

- 1 The photograph shows a multifuel camping stove designed to use various fuels.
This stove can burn the hydrocarbon fuels, propane gas, petrol, kerosene or diesel.



- (a) Suggest **two** reasons why it is usually difficult to burn different hydrocarbon fuels efficiently in the same appliance.

(2)

reason 1

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reason 2

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- (b) The fuels that can be used in the stove are obtained by the fractional distillation of crude oil.

Which of these statements about the fractions obtained by the fractional distillation of crude oil is correct?

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

(1)

- A** each fraction is a pure substance
- B** fuel oil is used as fuel for cars
- C** diesel oil is used as a fuel for some trains
- D** some fractions are biofuels

2 (a) Which of these is the formula of a molecule of a hydrocarbon?

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

(1)

A $\text{CH}_3\text{COOCH}_3$

B $\text{CH}_3\text{CH}_2\text{Cl}$

C CH_3CH_3

D CH_3COOH

(b) The formula of a molecule of propene is C_3H_6 .

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

(2)

(c) Methane burns in oxygen to form carbon dioxide and water.

Write the balanced equation for this reaction.

(3)

*(d) Natural gas is mainly methane.

A gas with similar composition, known as bio-methane, can be produced from plants grown specifically for this purpose.

Describe the advantages and disadvantages of using bio-methane rather than natural gas as a source of energy.

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(Total for Question 2 = 12 marks)

3 (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.

fraction	relative amount obtained	relative demand
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.

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

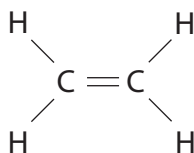
Complete the sentence by putting a cross (☒) in the box next to your answer.

(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** CH₂
- B** C₂H₄
- C** C_nH_{2n}
- D** (CH₂)_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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(Total for Question 3 = 11 marks)

4 (a) Ethanol is produced by the fermentation of glucose.

Yeast is needed for the fermentation reaction.

(i) State **two** other conditions for fermentation.

(2)

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

A dilute solution of ethanol can be converted to a concentrated solution of ethanol by

(1)

- A filtration
- B fractional distillation
- C dehydration
- D cracking

(iii) Write the balanced equation for the fermentation of glucose, $C_6H_{12}O_6$.

(2)

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(b) In industry, ethene is converted to ethanol.

(i) State **two** conditions for this reaction.

(2)

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(ii) A country has large reserves of crude oil.

It is a relatively wealthy country with a large population but it has only a small amount of fertile land.

Explain why the country would prefer to produce its ethanol from ethene rather than by fermentation.

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(Total for Question 4 = 10 marks)

5 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

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(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

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(c) A country has large amounts of available fertile land.

It has no reserves of crude oil.

It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

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(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol CH_3OH

ethanol $\text{C}_2\text{H}_5\text{OH}$

propanol $\text{C}_3\text{H}_7\text{OH}$

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

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(Total for Question 5 = 9 marks)