

**Instructions:** 1) Answers to the two sections should be written on separate books.

2) All questions are compulsory

3) Use of scientific calculator is permitted

4) Figures to the right indicate full marks

### Section A: Physical Chemistry

40 Marks

**Q1. Answer any five of the following:**

(2x5=10)

- Distinguish between state function and path function and give examples in each case.
- Change in free energy can be used as a criterion of spontaneity of a process. Explain.
- Following are the acids and their respective dissociation constants, arrange them in the increasing order of their acidic strength.

a) HCN ( $4.9 \times 10^{-10}$ ) b) Acetic acid ( $1.74 \times 10^{-5}$ )

b)  $\text{HNO}_2$  ( $4.5 \times 10^{-4}$ ) d) Formic acid ( $1.8 \times 10^{-4}$ )

- Define heat Capacity and Give the expressions for heat capacity at constant volume and at constant pressure.

- What is equilibrium constant? Write the equilibrium constant for the following reaction



- Define Buffer Capacity and Buffer Index.

- State any two applications of solubility product.

**Q.2. A i)** Obtain an expression of hydrolysis constant and degree of hydrolysis for the salt of weak acid and strong base. (4)

ii) Calculate the pH of a 0.05M NaOH solution, also find the concentration of  $\text{H}^+$  ions. (3)

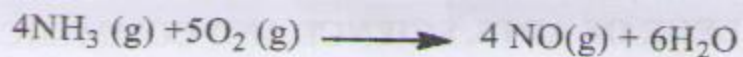
OR

**Q.2.A iii)** Obtain an expression of hydrolysis constant and degree of hydrolysis for the salt of strong acid and weak base. (4)

iv) Calculate the pH of buffer solution consisting of 0.10 M  $\text{CH}_3\text{COOH}$  and 0.25 M  $\text{CH}_3\text{COONa}$ . ( $K_a$  for  $\text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$  M). (3)

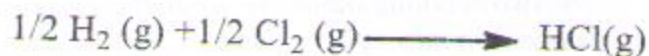
**Q2 B i)** Chemical Equilibrium is static or dynamic Nature? Justify your answer. (4)

ii) Calculate the standard free energy change in KJ for the reaction and comment on its feasibility (Spontaneity). (4)



$\Delta G^\circ_f$  for  $\text{NH}_3(\text{g})$ ,  $4\text{NO}(\text{g})$ ,  $6\text{H}_2\text{O}$  are -16.74, 86.61 and -237 KJ respectively.

**Q3A i)** Calculate the heat of Formation of HCl at 348K from the following data: (4)



Given  $\Delta H^\circ = -923900 \text{ J at } 298\text{K}$

Heat Capacities over this temperature range are as follows:

$\text{H}_2(\text{g}) C_p = 28.53 \text{ J/K/mol}$

$\text{Cl}_2(\text{g}) C_p = 32.26 \text{ J/K/mol}$

$\text{HCl}(\text{g}) C_p = 28.49 \text{ J/K/mol}$

ii) State First, Second and Third Law of Thermodynamics. (3)

OR

**Q3A iii)** Calculate the enthalpy change for the following reaction. (4)



Given the bond energies of H-H, Br-Br and H-Br are 335, 172 and 292 KJmol<sup>-1</sup> respectively.

iv) Differentiate between open, closed, and isolated system. (3)

**Q3B i)** As per Le Chatelier's principle explain the effect of change in concentration and catalyst on chemical equilibrium. (4)

ii) Explain the Buffer action of an acidic Buffer on addition of Acid and Base. (4)

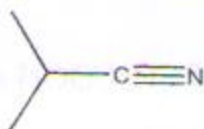
### Section B: Organic Chemistry

40 Marks

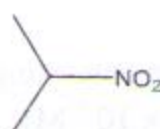
**Q.4.** Answer any five questions of the following. (2 x 5 = 10)

i. What happens when acetylene (3moles) is heated in a red-hot tube? Write the complete reaction.

ii. Using a suitable alkyl halide, mention the steps involved in the preparation of the following compounds.



compound A



compound B

iii. Give any one method of

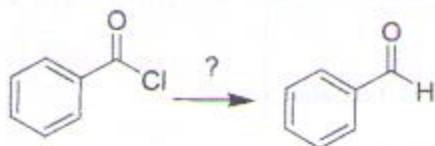
compound A

compound B

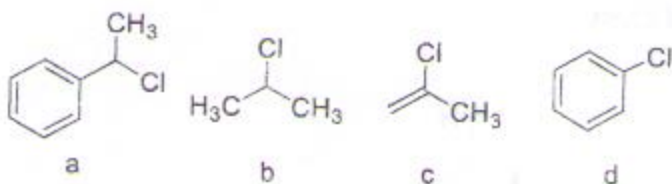
iii. Give any one method of preparation acetone.



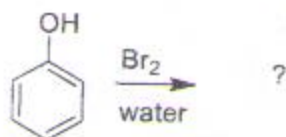
iv. Identify the missing reagent in the following transformation.



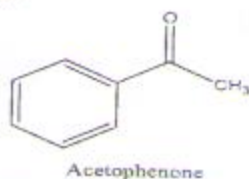
v. Arrange the following aryl/alkyl halides (a, b, c & d) in the increasing order of reactivity towards nucleophilic substitution reaction.



vi. Predict the product for the following:

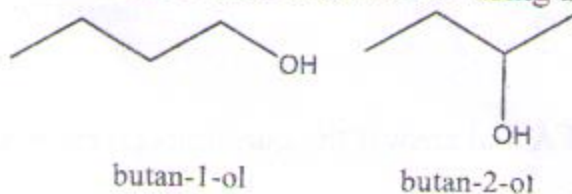


vii. Identify the name reaction involved in the preparation of acetophenone. Give the complete reaction.



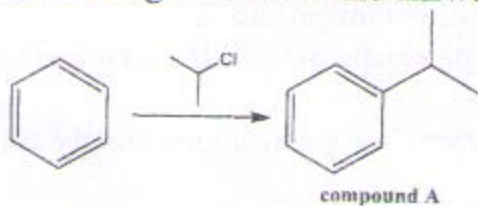
Q5A.i) Explain the reaction and the mechanism involved in the sulfonation of benzene. (4)

ii) Distinguish between butan-1-ol and butan-2-ol using a suitable chemical test? (3)



OR

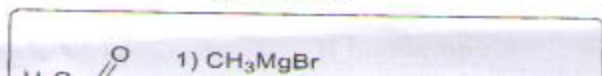
Q5A.iii) Consider the reaction given below and answer the following questions:



- Identify the name reaction involved in the formation of product A. (1)
  - What catalyst would be required to carry out the above reaction. (1)
  - Will product A undergo oxidation with  $\text{KMnO}_4$ . Write the complete reaction. (2)
- = (4)

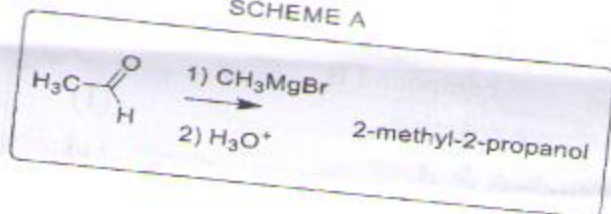
iv) a) Which among the following scheme is incorrect for the preparation of 2-methyl-2-propanol? Justify your answer. (1½)

SCHEME A

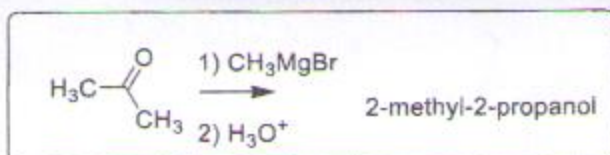


- iv) a) Which among the following scheme is incorrect for the preparation of 2-methyl-2-propanol? Justify your answer. (1) = (4) (2) (1½)

SCHEME A



SCHEME B



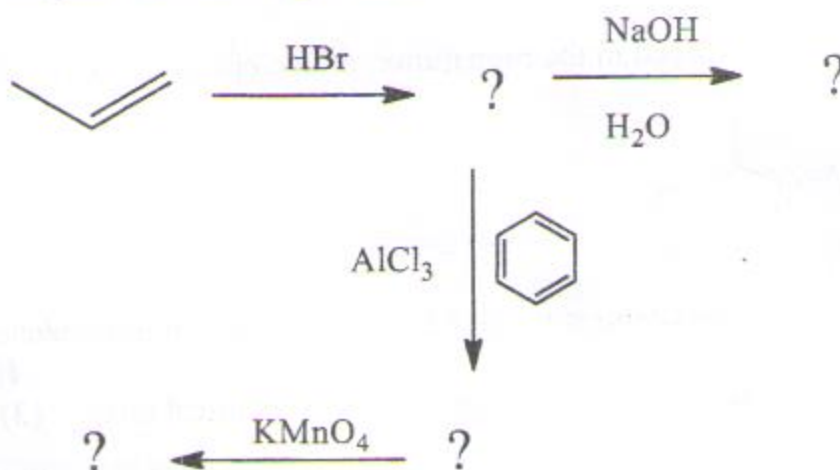
b) Complete the reaction given below:

(1½)

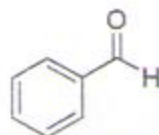


Q5B.i) Complete the following scheme:

(4)



ii) Consider the following **compound A** and answer the questions given below.



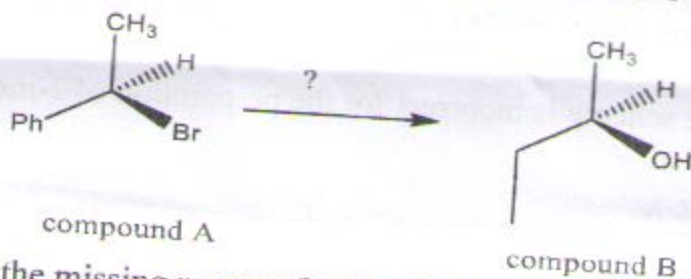
**Compound A**

- |   |      |   |       |
|---|------|---|-------|
| a) Name compound A.   | (½)  | } | = (4) |
| b) Identify the functional group present in <b>compound A</b> .   | (1)  |   |       |
| c) Give the structure of the principal product expected from <b>compound A</b> when reacted with $\text{NH}_2\text{OH}$ . | (1)  |   |       |
| d) Will <b>compound A</b> undergo Canizzarro's condensation? Justify your answer. (1½)                                    | (1½) |   |       |

Q.6.A. i) Consider the reaction below and answer the following questions



Q.6.A. i) Consider the reaction below and answer the following questions



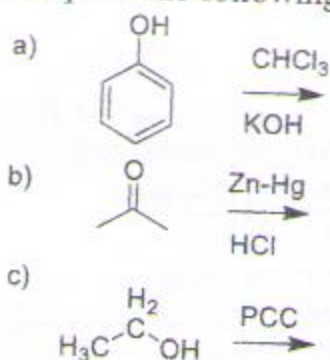
- Identify the missing reagent for the above reaction.
- Assign R/S configuration for compounds A & B.
- Does the reaction follow SN1 or SN2 mechanism pathway?
- What product is expected if AgCN is reacted with A?

(1)  
(1)  
(1)  
(1) } = (4)



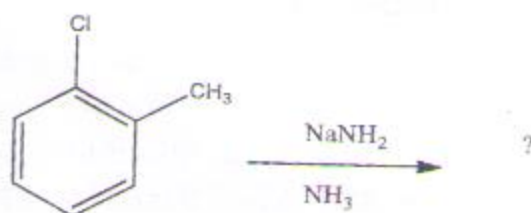
Q.6.A. ii) Complete the following

(3)



OR

Q6A.iii) Predict the product and explain the mechanism involved in the following reaction. (4)

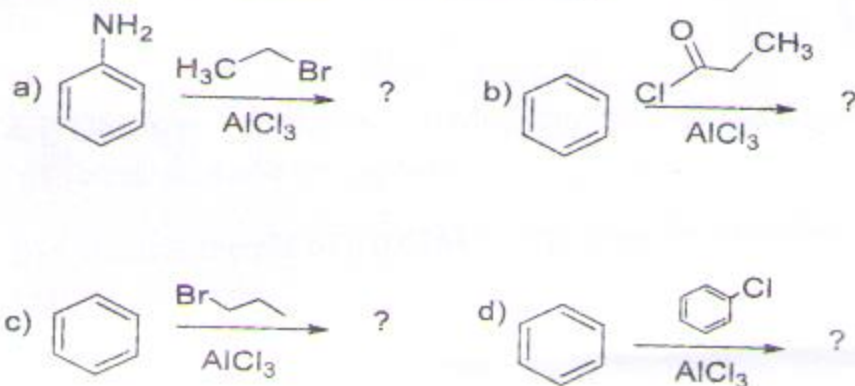


iv) Identify and mention the suitable reaction conditions for the following conversions.

- a) Phenol to picric acid (1½)  
 b) Acetone to propane (1½)

Q.6. B. i) Predict the product for the following:

(4)

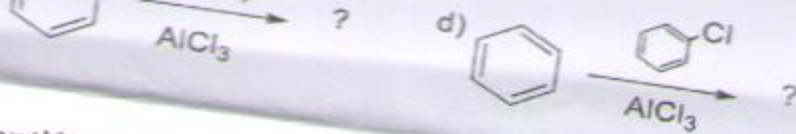


Q6B.ii) Identify the correct match from column A to column B.

(4)

Column A	Column B
1. Iodoform reaction	a) Only Acetic acid is formed
2. Aldol condensation	b) Deals with $\text{Ph}_3\text{P}=\text{CH}_2$
3. Cannizzaro's reaction	





Q6B.ii) Identify the correct match from column A to column B.

(4)

Column A	Column B
1. Iodoform reaction	a) Only Acetic acid is formed
2. Aldol condensation	b) Deals with $\text{Ph}_3\text{P}=\text{CH}_2$
3. Cannizarro's reaction	c) Given by Benzaldehyde
4. Wittig reaction	d) Forms the product 3-hydroxy butanal
	e) Presence Of Methyl Keto Group
	f) KCN is used as catalyst

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