1 (a) Some fuels are better fuels than others.

State one factor that makes a good fuel.

(1)

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(b) Bioethanol is a fuel that can be obtained from the plant, sugar beet.

(i) Bioethanol and petrol can both be used as fuels.

Explain one advantage of using bioethanol produced from sugar beet, rather than petrol produced from crude oil.

(2)

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(ii) The main component of bioethanol is ethanol.

When burnt completely, ethanol, C_2H_5OH, reacts with oxygen to produce carbon dioxide and water.

Write the balanced equation for this reaction.

(3)

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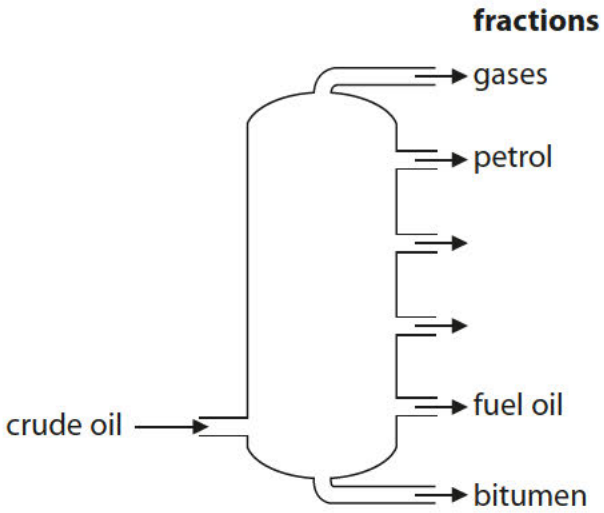
*(c) Useful products can be obtained by the fractional distillation of crude oil.

The diagram shows a fractional distillation column and the fractions obtained.



The petrol fraction is obtained from near the top of the column.
The bitumen fraction is obtained from the bottom of the column.

Explain how the petrol and bitumen fractions differ in their properties and uses.

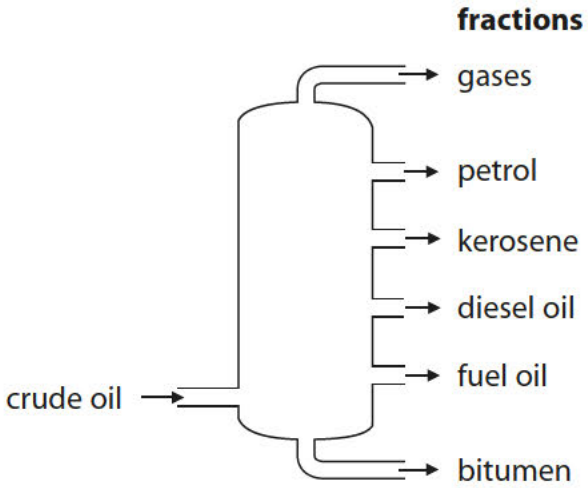
(6)

(Total for Question 1 = 12 marks)

2 Crude oil is a mixture of hydrocarbons.

(a) Crude oil is separated into fractions by fractional distillation.

The diagram shows a fractional distillation column and the fractions.



There are trends in the properties of the fractions from the top of the column to the bottom of the column.

Which of the following describes a correct trend from top of the column to the bottom?

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

(1)

- ☐ **A** the boiling points decrease
- ☐ **B** the ease of ignition decreases
- ☐ **C** the viscosity decreases
- ☐ **D** the number of carbon atoms in a molecule decreases

(b) Describe problems caused by one product of the incomplete combustion of a hydrocarbon fuel.

(2)

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(c) (i) When fuel oil is burnt, carbon dioxide is produced and released into the atmosphere.

Explain why some people are concerned about the release of large quantities of carbon dioxide into the atmosphere.

(2)

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(ii) Fuel oil can contain sulfur as an impurity.

Explain how burning this impurity can cause problems in the environment.

(3)

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(d) Crude oil is a source of many fuels.

These fuels are known as fossil fuels.

Describe advantages of replacing fossil fuels with biofuels.

(2)

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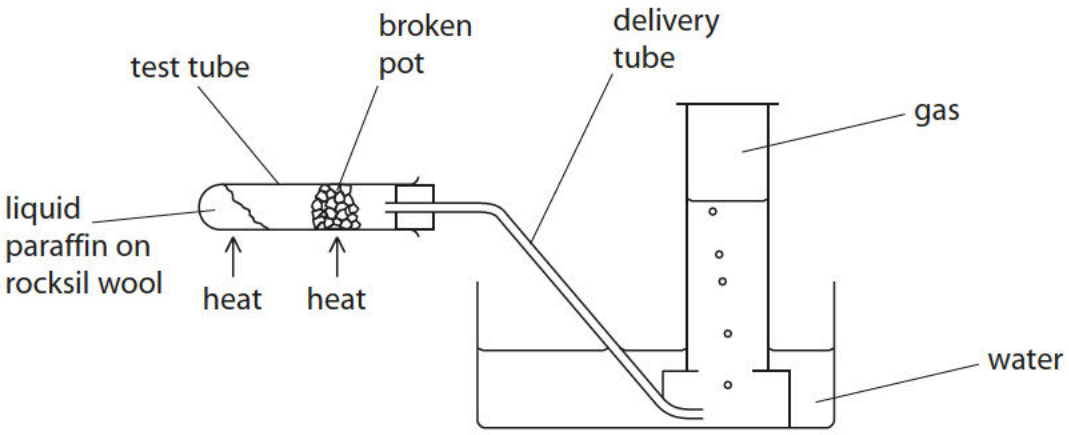
(Total for Question 2 = 10 marks)

3 (a) In the laboratory this apparatus is used to crack long chain hydrocarbon molecules to form shorter chain hydrocarbon molecules.



When the experiment is complete there is a danger that water will rise up the delivery tube into the hot test tube.

State what you would do to prevent this.

(1)

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

The equation for a reaction that occurs during cracking is

$$C_{12}H_{26} \rightarrow C_2H_6 + C_6H_{12} + X$$

In the balanced equation, X is

(1)

☐ **A** C_3H_8

☐ **B** C_4H_8

☐ **C** C_4H_{10}

☐ **D** C_6H_{14}

(c) Alkenes are unsaturated hydrocarbons.

State what is meant by **unsaturated**.

(1)

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(d) Propane and propene are bubbled through separate samples of bromine water.

Describe what you would **see** in these tests.

(3)

(e) In industry, long chain hydrocarbon molecules are cracked to form shorter chain hydrocarbon molecules.

Explain why this process is important.

(2)

(Total for Question 3 = 8 marks)

4 Known crude oil deposits are being used up.
In the past, most of our fuels, such as petrol, have been obtained from crude oil.

(a) Fuels such as those obtained from crude oil are non-renewable. Efforts are being made to replace these types of fuels with renewable fuels.

Explain the difference between **non-renewable** and **renewable** fuels.

(2)

*(b) Evaluate the advantages and disadvantages of using bioethanol, instead of petrol, as a fuel for cars.

(6)

(c) The photograph shows one of the new buses for London.

The bus uses hydrogen as a fuel.
There are six hydrogen fuel tanks, which can be seen on the roof of the bus.
The hydrogen from the tanks reacts with oxygen from the air in a fuel cell to release energy to power the bus.

(i) Write the balanced equation for the overall reaction that takes place when the hydrogen reacts with oxygen in the fuel cell.

(3)

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(ii) Like all fuels, hydrogen, when mixed with air and ignited, explodes.

Apart from the possibility of an explosion, state another disadvantage of using hydrogen, rather than diesel, as a fuel for buses.

(1)

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(Total for Question 4 = 12 marks)