



A-Level Chemistry

Organic Synthesis

Question Paper

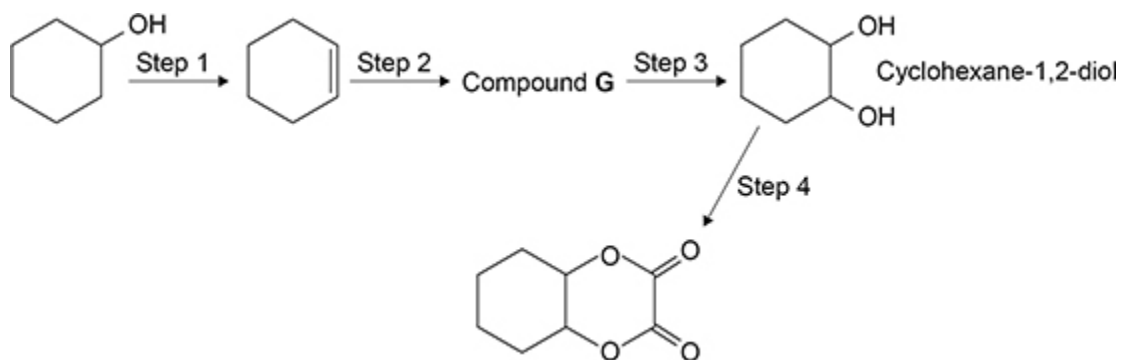
Time available: 78 minutes

Marks available: 72 marks

www.accesstuition.com

1.

This question is about making a diester from cyclohexanol.



(a) State the type of reaction in step 1.

Give the name of the reagent needed for step 1.

Type of reaction _____

Reagent _____

(2)

(b) State the reagents needed and give equations for step 2 and step 3.

Show the structure of Compound G in your equations.

Step 2 reagent _____

Step 2 equation

Step 3 reagent _____

Step 3 equation

(4)

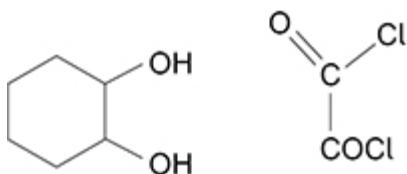
(c) Cyclohexane-1,2-diol reacts with ethanedioyl dichloride.

Give the name of the mechanism for this reaction.

Complete the mechanism to show the formation of **one** ester link in the first step of this reaction.

Mechanism name _____

Mechanism



(5)

(d) Suggest why chemists usually aim to design production methods

- with fewer steps
- with a high percentage atom economy.

Fewer steps _____

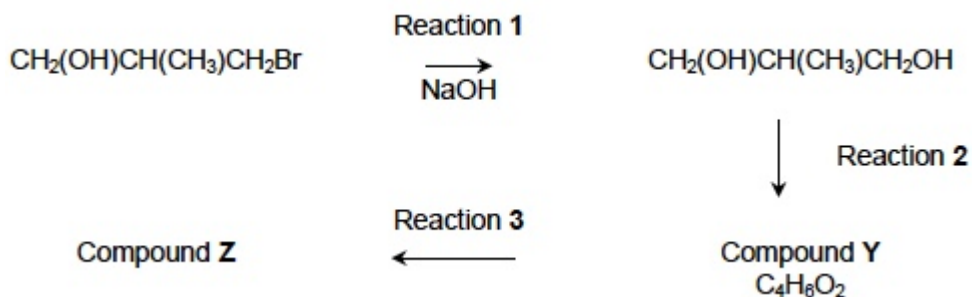
High percentage atom economy _____

(2)

(Total 13 marks)

2.

Halogenoalkanes are useful compounds in synthesis. A reaction pathway is shown.



(d) Compound **Z** has the empirical formula C_3H_4NO

Give the structure of Compound **Z**.

Suggest the reagent for Reaction **3**.

Structure

Reagent for Reaction **3** _____

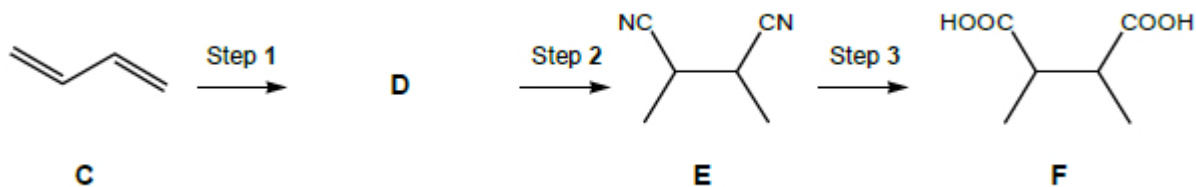
(2)

(Total 7 marks)

3.

Chemists design synthetic routes to convert one organic compound into another.

Buta-1,3-diene, **C**, is converted into compound **F** as shown in the diagram below.



(a) State the IUPAC name of compound **F**.

(1)

(b) Deduce the structure of compound **D**.

For each of the conversions in steps **1** and **2**, suggest a reagent for the conversion and name the mechanism.

Suggest the type of reaction occurring in step **3**.

Structure of **D**

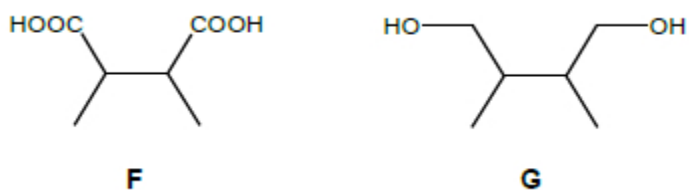
Step 1 _____

Step 2 _____

Type of reaction in Step 3 _____

(6)

(c) Compound **F** can also be made from compound **G**.



State a reagent (or combination of reagents) that can be used in a test-tube reaction to distinguish between **F** and **G**.

Describe what you would observe when the reagent is added to each compound and the test tube is shaken.

Reagent(s) _____

Observation with **F** _____

Observation with **G** _____

(3)

(d) Compounds **F** and **G** react to form a polymer.

Draw the repeating unit of the polymer.

(2)

- (e) In an experiment, 0.930 kg of purified **F** were obtained from 1.11 dm³ of **G** (density 1.04 g cm⁻³).

Calculate the percentage yield.

Give your answer to the appropriate number of significant figures.

Percentage yield _____ %

(4)

- (f) One reason for a yield of less than 100% in part (e) is that **G** reacts to form a number of other compounds.

The other compounds are all liquids at room temperature.

Name the technique that should be used to separate and collect each of these other compounds from the reaction mixture.

Include in your answer a description of the apparatus.

Your description of the apparatus can be either a description in words or a labelled sketch.

Name of technique _____

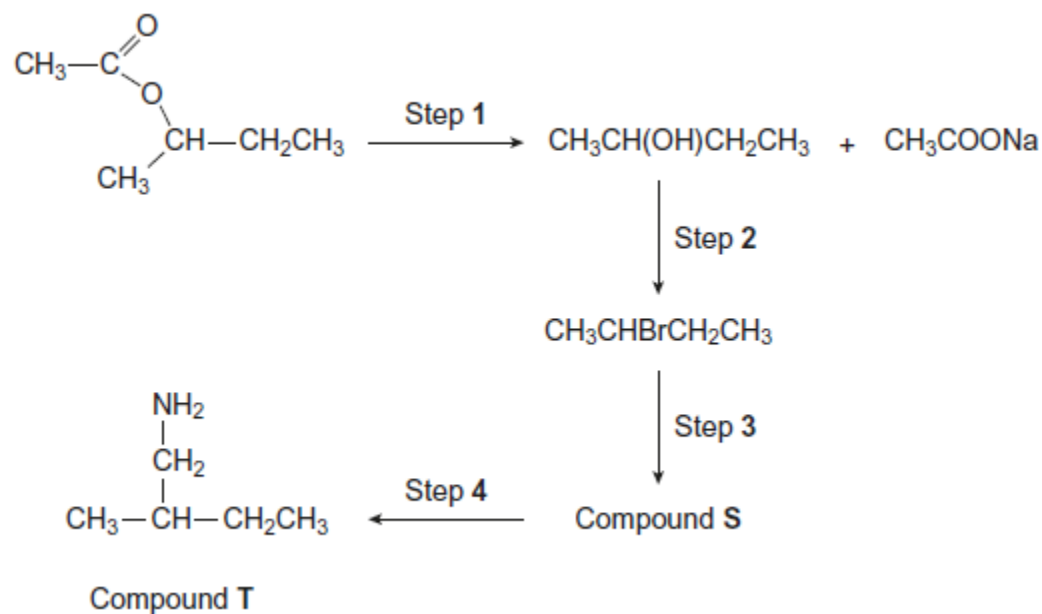
Apparatus

(4)

(Total 20 marks)

4.

A four-step synthesis of compound **T** is shown.



- (a) Give the reagent and conditions for Step 1.
State how you could obtain a sample of the alcohol from the reaction mixture formed in Step 1.

(3)

- (b) Draw the structure of compound **S**.
For each of Steps 3 and 4, give a reagent and one condition, other than heat.

(5)

(Total 8 marks)

- (c) Identify a suitable reagent or combination of reagents for Step 4. Draw the repeating unit of the polymer formed by reaction of 1,4-diaminobenzene with pentanedioic acid.

(3)
(Total 15 marks)