot cycle mentioning the processes.

(iii) A Carnot engine working between 0° C and 100° C takes up 840 J from the high temperature reservoir. Calculate the work done, heat rejected and the efficiency of the engine.

(iv) Define with example 'Buffer solution' and 'Buffer capacity'.

(b) (i) Derive the equation for pH due to hydrolysis of a salt of weak acid and strong base. 4+2+2+2

(ii) Discuss the effect of pressure and temperature on the following reaction:

$$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightleftharpoons NH_3(g) \; ; \; \Delta H = -ve$$

(iii) Define 'entropy of a system' and 'inversion temperature'.

(iv) Find out the relation between K_p s for the following reactions:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

and

$$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightleftharpoons NH_3(g)$$

SECTION-B

Marks: 18

ORGANIC CHEMISTRY

GROUP-A

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

(a) $AlCl_3$ is used in the generation of

(i) Nucleophile (ii) Electrophile (iii) Carbanion (iv) Free radical

(b) Which of the following will give nucleophilic substitution by S_N1 mechanism

(i) CH_3Cl (ii) C_6H_5Cl

(iii) $CH_2 = CH - Cl$ (iv) $CH_3 - CH = CH - Cl$

(c) The migratory order of alkyl or aryl group to intermediate carbocation in pinacol pinacolone rearrangement is

(i) *p*-anisyl > *p*-tolyl > phenyl > R (ii) R > phenyl > *p*-anisyl > *p*-tolyl

(iii) *p*-tolyl > phenyl > *p*-anisyl > R (iv) phenyl > R > *p*-tolyl > *p*-anisyl

(d) α, β-unsaturated carbonyl compound can be obtained by

(i) Aldol condensation (ii) Cannizzaro reaction

(iii) Iodoform reaction (iv) Benzoin condensation

(e) When phenol is treated with neutral $FeCl_3$, it has

(i) Yellow colour (ii) Violet colour (iii) Red colour (iv) None of these

GROUP-B

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

(a) (i) Nitrobenzene or Benzoic acid does not undergo Friedel Crafts reaction. — Why? 2+2+1

(ii) How would you prepare in good yield from Benzene to Ethyl benzene without using Friedel Crafts alkylation reaction?

(iii) Trimethyl acetaldehyde undergoes Cannizzaro reaction but acetaldehyde does not. — Explain.

(b) (i) Tertiary alkyl halides are practically inert to substitution by S_N2 mechanism. Account for the observation. 2+2+1

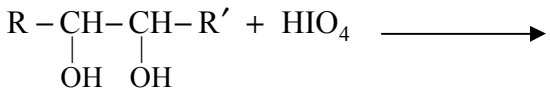
(ii) How will you distinguish 1°, 2° and 3° alcohol by Lucas test?

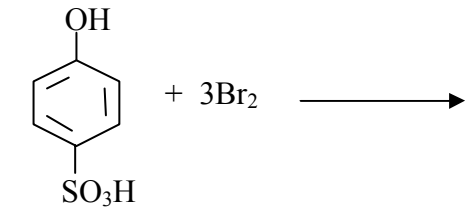
(iii) What is ambident nucleophile? Give example.

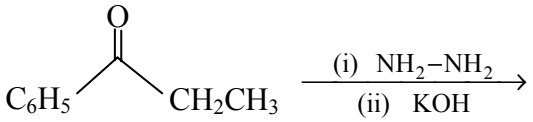
GROUP-C

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

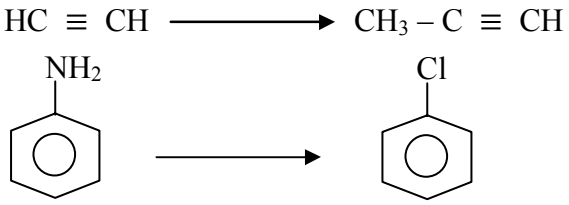
(a) (i) Predict product(s) from the following reactions: (1+1+1)+(2+2)+3







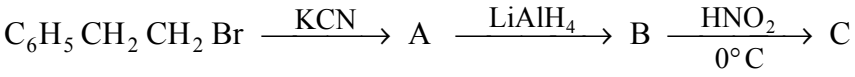
(ii) Convert the following:



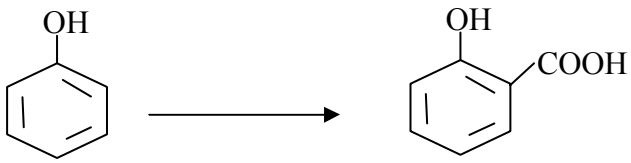
(iii) Discuss Pinacol-Pinacolone rearrangement with mechanism of the reaction.

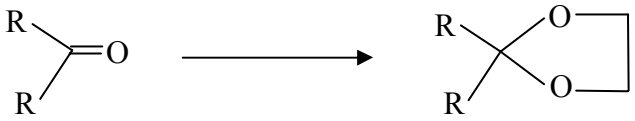
(b) (i) Discuss the ionic mechanism of nitration of benzene with conc. HNO_3 and conc. H_2SO_4. What is the role of conc. H_2SO_4? *o*-nitrophenol is less soluble in water than *p*-nitrophenol. — Why? (3+1)+3+2+1

(ii) Identify the products:



(iii) Identify the reagents for the following conversions:





(iv) What is Schotten-Baumann Reaction?

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