

(b). Hex-1-ene can also be polymerised to form poly(hex-1-ene).

i. Draw a section of poly(hex-1-ene) containing **two** repeat units.

[1]

ii. Waste poly(hex-1-ene) can be disposed of usefully by recycling.

State **two** other methods of disposing of polymers that can be beneficial to the environment.

1

2

[2]

2. A student hydrolyses a haloalkane, **E**, using the following method.

- 0.0100 mol of haloalkane **E** is refluxed with excess NaOH(aq) to form a reaction mixture containing an organic product **F**.
- The reaction mixture is neutralised with dilute nitric acid.
- Excess AgNO₃(aq) is added to the reaction mixture. 1.88 g of a precipitate **G** forms.

Organic product, **F**, has a molar mass of 74.0 g mol⁻¹ and has a chiral carbon atom.

i. Draw a **labelled** diagram to show how the student would carry out the hydrolysis of haloalkane **E**.

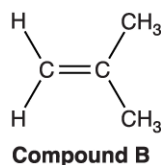
[2]

ii. Analyse the information to identify **E**, **F** and **G**.

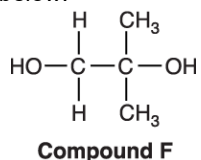
Show your working.

[3]

5. Compound **B**, shown below, can be used to synthesise organic compounds with different functional groups.



The structure of compound **F** is shown below.



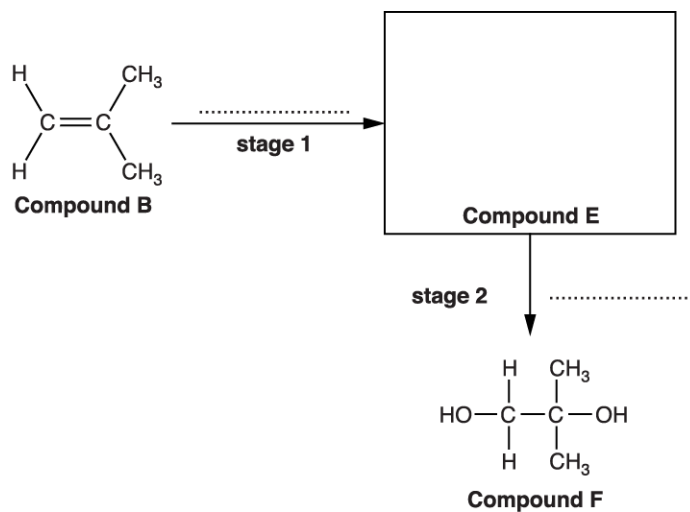
- i. What is the empirical formula of compound **F**?

----- [2]

- ii. A student plans a two-stage synthesis for preparing compound **F** from compound **B**.

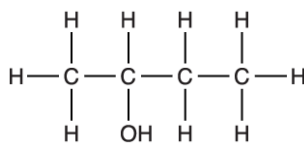
The synthesis first prepares compound **E**, as shown in the flowchart.

Draw the structure of compound **E** in the box and state the reagents for each stage on the dotted lines.



[3]

6. This question is about the properties and reactions of butan-2-ol.



Some properties of butan-2-ol are listed in the table.

Melting point	-115 °C
Boiling point	99.5 °C

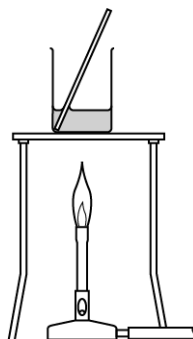
Butan-2-ol can be oxidised by heating with an oxidising agent.

- i. Write an equation for the reaction.

Use [O] to represent the oxidising agent and show the structure of the organic product.

[2]

- ii. A student plans to carry out this oxidation using the apparatus shown in the diagram.



Give **one** reason why the apparatus is **not** suitable and describe a more suitable way of carrying out this oxidation.

[2]

- (b). Ethanedioic acid removes excess dichromate ions, $\text{Cr}_2\text{O}_7^{2-}$, as in the equation below.
$$3(\text{COOH})_2 + \text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ \rightarrow 6\text{CO}_2 + 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$$

Suggest how you could tell when the excess dichromate has completely reacted with the ethanedioic acid.

----- [1]

- (c). A student monitors the course of this reaction using thin-layer chromatography (TLC).

Outline how TLC could be used to monitor the course of the reaction.

----- [2]

- (d). Plan an experiment that would allow the student to confirm the identity of the pure organic product by means of a chemical test.

----- [3]

8. A student carries out the following experiment to investigate the reaction between hexane and chlorine. The chlorine is made by aqueous sodium chlorate(I) with dilute hydrochloric acid.

Procedure	Observations
1 cm ³ of hexane is mixed with 1 cm ³ dilute aqueous sodium chlorate(I) in a test-tube.	The mixture forms two colourless layers.
1 cm ³ dilute hydrochloric acid is slowly added to the mixture.	The acid mixes with the lower layer, which turns a pale green colour.
The tube is then stoppered and shaken.	The pale green colour moves to the upper layer, leaving the lower layer colourless.
The tube is placed under a bright light and shaken at regular intervals for about 10 minutes. The stopper is loosened regularly to release any pressure.	The pale green colour slowly disappears leaving two colourless layers after about 10 minutes.

- i. The reaction between aqueous sodium chlorate(I) and dilute hydrochloric acid produces aqueous sodium chloride as well as chlorine.

Suggest an equation for this reaction.

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- ii. Outline a simple practical test that would confirm the presence of chloride ions in the lower layer, and give the expected

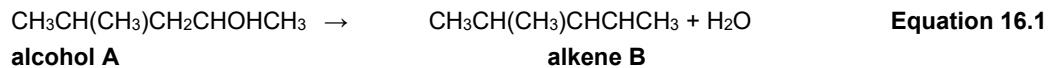
test:

result:

-
- iii. Name the apparatus that could be used to separate the two liquid layers present at the end of the experiment.

9. This question is about alkenes.

When alcohol **A** is heated with an acid catalyst, a reaction takes place forming alkene **B**.
The equation for this reaction is shown below as **Equation 16.1**.



- i. State the type of reaction in **Equation 16.1**.

----- [1]

- ii. Alkene **B** has two stereoisomers.

Explain what is meant by the term *stereoisomers*, and draw the **skeletal** formulae of the two stereoisomers of alkene **B**.

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[3]

- iii. The reaction of **A** with an acid catalyst also forms another alkene, **C**.

Alkene **C** is a structural isomer of alkene **B**.

Suggest the structure of alkene **C**.

[1]

