

1 (a) (i) Which of the following is the formula for a molecule of butane?

Put a cross (☒) in the box next to your answer.

(1)

**A**  $C_3H_6$

**B**  $C_3H_8$

**C**  $C_4H_8$

**D**  $C_4H_{10}$

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Ethanol,  $C_2H_5OH$ , can be converted into ethanoic acid,  $CH_3COOH$ .

In this reaction, ethanol is

(1)

**A** dehydrated

**B** neutralised

**C** oxidised

**D** reduced

(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

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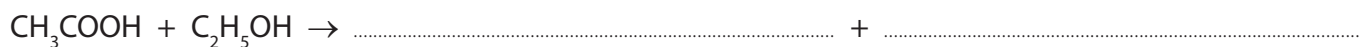
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(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)



**(Total for Question 1 = 8 marks)**

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2 (a) During fractional distillation, crude oil is separated into a number of fractions.

The table shows the relative amount of these fractions that can be obtained from crude oil.

The table also shows the relative demand for each of these fractions.

<b>fraction</b>	<b>relative amount obtained</b>	<b>relative demand</b>
LPG	2	6
petrol	12	29
kerosene	16	11
diesel	24	29
fuel oil and bitumen	46	25

(i) For which fractions does the demand exceed the supply?

Put a cross (☒) in the box next to your answer.

(1)

- A** kerosene, diesel, fuel oil and bitumen
- B** LPG, petrol and diesel
- C** LPG, petrol and kerosene
- D** petrol, diesel, fuel oil and bitumen

(ii) In another process, called cracking, large molecules in some fractions are converted into smaller molecules.

Explain why cracking is needed.

(2)

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- (b) The table shows the number of carbon atoms per molecule in the substances present in each of the fractions.

<b>fraction</b>	<b>number of carbon atoms per molecule</b>
LPG	1 – 4
petrol	4 – 12
kerosene	9 – 16
diesel	15 – 25
fuel oil and bitumen	over 25

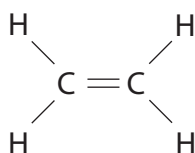
Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

As the number of carbon atoms in the molecules of a hydrocarbon increases

- A** the number of hydrogen atoms in the molecule remains the same
- B** the boiling point of the hydrocarbon increases
- C** the hydrocarbon becomes easier to burn
- D** the viscosity of the hydrocarbon decreases

- (c) The structure of a molecule of ethene is



- (i) What is the formula of a molecule of ethene?

Put a cross (☒) in the box next to your answer.

(1)

- A**  $\text{CH}_2$
- B**  $\text{C}_2\text{H}_4$
- C**  $\text{C}_n\text{H}_{2n}$
- D**  $(\text{CH}_2)_n$

(ii) Ethene can be converted into poly(ethene).

Write a balanced equation for this reaction.

(2)

(d) Many power stations generate electricity by burning fossil fuels, such as fuel oil. This process adds carbon dioxide to the atmosphere.

(i) Explain why some people are concerned about the increase in the amount of carbon dioxide in the atmosphere.

(2)

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(ii) Some hydrocarbon fuels can contain sulfur impurities.

Explain how the product of combustion of these sulfur impurities affects the environment.

(2)

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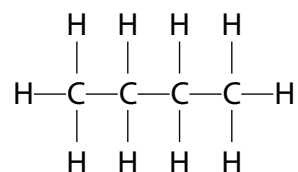
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**(Total for Question 2 = 11 marks)**

3 Alkanes and alkenes are hydrocarbons.

The structure of a molecule of butane is shown.



(a) Which of the following is the empirical formula for butane?

(1)

- A CH
- B CH<sub>2</sub>
- C C<sub>2</sub>H<sub>5</sub>
- D C<sub>4</sub>H<sub>10</sub>

(b) Figure 5 shows some information about the alkenes, ethene and propene.

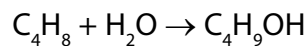
Complete the table. The structure of propene must show all covalent bonds.

(2)

name of alkene	molecular formula	structure
ethene		$\begin{array}{ccc} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$
propene	C <sub>3</sub> H <sub>6</sub>	

Figure 5

(c) Butene reacts with steam to produce butanol.



- (i) Calculate the maximum mass of butanol,  $\text{C}_4\text{H}_9\text{OH}$ , that can be produced when 1.4 kg of butene,  $\text{C}_4\text{H}_8$ , reacts with excess steam.

(relative atomic masses: H = 1, C = 12, O = 16  
relative molecular mass of butene,  $\text{C}_4\text{H}_8$  = 56)

(3)

mass of butanol = ..... kg

- (ii) What type of reaction takes place between butene and steam?

(1)

- A** addition
- B** dehydration
- C** neutralisation
- D** substitution

(d) A sample of each of three hydrocarbons, **X**, **Y** and **Z**, was shaken with bromine water. Bromine water is orange coloured.

The results are:

**X** orange mixture becomes colourless

**Y** orange mixture becomes colourless

**Z** mixture remains orange

Using the results, comment on the structures of the hydrocarbons **X**, **Y** and **Z**.

(2)

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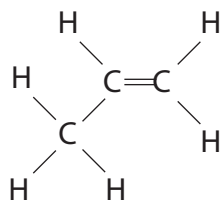
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**(Total for Question 3 = 9 marks)**

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4 The diagram shows the structure of a propene molecule.



(a) Which row of the table describes propene?

Put a cross (☒) in the box next to your answer.

(1)

	hydrocarbon	unsaturated
<input checked="" type="checkbox"/> <b>A</b>	yes	no
<input checked="" type="checkbox"/> <b>B</b>	no	yes
<input checked="" type="checkbox"/> <b>C</b>	yes	yes
<input checked="" type="checkbox"/> <b>D</b>	no	no

(b) Propene can form the polymer poly(propene).

Draw a diagram to show the part of a poly(propene) molecule formed from two propene molecules.

(2)

(c) Describe a test that shows that molecules of propene contain carbon to carbon double bonds.

(2)

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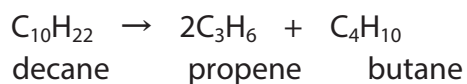
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(d) Propene can be made by cracking fractions obtained from crude oil.

(i) This equation shows the cracking of decane to produce propene and butane.



Give the total mass of products formed if 17 g of decane is cracked in this way.

(1)

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(ii) Explain what is meant by **cracking**.

(2)

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(iii) Explain why it is necessary to crack crude oil fractions that contain large molecules.

(2)

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**(Total for Question 4 = 10 marks)**

5 Propene is an alkene.

The formula of its molecule is  $C_3H_6$ .

(a) (i) Draw the structure of a propene molecule, showing all of the bonds.

(2)

(ii) One molecule of decane,  $C_{10}H_{22}$ , can be cracked to produce one molecule of propene and one molecule of an alkane **X** only.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The formula of a molecule of alkane **X** is

(1)

**A**  $C_7H_{14}$

**B**  $C_7H_{16}$

**C**  $C_8H_{16}$

**D**  $C_{13}H_{28}$

(b) Propane is an alkane.

Propane and propene are both gases.

Given a sample of each gas, describe a test to show which gas is propane and which gas is propene.

(3)

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