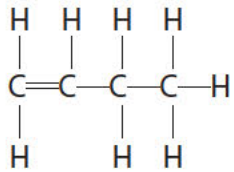
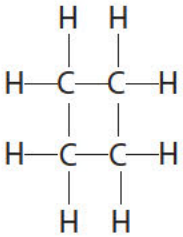
1 But-1-ene is a member of the homologous series of alkenes.

The displayed formula of but-1-ene is



The saturated compound cyclobutane is an isomer of but-1-ene.

The displayed formula of cyclobutane is



(a) (i) State what is meant by the term **isomers**.

(2)

.....

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(ii) Draw the displayed formula of another isomer of but-1-ene.

(1)

(iii) Describe a test that would distinguish between but-1-ene and cyclobutane.

(3)

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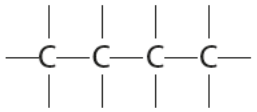
.....

(b) Using your knowledge of the reactions of ethene, complete the two chemical equations to show the formula of the organic product.

(i) The reaction between but-1-ene and steam.

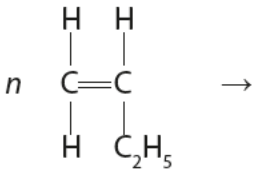
(1)

$$CH_2 = CHCH_2CH_3 + H_2O \rightarrow$$



(ii) The polymerisation of but-1-ene.

(2)



(Total for Question 1 = 9 marks)

2 Ethene is an unsaturated hydrocarbon.

(a) (i) The molecular formula of ethene is

(1)

- ☒ **A** CH_4
- ☒ **B** C_2H_6
- ☒ **C** C_2H_4
- ☒ **D** C_3H_6

(ii) Ethene is bubbled into bromine water until there is no further change.

What is the appearance of the solution formed?

(1)

- ☒ **A** brown
- ☒ **B** colourless
- ☒ **C** purple
- ☒ **D** red

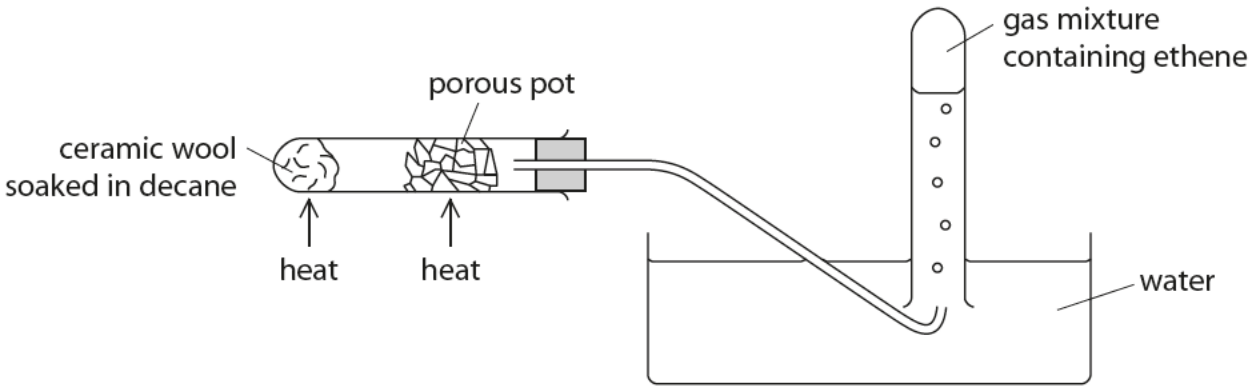
(iii) Ethene can be formed from ethanol.

This type of reaction is called

(1)

- ☒ **A** dehydration
- ☒ **B** oxidation
- ☒ **C** reduction
- ☒ **D** substitution

(b) This apparatus can be used to decompose decane ($C_{10}H_{22}$).



(i) What name is given to this type of thermal decomposition?

(1)

.....

(ii) Porous pot contains oxides such as silica and alumina.

What is the purpose of the porous pot in this experiment?

(1)

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.....

(iii) Suggest why the gas collected is a mixture and not pure ethene.

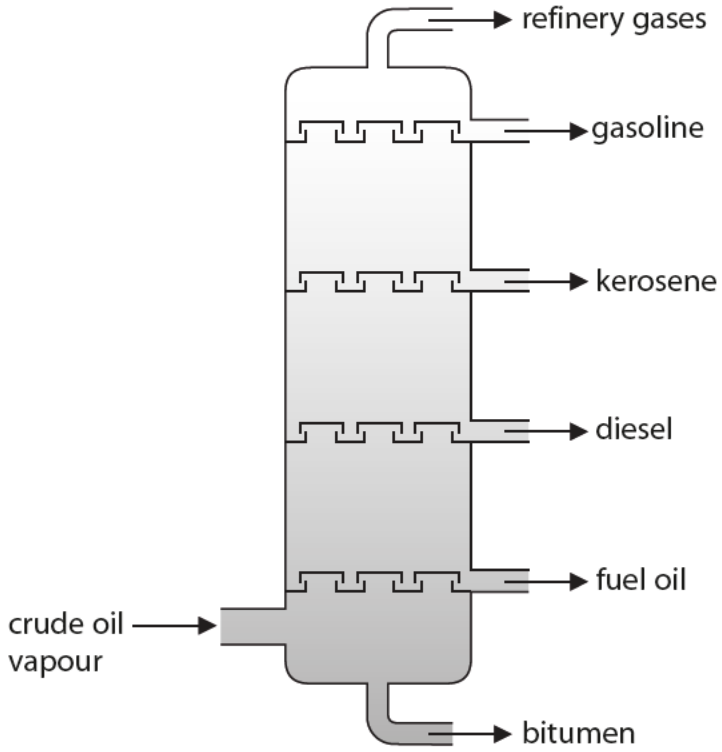
(1)

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(Total for Question 2 = 6 marks)

3 Crude oil is a complex mixture of organic compounds called hydrocarbons. It is separated into fractions using a fractionating tower.



(a) Which fraction has the lowest boiling point?

(1)

.....

(b) Which fraction is the most viscous?

(1)

.....

(c) (i) Some fractions containing long-chain hydrocarbons are cracked. The cracking of octadecane, ($C_{18}H_{38}$), produces octane, (C_8H_{18}), and one other product.

Write a chemical equation for this cracking reaction.

(1)

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(ii) Explain why it is important to crack long-chain hydrocarbon fractions.

(2)

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(d) Octane is one of the hydrocarbons in the petrol used in cars.

The equation for the complete combustion of octane is

$$C_8H_{18} + 12½O_2 \rightarrow 8CO_2 + 9H_2O$$

The incomplete combustion of octane produces a poisonous gas that reduces the capacity of blood to carry oxygen.

Write a chemical equation for this incomplete combustion of octane.

(2)

.....

(Total for Question 3 = 7 marks)

4 The table shows percentage by mass of the fractions obtained from a sample of crude oil and the percentage market demand for these fractions.

Fraction	Percentage by mass in crude oil	Market demand (%)
refinery gases	3	5
gasoline	12	28
kerosene	9	20
diesel	15	25
fuel oil	51	20
bitumen	10	2

(a) Why is the market demand for the gasoline fraction greater than that for the fuel oil fraction?

(1)

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.....

.....

(b) Cracking is used to make long-chain hydrocarbon molecules into shorter-chain hydrocarbon molecules.

(i) Complete the equation to show the other hydrocarbon molecule formed when $C_{20}H_{42}$ is cracked.

(1)

$$C_{20}H_{42} \rightarrow C_{16}H_{34} + \text{.....}$$

(ii) Give the name of a catalyst used in industry to crack long-chain hydrocarbons and state a temperature at which cracking is carried out.

(2)

Catalyst .....

Temperature .....

(c) Ethene (C_2H_4) can be produced by cracking long-chain hydrocarbon molecules obtained from crude oil. The ethene produced can then be used to make ethanol.

Ethanol can also be made by the fermentation of sugars.

(i) Give **two** advantages of making ethanol from ethene, rather than by fermentation.

(2)

1 .....

.....

2 .....

.....

(ii) Suggest **two** reasons why ethanol is sometimes made by fermentation, rather than from ethene.

(2)

1 .....

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2 .....

.....

(Total for Question 4 8 marks)