

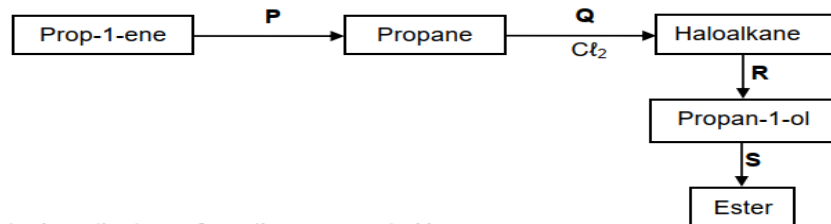


PHYSICAL SCIENCES

ORGANIC CHEMISTRY - ORGANIC REACTIONS

QUESTION 1

The flow diagram below shows the preparation of an ester using prop-1-ene as a starting reagent. P, Q, R and S represent different organic reactions.



1.1 Write down the type of reaction represented by:

- 1.1.1 Q (1)
1.1.2 R (1)

1.2 For reaction P write down the:

- 1.2.1 Type of addition reaction (1)
1.2.2 Balanced equation using structural formulae (3)

1.3 Write down the structural formula of the haloalkane formed in reaction Q. (2)

1.4 In reaction S propan-1-ol reacts with ethanoic acid to form the ester. For this reaction write down the:

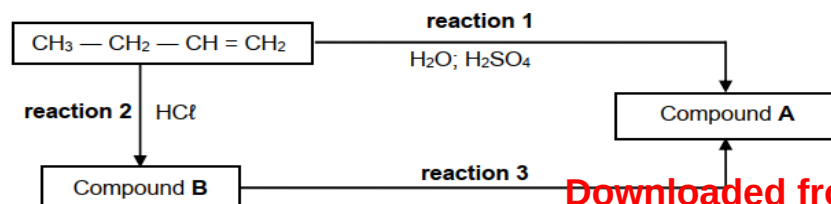
- 1.4.1 Name of the reaction that takes place (1)
1.4.2 FORMULA or NAME of the catalyst needed (1)
1.4.3 Structural formula of the ester formed (2)
1.4.4 IUPAC name of the ester formed (2)

1.5 The propan-1-ol formed in reaction R can be converted to prop-1-ene. Write down the FORMULA or NAME of the inorganic reagent needed. (1)

[15]

QUESTION 2

In the flow diagram below, but-1-ene is used as starting material in the preparation of compound A



2.1 Is but-1-ene a SATURATED or UNSATURATED compound? Give a reason for the answer. (2)

2.2 Compound A is the major product formed in reaction 1. Write down the:

- 2.2.1 Structural formula of compound A (2)
2.2.2 Type of reaction that takes place (1)

2.3 For compound B, write down the:

- 2.3.1 IUPAC name (2)
2.3.2 Structural formula of the positional isomer (2)

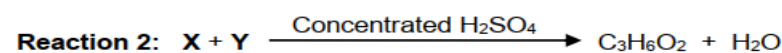
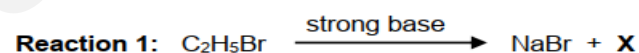
2.4 For reaction 3, write down:

- 2.4.1 TWO reaction conditions needed (2)
2.4.2 The type of reaction that occurs (1)
2.4.3 A balanced equation, using molecular formulae (3)

[15]

QUESTION 3

Consider the incomplete equations of two reactions below. X represents the organic product formed in reaction 1, which is a SUBSTITUTION REACTION. In reaction 2, X reacts with reactant Y as shown.



3.1 Consider reaction 1. Write down the:

- 3.1.1 Type of substitution reaction that takes place (1)
3.1.2 TWO reaction conditions (2)
3.1.3 IUPAC name of compound X (1)

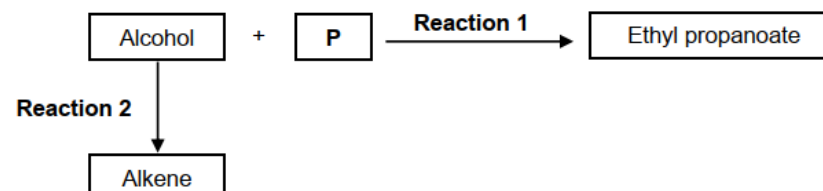
3.2 Consider reaction 2. Write down the:

- 3.2.1 Type of reaction that takes place (1)
3.2.2 Structural formula of compound Y (2)
3.2.3 IUPAC name of the organic product (2)

[9]

QUESTION 4

4.1 The flow diagram below shows two organic reactions. The letter P represents an organic compound.



Use the information in the flow diagram to answer the questions that follow.

Write down the:

4.1.1 Type of reaction of which Reaction 1 is an example (1)

4.1.2 STRUCTURAL FORMULA of the functional group of ethyl propanoate (1)

4.1.3 IUPAC name of compound P (1)

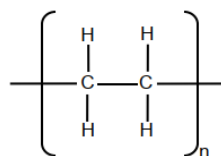
Reaction 2 takes place in the presence of an acid catalyst and heat. Write down the:

4.1.4 Type of reaction of which Reaction 2 is an example (1)

4.1.5 NAME or FORMULA of the acid catalyst (1)

4.1.6 STRUCTURAL FORMULA of the alkene (2)

4.2 The condensed formula of a polymer is shown below.



Write down the:

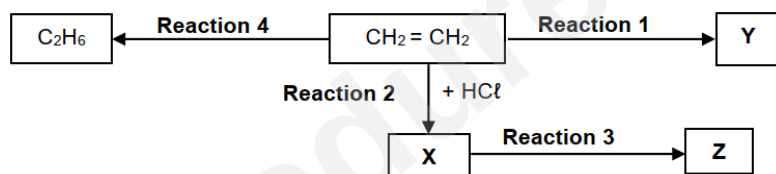
4.2.1 STRUCTURAL FORMULA of the monomer that is used to prepare the above polymer (2)

4.2.2 Type of polymerisation reaction (ADDITION or CONDENSATION) that is used to prepare this polymer (1)

[10]

QUESTION 5

The flow diagram below shows different organic reactions using $\text{CH}_2 = \text{CH}_2$ as the starting reactant. X, Y and Z represent different organic compounds.



5.1 During Reaction 1, $\text{CH}_2 = \text{CH}_2$ undergoes polymerisation to form compound Y. For this reaction, write down the:

5.1.1 Type of polymerisation (1)

5.1.2 NAME of compound Y (1)

5.2 For Reaction 2, write down the:

5.2.1 IUPAC name of compound X (2)

5.2.2 Type of addition reaction of which this is an example (1)

5.3 During Reaction 3, compound X reacts with excess hot water. Write down the:

5.3.1 STRUCTURAL FORMULA of compound Z (3)

5.3.2 NAME or FORMULA of the INORGANIC product (1)

5.4 Reaction 4 is an addition reaction.

5.4.1 Is C_2H_6 a SATURATED or an UNSATURATED compound? Give a reason for the answer. (2)

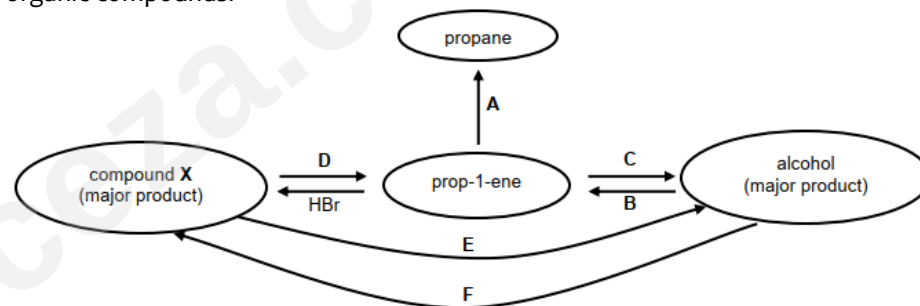
5.4.2 Write down the NAME or FORMULA of the INORGANIC reactant needed for this reaction. (1)

5.4.3 Using molecular formulae, write down a balanced equation for the complete combustion of C_2H_6 . (3)

[14]

QUESTION 6

The flow diagram below shows how prop-1-ene can be used to prepare other organic compounds.



6.1 Write down the type of reaction represented by:

6.1.1 A (1)

6.1.2 D (1)

6.1.3 F (1)

6.2 Write down the:

6.2.1 NAME or FORMULA of the catalyst needed for reaction A (1)

6.2.2 NAME or FORMULA of the inorganic reagent needed for reaction B (1)

6.2.3 Type of addition reaction represented by reaction C (1)

6.2.4 IUPAC name of compound X (2)

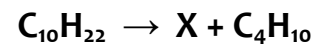
6.3 Use structural formulae to write down a balanced equation for reaction B. (5)

6.4 Both reactions D and E take place in the presence of a strong base. State TWO conditions that will favour reaction D over reaction E. (2)

[15]

QUESTION 7

Butane (C_4H_{10}) is produced in industry by the THERMAL cracking of long-chain hydrocarbon molecules, as shown in the equation below. X represents an organic compound that is produced.

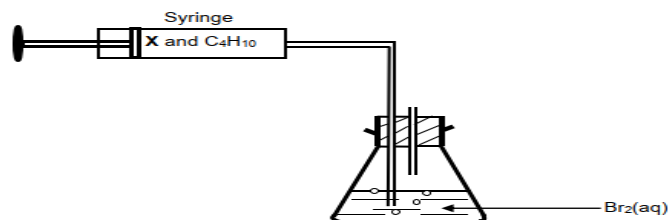


7.1 Write down:

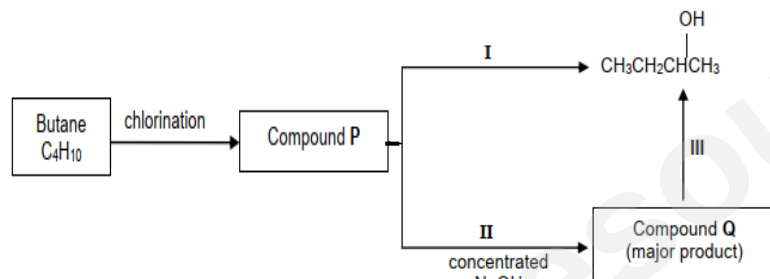
7.1.1 ONE condition required for THERMAL cracking to take place (1)

7.1.2 The molecular formula of compound X (1)

- 7.1.3 The homologous series to which compound X belongs (1)
 7.2 A mixture of the two gases, compound X and butane, is bubbled through bromine water, $\text{Br}_2(\text{aq})$, in a conical flask, as illustrated. THE REACTION IS CARRIED OUT IN A DARKENED ROOM.



- The colour of the bromine water changes from reddish brown to colourless when the mixture of the two gases is bubbled through it. Which ONE of the gases (X or BUTANE) decolorises the bromine water? Explain the answer. (4)
 7.3 Study the flow diagram below, which represents various organic reactions, and answer the questions that follow.



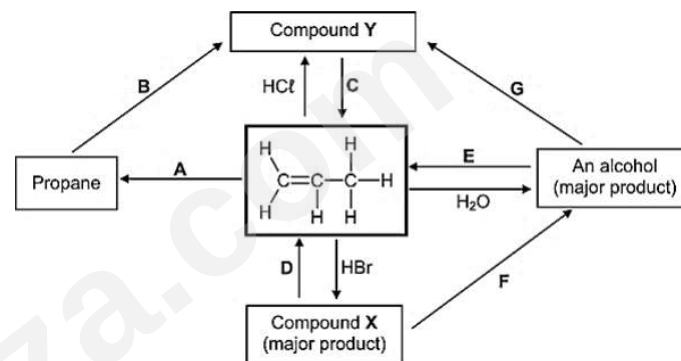
Write down the:

- 7.3.1 IUPAC name of compound P (1)
 7.3.2 Type of reaction labelled I (1)
 7.3.3 Structural formula of compound Q (2)
 7.3.4 The type of addition reaction represented by reaction III (1)

[13]

QUESTION 8

The flow diagram below shows how an alkene can be used to prepare other organic compounds. The letters A to G represent different organic reactions.



8.1 Write down the type of reaction represented by:

8.1.1 A (1)

8.1.2 B (1)

8.1.3 E (1)

8.2 Write down the IUPAC name of compound X. (2)

8.3 For reaction D, write down:

8.3.1 The type of elimination reaction (1)

8.3.2 TWO reaction conditions (2)

8.4 Write down the:

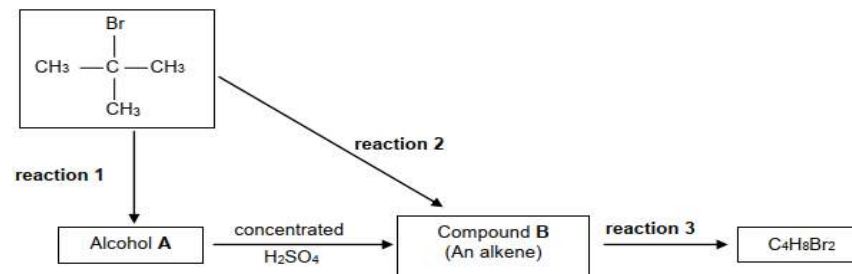
8.4.1 FORMULA of an inorganic reactant needed for reaction F (1)

8.4.2 Balanced equation, using structural formulae, for reaction G (4)

[13]

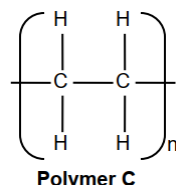
QUESTION 9

9.1 Consider the reactions represented in the flow diagram below.



Write down the:

- 9.1.1 Type of reaction represented by reaction 1 (1)
 9.1.2 NAME or FORMULA of the inorganic reactant needed for reaction 1 (1)
 9.1.3 Type of alcohol (PRIMARY, SECONDARY or TERTIARY) of which alcohol A is an example (1)
 9.1.4 Type of reaction represented by reaction 2 (1)
 9.1.5 IUPAC name of compound B (2)
 9.1.6 Type of addition reaction represented by reaction 3 (1)
 9.1.7 Balanced equation for reaction 3 using structural formulae (4)
 9.2 A wide range of synthetic polymers are produced by combining large numbers of similar small organic molecules bonded to each other in a repeating pattern. Polymer C below is an example of such a polymer.



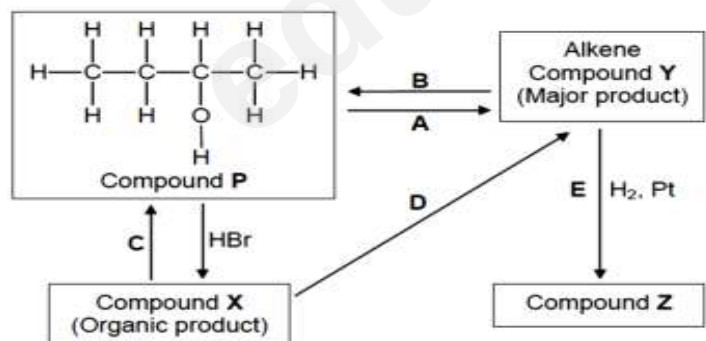
Write down:

- 9.2.1 ONE word for the underlined phrase (1)
 9.2.2 The homologous series to which the 'small organic molecules' used to produce polymer C belong (1)
 9.2.3 The type of polymerisation which takes place to produce polymer C (1)
- [14]

QUESTION 10

The flow diagram below shows how an alcohol (compound P) can be used to prepare other organic compounds.

The letters A to E represent different organic reactions. X, Y and Z are organic compounds.



- 10.1 Is compound P a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for the answer. (2)
 10.2 Write down the type of:
 10.2.1 Elimination reaction represented by A (1)
 10.2.2 Addition reaction represented by B (1)
 10.2.3 Elimination reaction represented by D (1)
 10.3 Sodium hydroxide is used as one of the reactants in reaction C.
 10.3.1 What type of reaction takes place here? (1)
 10.3.2 State the TWO reaction conditions for this reaction. (2)
 10.3.3 Write down the IUPAC name of compound X. (2)
 10.4 Write down the FORMULA of an inorganic reactant needed for reaction D. (1)
 10.5 Using STRUCTURAL FORMULAE, write down a balanced equation for reaction E. (3)
 10.6 Write down the IUPAC name of compound Z. (1)
- [15]

QUESTION 11

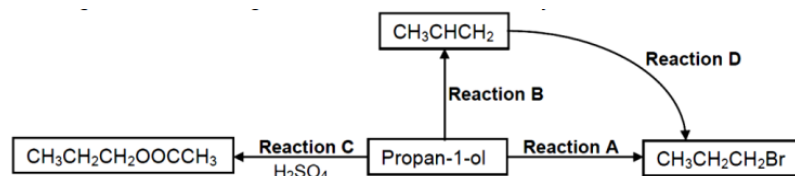
Consider the incomplete equations for reactions I to IV below. P, Q, R and S are organic compounds.

I	$Q + Br_2 \longrightarrow 2\text{-bromobutane} + HBr$
II	$nP \longrightarrow \left[CH_2 - CH_2 \right]_n$
III	$R \xrightarrow{\text{heat}} 2P + Q$
IV	$2\text{-bromobutane} + KOH \text{ (in ethanol)} \xrightarrow{\text{heat}} S + T + H_2O$

- 11.1 Define a cracking reaction. (2)
 11.2 Write down the reaction number (I, II, III or IV) that represents EACH of the following:
 11.2.1 A cracking reaction (1)
 11.2.2 An addition reaction (1)
 11.2.3 A substitution reaction (1)
 11.3 Write down:
 11.3.1 ONE reaction condition for reaction I (1)
 11.3.2 The compound (P, Q, R or S) that represents an unsaturated hydrocarbon (1)
 11.3.3 The IUPAC name of compound P (1)
 11.3.4 The molecular formula of compound R (2)
 11.3.5 The structural formula of compound Q (2)
 11.3.6 The structural formula of compound S (2)
- [14]

QUESTION 12

Propan-1-ol can undergo a number of organic reactions, as indicated by the letters A to D in the diagram below.



12.1 Write down the type of reaction represented by:

- 12.1.1 A (1)
 12.1.2 B (1)
 12.1.3 C (1)
 12.1.4 D (1)

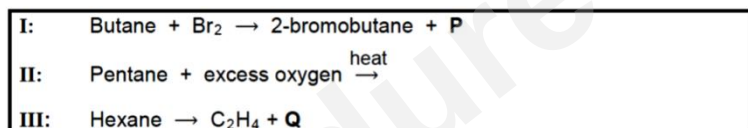
12.2 For reaction C, write down the:

- 12.2.1 Function of H_2SO_4 (1)
 12.2.2 IUPAC name of the organic product (2)
 12.2.3 Structural formula of the other organic reactant (2)
 12.3 Use STRUCTURAL FORMULAE for all organic reactants and products to write a balanced equation for reaction A. (5)

[14]

QUESTION 13

13.1 Three reactions of organic compounds from the same homologous series are shown below.

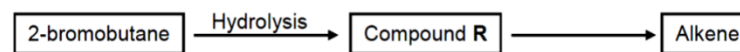


- 13.1.1 Define a homologous series. (2)
 13.1.2 Name the type of reaction represented by I. (1)
 13.1.3 Write down the formula of the inorganic compound P. (1)
 13.1.4 Give the structural formula of a POSITIONAL isomer of 2-bromobutane. (2)
 13.1.5 Using molecular formulae, write down a balanced equation for reaction II. (3)

Reaction III is an example of a cracking reaction.

- 13.1.6 Define a cracking reaction. (2)
 13.1.7 Give the structural formula of organic compound Q. (2)

13.2 Study the flow diagram below.

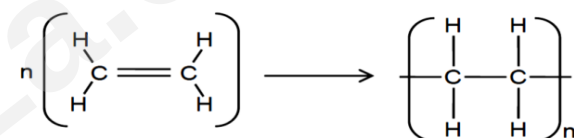


- 13.2.1 Write down the IUPAC name of compound R. (2)
 13.2.2 Compound R reacts in the presence of concentrated phosphoric acid to form an alkene.
 Write down the structural formula of the MAJOR PRODUCT in this reaction. (2)

[17]

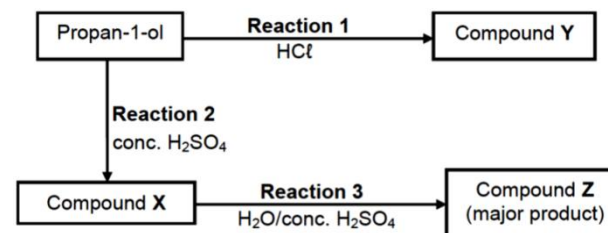
QUESTION 14

14.1 The balanced equation for a polymerisation reaction is shown below.



Write down the:

- 14.1.1 Type of polymerisation reaction represented by the equation (1)
 14.1.2 IUPAC name of the monomer (1)
 14.1.3 IUPAC name of the polymer (1)
 14.2 Propan-1-ol undergoes two different reactions, as shown in the diagram below.



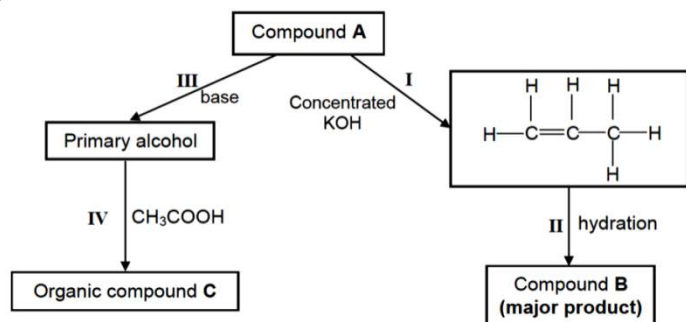
Write down the:

- 14.2.1 Type of reaction represented by reaction 2 (1)
 14.2.2 Function of concentrated H_2SO_4 in reaction 2 (1)
 14.2.3 IUPAC name of compound X (2)
 14.2.4 STRUCTURAL FORMULA of compound Y (2)
 14.2.5 Type of reaction represented by reaction 3 (1)
 14.2.6 IUPAC name of compound Z (2)

[12]

QUESTION 15

The flow diagram below shows how compound A can be used to prepare other organic compounds. The numbers I, II, III and IV represent different organic reactions. Use the information in the flow diagram to answer the following questions.



15.1 Name the homologous series to which compound A belongs.

(1)

15.2 Write down the TYPE of reaction represented by:

15.2.1 I

(1)

15.2.2 III

(1)

15.2.3 IV

(1)

15.3 Consider reaction III.

Write down the:

15.3.1 TWO reaction conditions for this reaction

(2)

15.3.2 IUPAC name of the primary alcohol that is formed

(2)

15.4 Draw the STRUCTURAL FORMULA for compound B.

(2)

15.5 Consider reaction IV. Write down the:

15.5.1 Structural formula of organic compound C

(2)

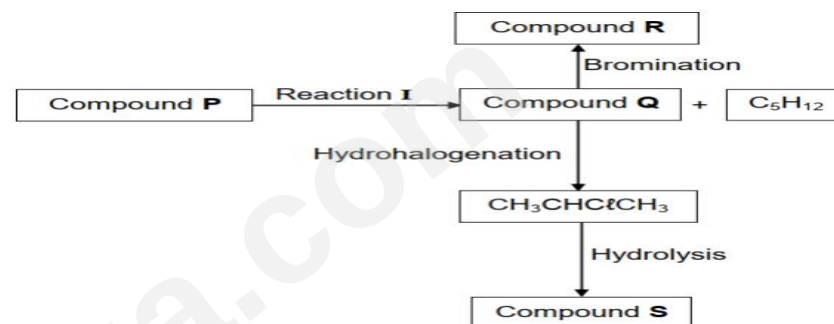
15.5.2 NAME or FORMULA of the catalyst that is used

(1)

[13]

QUESTION 16

The flow diagram shows how various organic compounds can be prepared using compound P as starting reagent.



16.1 Write down the meaning of the term hydrohalogenation.

(2)

16.2 Write down the STRUCTURAL FORMULA of compound Q.

(2)

16.3 Reaction I is an elimination reaction.

Write down the:

16.3.1 TYPE of elimination reaction

(1)

16.3.2 MOLECULAR FORMULA of compound P

(1)

16.4 Write down the IUPAC name of compound R.

(2)

16.5 For the HYDROLYSIS REACTION, write down the:

16.5.1 Balanced equation using structural formulae

(5)

16.5.2 TWO reaction conditions

(2)

[15]