AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.1.2

Fractional distillation and petrochemicals

Past-paper questions

Tier	**Foundation**
Question groups	**20**
Available paper years	**2007–2023**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.7.1.2 Fractional distillation and petrochemicals

Question 01

March 2007 | CHY1A | Original Q8 | Legacy

QUESTION EIGHT

Crude oil is a non-renewable energy source. Petrol is a fuel obtained from the fractional distillation of crude oil.

Gasohol is also a fuel. It is a mixture of 90 % petrol and 10 % ethanol. The ethanol can be produced from the waste stems and leaves when crops have been harvested. So ethanol is a renewable energy source.

	Mass in grams of gas produced by completely burning 10 cm^3 of fuel		
Fuel	Carbon dioxide from petrol	Carbon dioxide from ethanol	Water vapour
Petrol	26.4	0	12.6
Gasohol	23.8	1.5	12.2

8A What is the total mass of carbon dioxide produced when 10 cm^3 of gasohol is burned?

1 22.3 g

2 23.8 g

3 25.3 g

4 26.4 g

8B How much more carbon dioxide is produced when 10 cm^3 of petrol is burned than when 10 cm^3 of gasohol is burned?

1 0.4 g

2 1.1 g

3 1.6 g

4 24.9 g

4.7.1.2 Fractional distillation and petrochemicals

Question 01 · continued

8C Why is the water vapour produced by burning fuels not a problem?

1 It condenses to a liquid.

2 It does not cause corrosion.

3 It is not a pollutant.

4 Very little is produced.

8D Carbon dioxide causes environmental problems.

Why is carbon dioxide from burning ethanol thought to be less of a problem than carbon dioxide from burning petrol?

1 Not as much carbon dioxide is produced.

2 The carbon dioxide produced has different chemical properties.

3 It is just recycling carbon dioxide removed from the air by plants.

4 The ethanol is not produced from crude oil.

4.7.1.2 Fractional distillation and petrochemicals

Question 02

November 2007 | CHY1A | Original Q6 | Legacy

QUESTION SIX

This question is about fractional distillation of crude oil.

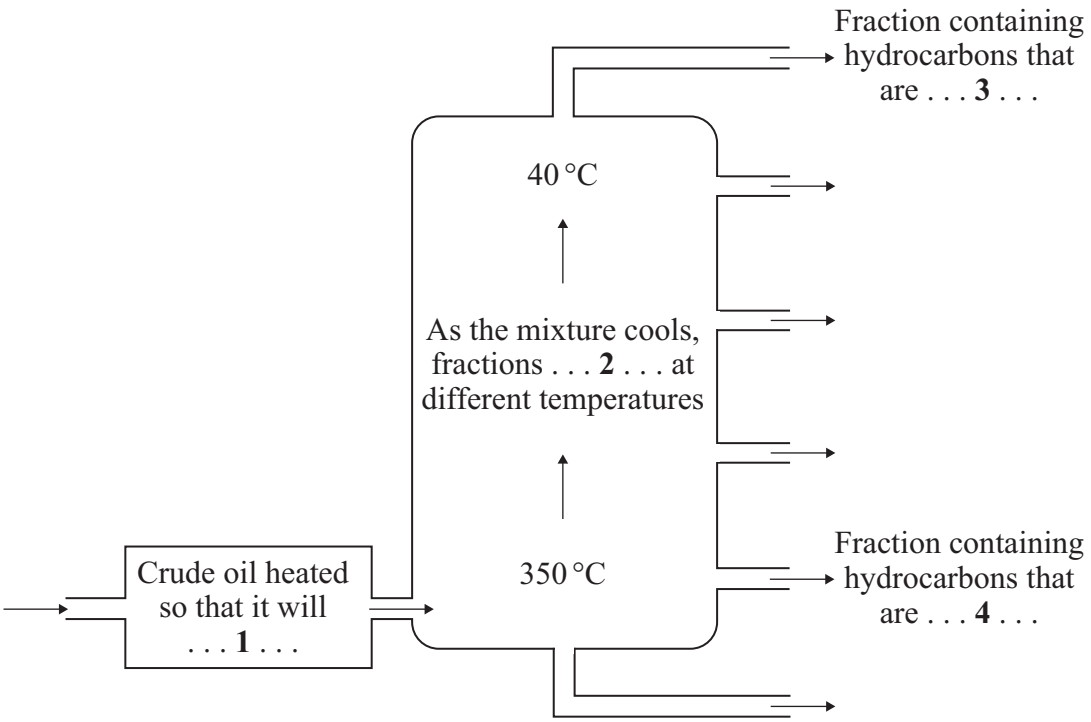
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences on the diagram.

A condense

B vaporise

C viscous

D volatile



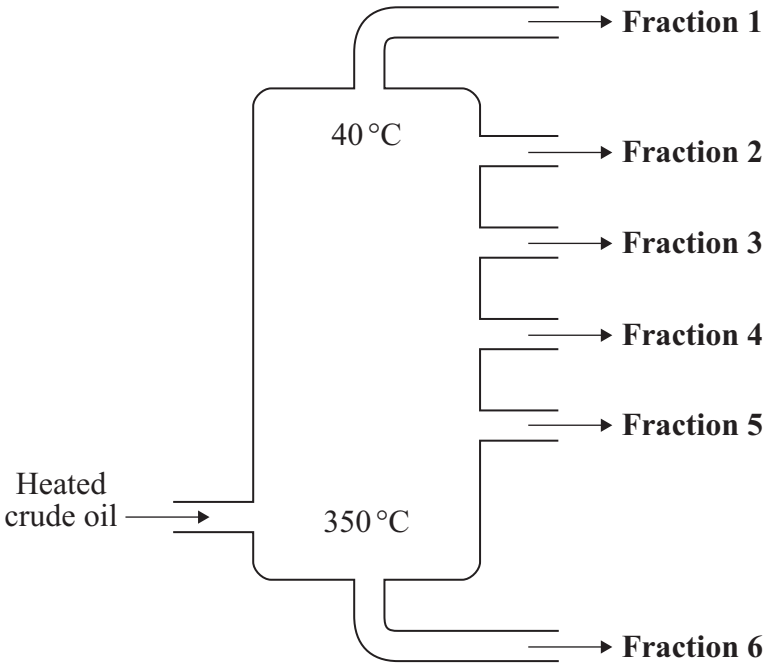
4.7.1.2 Fractional distillation and petrochemicals

Question 03

November 2009 | CHY1AP | Original Q8 | Legacy

QUESTION EIGHT

In a fractionating column, crude oil is separated into a number of fractions.



8A Each fraction contains . . .

1 only alkanes that are liquids.

2 only alkanes that condense at temperatures above 40 °C.

3 alkanes with similar boiling points.

4 alkanes with the same chemical formula.

8B Which statement is true for the alkanes in **Fraction 1**?

1 They burn to produce carbon dioxide and sulfur dioxide only.

2 They have the general formula C_nH_{2n-2}

3 They are saturated compounds.

4 They are compounds of carbon, hydrogen and oxygen.

4.7.1.2 Fractional distillation and petrochemicals

Question 03 · continued

8C When compared with the alkanes in **Fraction 6**, the alkanes in **Fraction 1** . . .

1 will ignite more easily.

2 will be more viscous.

3 will have higher boiling points.

4 will have larger molecules.

8D In a molecule of the alkane called propane, there are eight hydrogen atoms.

The formula for propane is . . .

1 C_2H_8

2 C_3H_8

3 C_4H_8

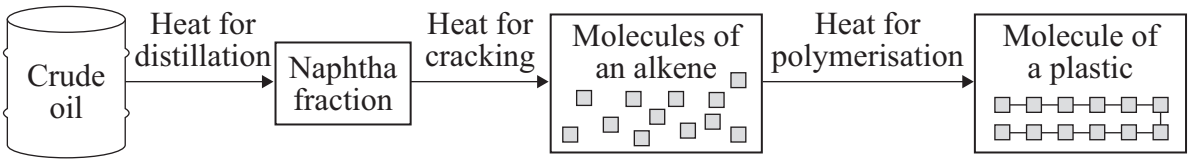
4 C_3H_8O

4.7.1.2 Fractional distillation and petrochemicals

Question 04

5 Crude oil is used to make plastics.

5 (a) To make a plastic from crude oil involves many processes.



5 (a) (i) How do alkene molecules form a molecule of a plastic?

.....

.....

(1 mark)

5 (a) (ii) Suggest **one** of the main costs of making a plastic from crude oil.

.....

.....

(1 mark)

5 (a) (iii) Suggest **two** problems caused by the disposal of plastics in landfill sites.

1 .....

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2 .....

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(2 marks)

4.7.1.2 Fractional distillation and petrochemicals

Question 04 · continued

for mark

5 (b) Some companies are using bio-plastics made from plants such as corn.
Less fossil fuel is used to make bio-plastics than is used to make plastics from crude oil.

Plastics made from plants would be more environmentally friendly than plastics made from crude oil.

Explain why.

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(2 marks)

6

Turn over for the next question

4.7.1.2 Fractional distillation and petrochemicals

Question 05

November 2010 | CHY1AP | Original Q4 | Legacy

QUESTION FOUR

The substances that we get from the distillation of crude oil have a range of properties.

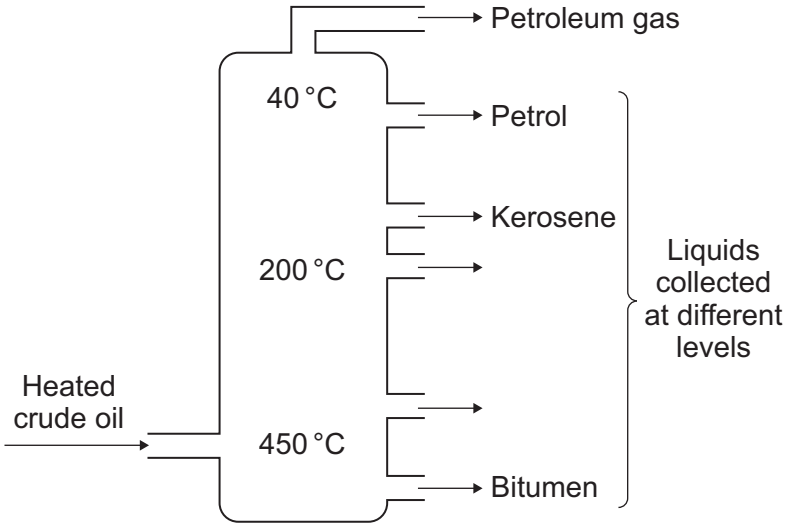
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A kerosene

B petroleum gas

C petrol

D bitumen



The substance with the lowest boiling point is . . . **1** . . . .

The substance collected at about 150 °C is . . . **2** . . . .

The most volatile liquid collected is . . . **3** . . . .

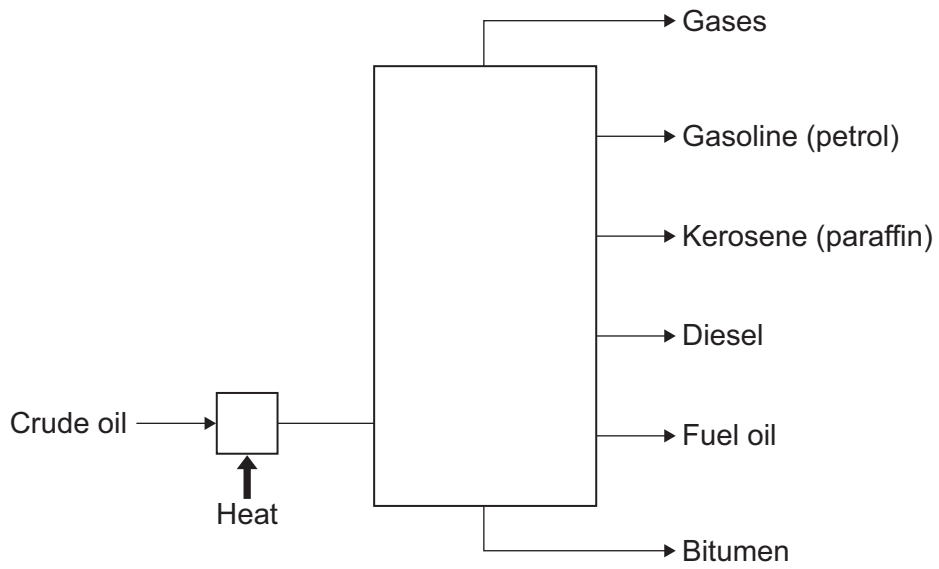
The most viscous substance collected is . . . **4** . . . .

4.7.1.2 Fractional distillation and petrochemicals

Question 06

7 Crude oil is used to produce many useful materials.

7 (a) The diagram shows some of the fractions produced from crude oil by fractional distillation.



Use the diagram to help you to explain how crude oil is separated into fractions.

You should use the words evaporated and condensed in your answer.

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(3 marks)

4.7.1.2 Fractional distillation and petrochemicals

Question 06 · continued

7 (b) The table shows some information about four of the fractions from crude oil that are used as fuels.

Fraction	Boiling point in °C	Number of carbon atoms found in the molecules
Gasoline (petrol)	20 – 200	5 – 10
Kerosene (paraffin)	180 – 260	10 – 16
Diesel	260 – 340	14 – 20
Fuel oil	370 – 600	20 – 70

Use the information in the table to help you to answer these questions.

7 (b) (i) How can you tell that each of the fractions is a mixture?

.....

.....

(1 mark)

7 (b) (ii) How does the number of carbon atoms in a molecule affect its boiling point?

.....

.....

(1 mark)

7 (c) Fuels are substances that release energy.

7 (c) (i) Name the reaction that releases energy from a fuel such as gasoline (petrol).

.....

(1 mark)

7 (c) (ii) Describe how fuel oil is broken down into smaller, more useful molecules such as gasoline (petrol).

.....

.....

.....

.....

(2 marks)

8

4.7.1.2 Fractional distillation and petrochemicals

Question 07

June 2011 | CHY1AP | Original Q9 | Legacy

QUESTION NINE

Crude oil is a mixture made up mainly of alkanes.

9A The alkanes are a series of hydrocarbons . . .

1 all of which are gases at room temperature (20 °C).

2 that have the general formula C_nH_{2n}.

3 in which the molecules have a carbon : hydrogen ratio of 1 : 4.

4 that are saturated.

Crude oil can be separated into fractions by fractional distillation.

9B In the fractionating column, the crude oil separates into fractions because . . .

1 the crude oil changes from a liquid into a vapour.

2 the alkanes condense at different temperatures.

3 the crude oil decomposes when it is heated.

4 the alkanes have different densities.

9C The petrol fraction has a boiling range from 40 °C to 70 °C.

The fraction does not have a fixed boiling point because it . . .

1 contains only one alkane.

2 contains several alkanes.

3 collects near the top of the column.

4 decomposes at 40 °C.

9D The petrol fraction is used as a fuel. Ethanol (C_2H_5OH), made from plant material, can be used as a fuel instead of petrol.

One advantage of ethanol over petrol is that ethanol . . .

1 does not produce carbon dioxide when it burns.

2 is a renewable fuel.

3 produces only water when it burns.

4 is a compound, not a mixture.

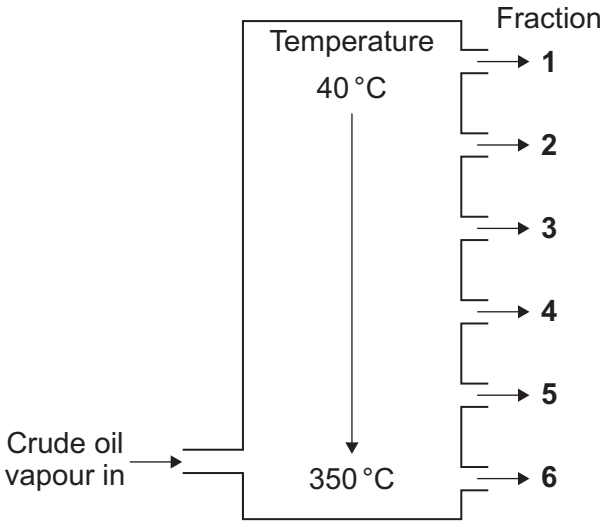
END OF TEST

4.7.1.2 Fractional distillation and petrochemicals

Question 08

June 2011 | CHY1F | Original Q5 | Legacy

5 Crude oil is a mixture of hydrocarbons.
Crude oil can be separated into fractions.



5 (a) (i) Complete the sentence.

The process used to separate the crude oil into fractions is called

fractional ..... .

(1 mark)

5 (a) (ii) Why do the fractions separate at different temperatures?

.....

.....

(1 mark)

4.7.1.2 Fractional distillation and petrochemicals

Question 08 · continued

5 (b) Tick (✓) **two** properties of fraction **6**.

Property	Tick (✓)
contains hydrocarbons	
has a small number of carbon atoms in each molecule	
is easy to ignite	
has a high boiling point	

(2 marks)

5 (c) Fraction **1** contains hydrocarbons called alkanes.
The general formula of an alkane is: C_nH_{2n+2}

What is the formula of the alkane that has 5 carbon atoms in each molecule?

Draw a ring around the correct answer.

C_5H_9 **C_5H_{10}** **C_5H_{11}** **C_5H_{12}**

(1 mark)

5

4.7.1.2 Fractional distillation and petrochemicals

Question 09

January 2012 | CH1FP | Original Q3 | Legacy

3 (a) Crude oil is a mixture of compounds.
These compounds are made up of hydrogen and carbon atoms only.

3 (a) (i) Draw a ring around the correct answer to complete the sentence.

Compounds made up of carbon and hydrogen atoms only are called

alcohols.

hydrocarbons.

vegetable oils.

(1 mark)

3 (a) (ii) The table shows five of these compounds.

Compound	State at room temperature (20 °C)	Boiling point in °C
ethane, C_2H_6	gas	−89
butane, C_4H_{10}	gas	0
hexane, C_6H_{14}	liquid	+69
pentadecane, $C_{15}H_{32}$	liquid	+270
heptadecane, $C_{17}H_{36}$	solid	+302

Tick (✓) **two** correct statements about the five compounds.

Statement	Tick (✓)
ethane has the smallest molecules	
hexane and pentadecane are liquid at 100 °C	
heptadecane has the highest boiling point	
butane boils at 100 °C	

(2 marks)

3 (a) (iii) Draw a ring around the correct answer to complete each sentence.

Fractional distillation is used to separate the compounds in crude oil.

The first step in fractional distillation is

cracking

displacing

evaporating

the crude oil.

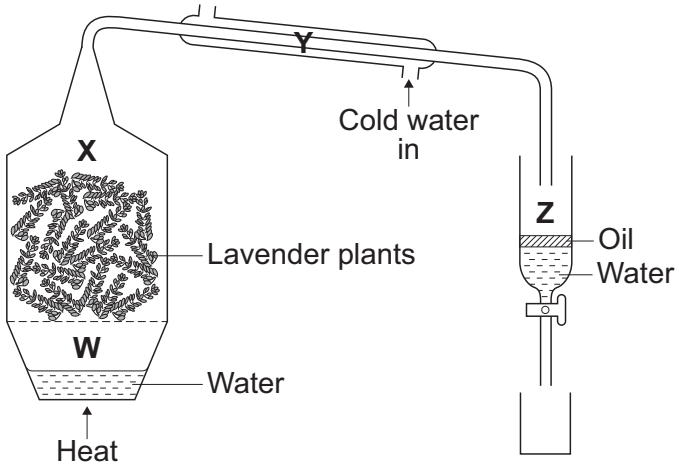
4.7.1.2 Fractional distillation and petrochemicals

Question 09 · continued

During fractional distillation the compounds [burn / condense / decompose] at different temperatures.

(2 marks)

3 (b) Steam distillation is used to separate oils from plants.
The diagram shows some apparatus that can be used to separate oil from lavender plants. Four parts of the apparatus are labelled **W**, **X**, **Y** and **Z**.



3 (b) (i) In which part, **W**, **X**, **Y** or **Z**, of the apparatus:

is steam produced ☐

are steam and oil condensed? ☐

(2 marks)

3 (b) (ii) Use the correct word from the box to complete the sentence.

dissolves	floats	sinks

When the oil separates from the water, the oil ..... .

(1 mark)

3 (b) (iii) Describe how part **Z** of the apparatus can be used to remove the water from the oil.

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(2 marks)

10

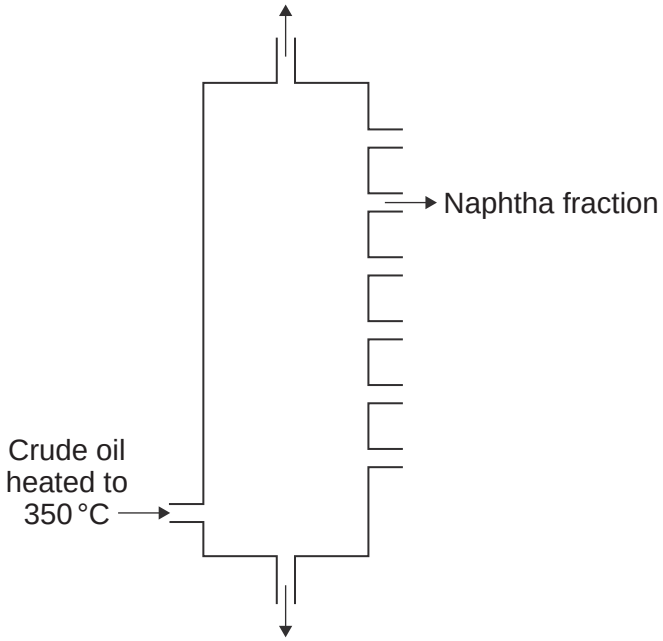
4.7.1.2 Fractional distillation and petrochemicals

Question 10

June 2012 | CH1FP | Original Q8 | Legacy

8 Crude oil is used to produce poly(ethene).

8 (a) Fractional distillation is used to separate crude oil into fractions.



8 (a) (i) Write a number, **2**, **3**, **4** or **5**, next to each stage so that the description of fractional distillation is in the correct order. Numbers **1** and **6** have been done for you.

Number	Stage
1	The crude oil is heated to 350 °C.
	When a fraction in the vapours cools to its boiling point, the fraction condenses.
	Any liquids flow down to the bottom of the column and the hot vapours rise up the column.
6	The condensed fraction is separated and flows out through a pipe.
	When the hot vapours rise up the column, the vapours cool.
	Most of the compounds in the crude oil evaporate.

(2 marks)

8 (a) (ii) The naphtha fraction is cracked to produce ethene (C_2H_4).
Ethene is used to make the polymer called poly(ethene).

Name **two** substances produced when poly(ethene) burns in air.

1 .....

2 .....

(2 marks)

4.7.1.2 Fractional distillation and petrochemicals

Question 10 · continued

8 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Each year in the UK, billions of plastic bags are given free to shoppers. These bags are made from poly(ethene) and are often used only once.
After being used many of these plastic bags are either thrown away as litter or buried in landfill sites.

In 2006 over 10 billion of these plastic bags were given free to shoppers.
In 2009 the number of plastic bags given to shoppers had decreased to 6.1 billion.
One reason for the decrease was because some supermarkets made people pay for their plastic bags.

From 2011 a new type of plastic shopping bag made mainly from poly(ethene) had a use-by date of only one year printed on the bag.

Use the information above and your knowledge and understanding to describe advantages and disadvantages of using plastic shopping bags made from poly(ethene).

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(6 marks)

10

4.7.1.2 Fractional distillation and petrochemicals

Question 11

January 2013 | CH1FP | Original Q7 | Legacy

7 This question is about oil reserves.

7 (a) Diesel is separated from crude oil by fractional distillation.

Describe the steps involved in the fractional distillation of crude oil.

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(3 marks)

7 (b) Diesel is a mixture of lots of different *alkanes.*

What are *alkanes*?

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(2 marks)

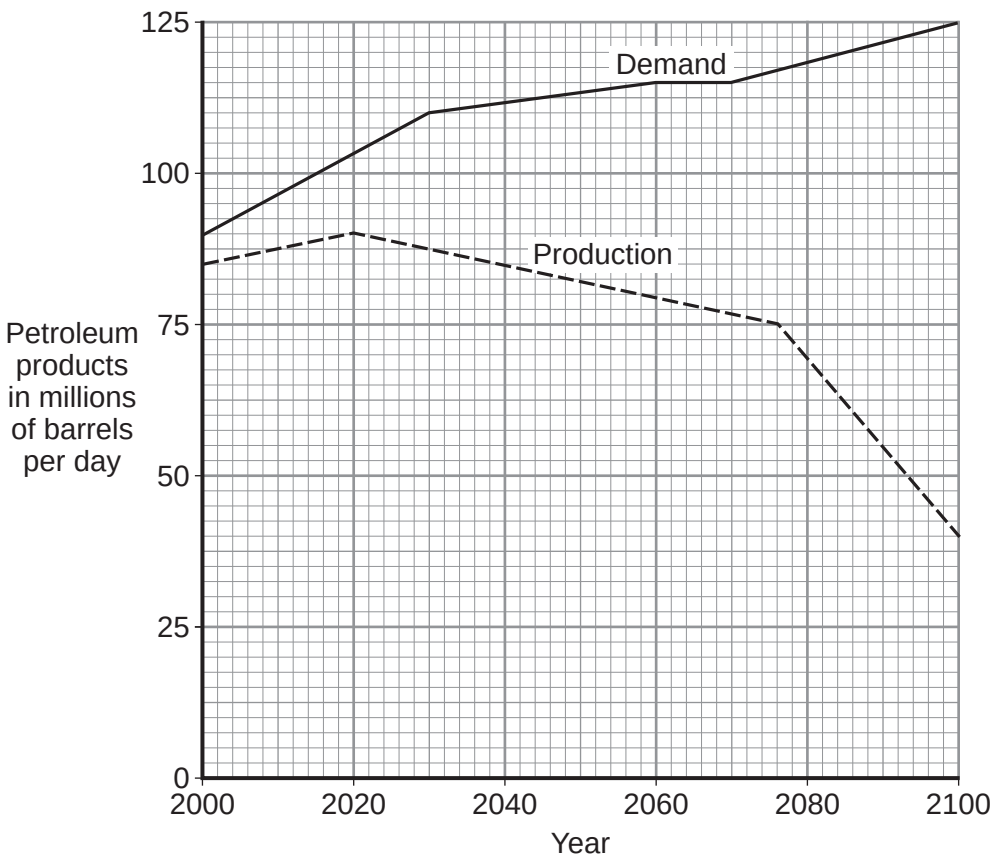
Question 7 continues on the next page

4.7.1.2 Fractional distillation and petrochemicals

Question 11 · continued

7 (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Petroleum products, such as petrol, are produced from crude oil.
The graph shows the possible future production of petroleum products from crude oil and the expected demand for petroleum products.



Canada's oil sands hold about 20% of the world's known crude oil reserves.

The oil sands contain between 10 to 15% of crude oil. This crude oil is mainly bitumen.

In Canada the oil sands are found in the ground underneath a very large area of forest. The trees are removed. Then large diggers and trucks remove 30 metres depth of soil and rock to reach the oil sands. The oil sands are quarried. Boiling water is mixed with the quarried oil sands to separate the bitumen from the sand. Methane (natural gas) is burned to heat the water.

The mixture can be separated because bitumen floats on water and the sand sinks to the bottom of the water. The bitumen is cracked and the products are separated by fractional distillation.

4.7.1.2 Fractional distillation and petrochemicals

Question 11 · continued

Use the information on page 18 and your knowledge and understanding to suggest the advantages and disadvantages of extracting petroleum products from oil sands.

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(6 marks)

11

4.7.1.2 Fractional distillation and petrochemicals

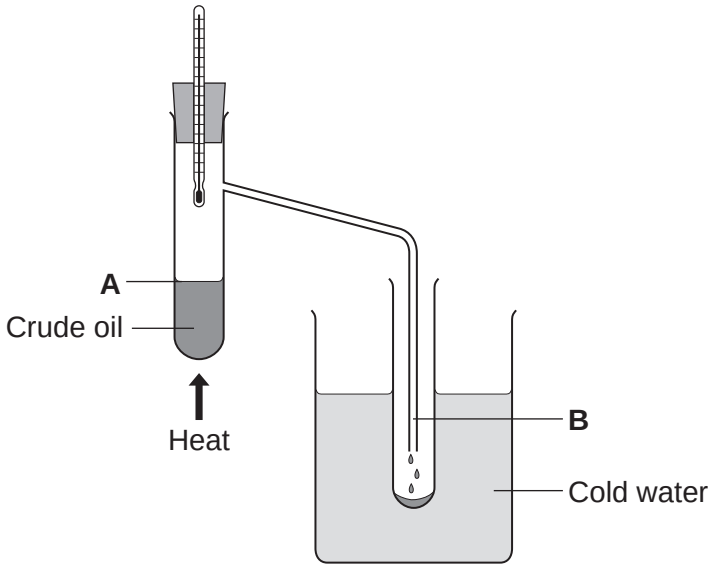
Question 12

June 2014 | CH1FP | Original Q4 | Legacy

4 Crude oil is a mixture of a very large number of compounds.

Figure 4 shows a laboratory experiment to separate crude oil.

Figure 4



4 (a) Complete the sentence.

[1 mark]

The name for compounds that contain only hydrogen and carbon is ..... .

4 (b) Use the correct word from the box to complete each sentence.

condensation	**decomposition**	**distillation**
evaporation	**reduction**	

4 (b) (i) The process of separating crude oil is fractional ..... .

[1 mark]

4 (b) (ii) The process taking place at **A** is ..... .

[1 mark]

4 (b) (iii) The process taking place at **B** is ..... .

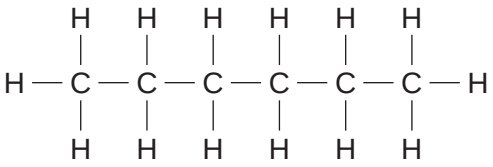
[1 mark]

4.7.1.2 Fractional distillation and petrochemicals

Question 12 · continued

4 (c) One of the compounds in crude oil is hexane. The displayed structure of hexane is shown in **Figure 5**.

Figure 5



Complete the sentences.

4 (c) (i) Each line between the atoms in hexane represents a covalent ..... .

[1 mark]

4 (c) (ii) Complete the chemical formula for hexane.

[1 mark]

C_6H.....

4 (c) (iii) Hexane can be broken down into smaller molecules by a process called ..... .

[1 mark]

4 (d) Small molecules, called alkenes, are used to make polymers.

4 (d) (i) Name the polymer made from butene.

[1 mark]

.....

4 (d) (ii) Incinerators are used to burn waste polymers, such as plastic bags.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of burning plastic bags.

[2 marks]

	Advantage Tick (✓)	Disadvantage Tick (✓)
Energy is released.		
More recycling is needed.		
Carbon dioxide is produced.		

10

4.7.1.2 Fractional distillation and petrochemicals

Question 13

June 2015 | CH1FP | Original Q3 | Legacy

3 Crude oil is a fossil fuel.

3 (a) To make crude oil more useful it is separated into fractions.

Use the correct word from the box to complete each sentence.

boiling	**compound**	**decomposition**	**distillation**
filtration	**mixture**	**molecule**	

3 (a) (i) Crude oil is a ..... of different substances.

[1 mark]

3 (a) (ii) The substances in crude oil have different ..... points.

[1 mark]

3 (a) (iii) Crude oil is separated by fractional ..... .

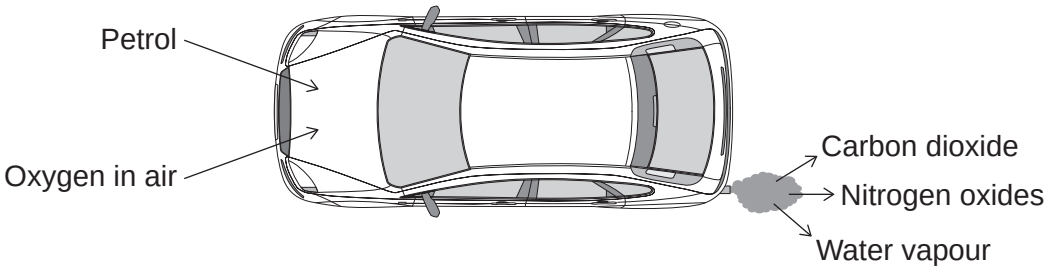
[1 mark]

3 (b) Petrol is one of the fractions produced from crude oil.

Car engines use a mixture of petrol and air.

Figure 5 shows some of the gases produced.

Figure 5



4.7.1.2 Fractional distillation and petrochemicals

Question 13 · continued

3 (b) (i) What type of reaction happens to petrol in a car engine?

[1 mark]

Tick (✓) **one** box.

combustion ☐

decomposition ☐

neutralisation ☐

3 (b) (ii) Petrol contains octane (C_8H_{18}).

Complete the word equation for the reaction of octane with oxygen.

[2 marks]

octane + ... ⟶ ..... + ...

3 (b) (iii) Cars use sulfur-free petrol as a fuel.

Describe why sulfur should be removed from petrol.

[2 marks]

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Question 3 continues on the next page

4.7.1.2 Fractional distillation and petrochemicals

Question 13 · continued

3 (c) Some fractions from crude oil contain large hydrocarbon molecules.

These molecules can be cracked to produce smaller, more useful molecules.

An equation for cracking decane is:

$$\underset{\text{decane}}{C_{10}H_{22}} \longrightarrow \underset{\text{propane}}{C_3H_8} + \underset{\text{ethene}}{C_2H_4} + \underset{\text{pentene}}{C_5H_{10}}$$

3 (c) (i) Why is propane useful?

[1 mark]

Tick (✓) **one** box.

Propane is a polymer. ☐

Propane is an alloy. ☐

Propane is a fuel. ☐

3 (c) (ii) Draw bonds to complete the displayed structure of ethene.

[1 mark]



4.7.1.2 Fractional distillation and petrochemicals

Question 13 · continued

3 (c) (iii) What is the colour change when bromine water reacts with ethene?

[1 mark]

Tick (✓) **one** box.

Orange to colourless ☐

Orange to green ☐

Orange to red ☐

3 (c) (iv) Complete the sentence.

[1 mark]

Pentene is useful because many pentene molecules can join together to form ..... .

12

4.7.1.2 Fractional distillation and petrochemicals

Question 14

June 2015 | CH1FP | Original Q4 | Legacy

4 Polymers and fuels can be produced from crude oil and from plants.

4 (a) There are many types of polymer. Each polymer has different properties.

4 (a) (i) Poly(chloroethene) is a polymer produced from crude oil.

Why is poly(chloroethene) used for water pipes?

[2 marks]

Tick (✓) **two** boxes.

The polymer is not biodegradable. ☐

The polymer is made from crude oil. ☐

The polymer decomposes when heated. ☐

The polymer is waterproof. ☐

The polymer does not conduct electricity. ☐

4 (a) (ii) Some shopping bags are made from a biopolymer.

Biopolymers are produced from plants.

Suggest **one** advantage of using a biopolymer.

[1 mark]

.....

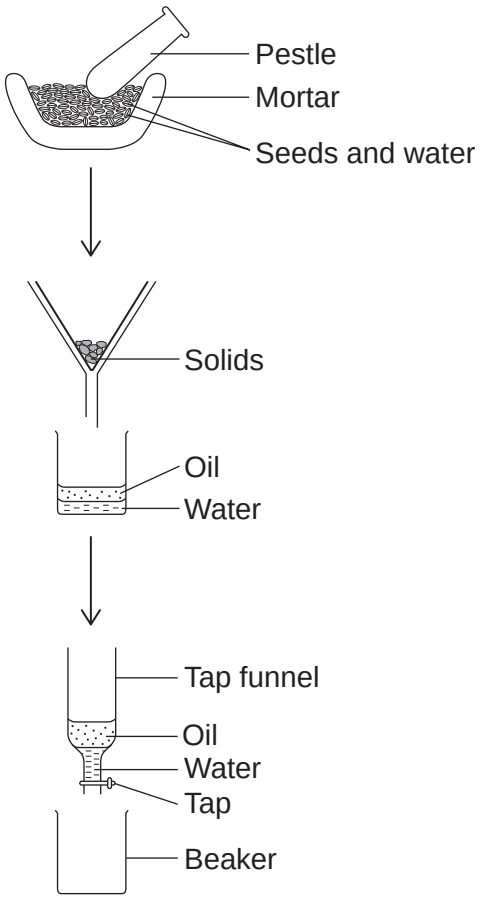
.....

4.7.1.2 Fractional distillation and petrochemicals

Question 14 · continued

4 (b) Some plants have seeds that contain vegetable oils.
The flow diagram in **Figure 6** shows how the oil can be extracted.

Figure 6



4 (b) (i) Use the correct word from the box to complete each sentence.

[2 marks]

burning	**crushing**	**distilling**	**filtering**

Oil is released from the seeds by..... .

Solids are removed from the oil and water by ..... .

4 (b) (ii) Describe how the tap funnel can be used to separate the oil from the water.

[2 marks]

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.....

.....

4.7.1.2 Fractional distillation and petrochemicals

Question 14 · continued

4 (c) Vegetable oils are used as foods and fuels.

4 (c) (i) Why are vegetable oils important foods and fuels?

[1 mark]

Tick (✓) **one** box.

They are used as emulsifiers. ☐

They have high boiling points. ☐

They provide a lot of energy. ☐

4 (c) (ii) Burning fossil fuels made from crude oil increases the overall percentage of carbon dioxide in the atmosphere.

Burning biofuels made from vegetable oil does **not** increase the overall percentage of carbon dioxide in the atmosphere.

Explain why.

[2 marks]

.....

.....

.....

.....

10

4.7.1.2 Fractional distillation and petrochemicals

Question 15

June 2016 | CH1FP | Original Q5 | Legacy

5 This question is about hydrocarbons.

5 (a) Most of the hydrocarbons in crude oil are alkanes.

5 (a) (i) Large alkane molecules can be cracked to produce more useful molecules.

The equation shows the cracking of dodecane.

$$\underset{\text{dodecane}}{C_{12}H_{26}} \longrightarrow \underset{\text{butane}}{C_4H_{10}} + \underset{\text{hexene}}{C_6H_{12}} + \underset{\text{ethene}}{C_2H_4}$$

Give **two** conditions used to crack large alkane molecules.

[2 marks]

1 _____

2 _____

5 (a) (ii) The products hexene and ethene are alkenes.

Complete the sentence.

[1 mark]

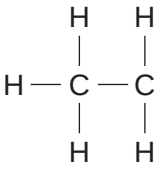
When alkenes react with bromine water the colour changes

from orange to _____ .

5 (a) (iii) Butane (C_4H_{10}) is an alkane.

Complete the displayed structure of butane.

[1 mark]



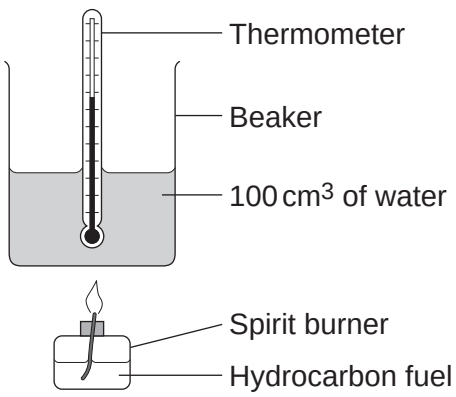
Question 5 continues on the next page

Question 15 · continued

5 (b) A group of students investigated the energy released by the combustion of four hydrocarbon fuels.

Figure 12 shows the apparatus used.

Figure 12



Each hydrocarbon fuel was burned for two minutes.

Table 2 shows the students' results.

Table 2

	After two minutes				
Name and formula of hydrocarbon fuel	**Mass of fuel used in g**	**Temperature increase of water in °C**	**Energy released by fuel in kJ**	**Energy released by 1.0 g of fuel in kJ**	**Relative amount of smoke in the flame**
Hexane, C_6H_{14}	0.81	40	16.80	20.74	very little smoke
Octane, C_8H_{18}	1.10	54	22.68	20.62	some smoke
Decane, $C_{10}H_{22}$	1.20	58	24.36		smoky
Dodecane, $C_{12}H_{26}$	1.41	67	28.14	19.96	very smoky

4.7.1.2 Fractional distillation and petrochemicals

Question 15 · continued

5 (b) (i) Calculate the energy released by 1.0 g of decane in kJ.

[2 marks]

Energy released = _____ kJ

5 (b) (ii) Suggest **one** improvement to the apparatus, or the use of the apparatus, that would make the temperature increase of the water for each fuel more accurate.

Give a reason why this is an improvement.

[2 marks]

5 (b) (iii) The students noticed that the bottom of the beaker became covered in a black substance when burning these fuels.

Name this black substance.

Suggest why it is produced.

[2 marks]

5 (b) (iv) A student concluded that hexane is the best of the four fuels.

Give **two** reasons why the results in **Table 2** support this conclusion.

[2 marks]

1 _____

2 _____

Question 5 continues on the next page

4.7.1.2 Fractional distillation and petrochemicals

Question 15 · continued

5 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Most car engines use petrol as a fuel.

- Petrol is produced from the fractional distillation of crude oil.
- Crude oil is a mixture of hydrocarbons.
- Sulfur is an impurity in crude oil.

Car engines could be developed to burn hydrogen as a fuel.

- Hydrogen is produced from natural gas.
- Natural gas is mainly methane.

Table 3 shows information about petrol and hydrogen.

Table 3

	Petrol	**Hydrogen**
State of fuel at room temperature	Liquid	Gas
Word equation for combustion of the fuel	petrol + oxygen ⟶ carbon dioxide + water	hydrogen + oxygen ⟶ water
Energy released from combustion of 1 g of the fuel	47 kJ	142 kJ

Describe the **advantages** and **disadvantages** of using hydrogen instead of petrol in car engines.

Use the information given and your knowledge and understanding to answer this question.

[6 marks]

4.7.1.2 Fractional distillation and petrochemicals

Question 16

June 2018 | 8462/1F | Original Q1

0 1 This question is about mixtures.

0 1 . 1 Substances are separated from a mixture using different methods.

Draw **one** line from each substance and mixture to the best method of separation.

[3 marks]

Substance and mixture	Method of separation
	Chromatography
Ethanol from ethanol and water	
	Crystallisation
Salt from sea water	Electrolysis
	Filtration
The different colours in black ink	
	Fractional distillation

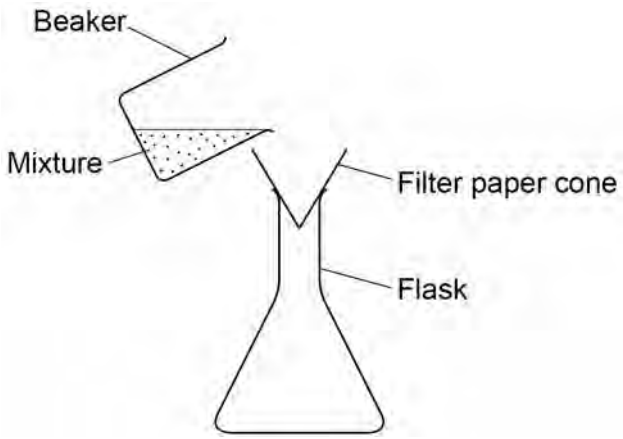
4.7.1.2 Fractional distillation and petrochemicals

Question 16 · continued

0 1 . 2 A student filters a mixture.

Figure 1 shows the apparatus.

Figure 1



Suggest **one** improvement to the apparatus.

[1 mark]

_____

_____

0 1 . 3 Complete the sentences.

Choose answers from the box.

[2 marks]

condense	**evaporate**	**freeze**	**melt**	**solidify**

In simple distillation, the mixture is heated to make the liquid _____.

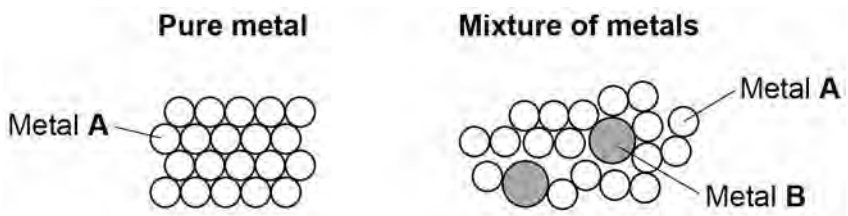
The vapour is then cooled to make it _____.

4.7.1.2 Fractional distillation and petrochemicals

Question 16 · continued

Figure 2 shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 2



0 1 . 4 Calculate the percentage of metal **B** atoms in the mixture of metals shown in **Figure 2**.

[2 marks]

Percentage of metal **B** atoms = _____ %

0 1 . 5 What is a mixture of metals called?

[1 mark]

Tick **one** box.

- An alloy ☐
- A compound ☐
- A molecule ☐
- A polymer ☐

Question 16 · continued

0 1 . 6 Why is the mixture of metals in **Figure 2** harder than the pure metal?

[1 mark]

Tick **one** box.

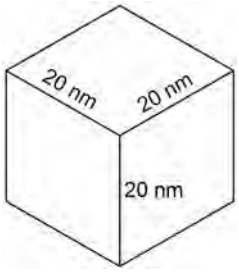
- The atoms in the mixture are different shapes. ☐
- The layers in the mixture are distorted. ☐
- The layers in the mixture slide more easily. ☐
- The mixture has a giant structure. ☐

0 1 . 7 A nanoparticle of pure metal **A** is a cube.

Each side of the cube has a length of 20 nm.

Figure 3 shows the cube.

Figure 3



What is the volume of the nanoparticle?

[1 mark]

Tick **one** box.

- 20 nm^3 ☐
- 60 nm^3 ☐
- 400 nm^3 ☐
- 8000 nm^3 ☐

11

4.7.1.2 Fractional distillation and petrochemicals

Question 17

June 2019 | 8462/2F | Original Q8

0 8 This question is about crude oil and hydrocarbons.

Figure 6 shows a fractionating column used to separate crude oil into fractions.

Figure 6

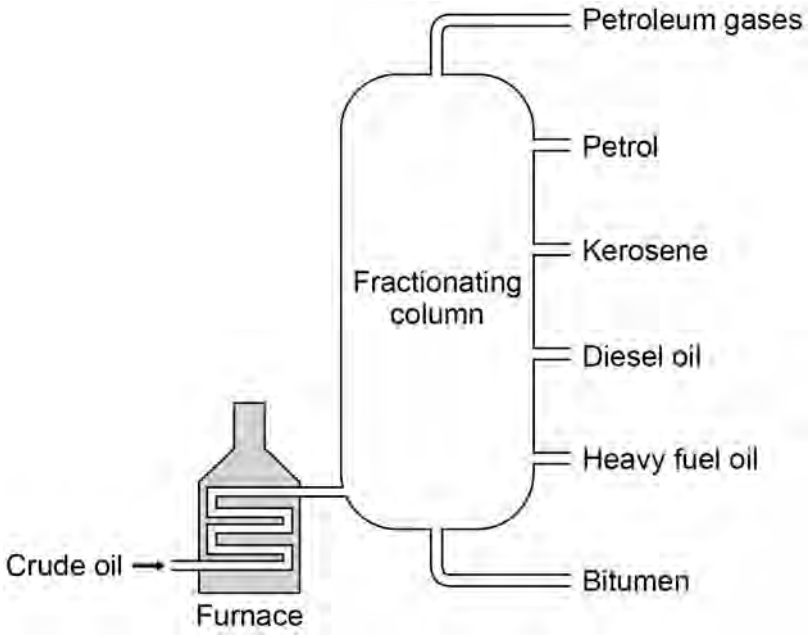


Table 5 gives information about some of the fractions.

Table 5

Fraction	Boiling point range in °C
Petroleum gases	Below 30
Petrol	40–110
Kerosene	180–260
Diesel oil	260–320
Heavy fuel oil	320–400
Bitumen	400–450

4.7.1.2 Fractional distillation and petrochemicals

Question 17 · continued

June 2019 | 8462/2F | Original Q8

0 8 . 1 Suggest a suitable temperature for the furnace in **Figure 6**.

[1 mark]

_____ °C

0 8 . 2 Explain why diesel oil collects above heavy fuel oil but below kerosene in the fractionating column.

Use **Table 5**.

[2 marks]

_____

_____

_____

_____

0 8 . 3 Suggest **two** reasons why bitumen is **not** used as a fuel.

[2 marks]

1 _____

_____

2 _____

_____

Question 8 continues on the next page

4.7.1.2 Fractional distillation and petrochemicals

Question 17 · continued

0 8 . 4 Petrol contains mainly alkanes.

Which of the following compounds is an alkane?

[1 mark]

Tick (✓) **one** box.

C_2H_4 ☐

C_4H_8 ☐

C_6H_{14} ☐

C_8H_{16} ☐

Large hydrocarbon molecules in the diesel oil fraction are cracked to produce smaller hydrocarbon molecules.

0 8 . 5 Describe the conditions needed to crack hydrocarbon molecules from the diesel oil fraction.

[2 marks]

4.7.1.2 Fractional distillation and petrochemicals

Question 17 · continued

0 8 . 6 Explain why large hydrocarbon molecules in the diesel oil fraction are cracked to produce smaller hydrocarbon molecules.

[2 marks]

0 8 . 7 Complete the equation for the cracking of $C_{15}H_{32}$

[1 mark]

$$C_{15}H_{32} \rightarrow C_{12}H_{26} + _____$$

11

Turn over for the next question

4.7.1.2 Fractional distillation and petrochemicals

Question 18

November 2021 | 8462/2F | Original Q9

0 9 This question is about alkanes.

Table 6 shows information about some alkanes.

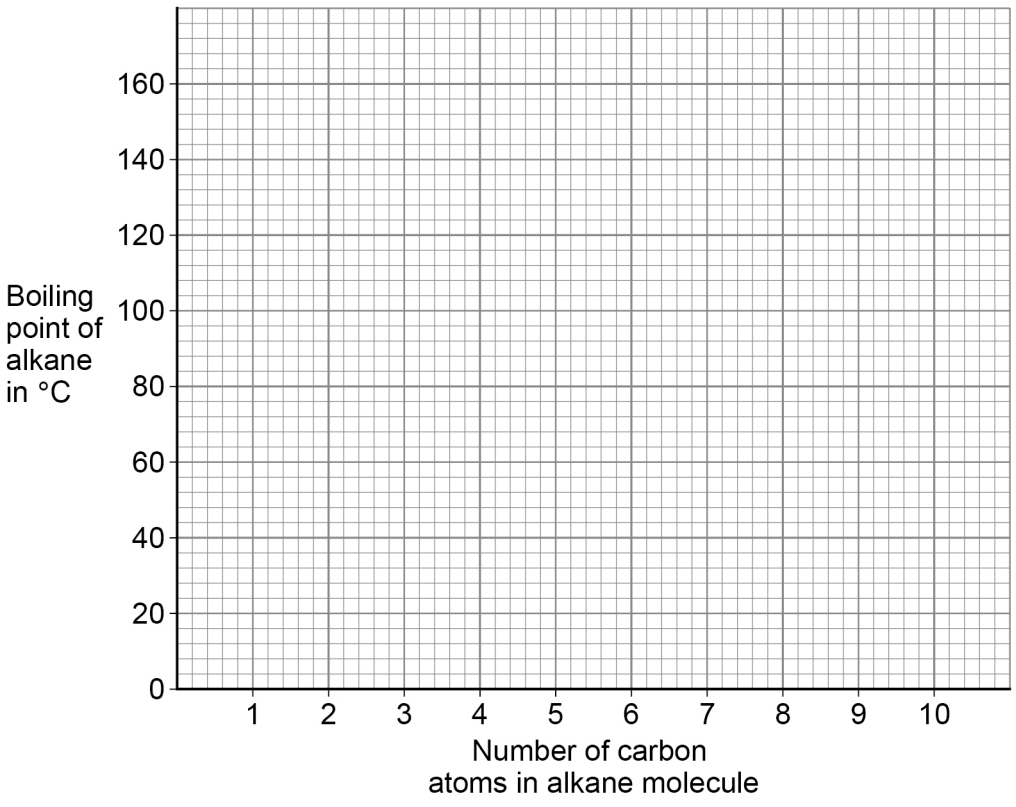
Table 6

Number of carbon atoms in alkane molecule	Boiling point of alkane in °C
4	0
5	36
6	69
7	**X**
8	126
9	151

0 9 . 1 Plot the data from **Table 6** on **Figure 7**.

[2 marks]

Figure 7



Question 18 · continued

0 9 . 2 Predict the boiling point **X** of the alkane with seven carbon atoms in a molecule.

Use **Table 6** and **Figure 7**.

[1 mark]

X = _____ °C

0 9 . 3 **Figure 7** is **not** suitable to show the boiling point of the alkane with three carbon atoms in a molecule.

Suggest **one** reason why.

[1 mark]

_____

_____

0 9 . 4 What is the state at 20 °C of the alkane with four carbon atoms in a molecule?

Use **Table 6**.

[1 mark]

_____

Question 9 continues on the next page

Question 18 · continued

Table 6 is repeated below.

Table 6

Number of carbon atoms in alkane molecule	Boiling point of alkane in °C
4	0
5	36
6	69
7	**X**
8	126
9	151

The alkane with nine carbon atoms in a molecule is called nonane.

0 9 . 5 Complete the formula of nonane.

[1 mark]

C_9H____

0 9 . 6 Nonane will condense lower in a fractionating column during fractional distillation than the other alkanes in **Table 6**.

Explain why.

You should refer to the temperature gradient in the fractionating column.

[2 marks]

8

4.7.1.2 Fractional distillation and petrochemicals

Question 19

0 2 This question is about hydrocarbons in crude oil.

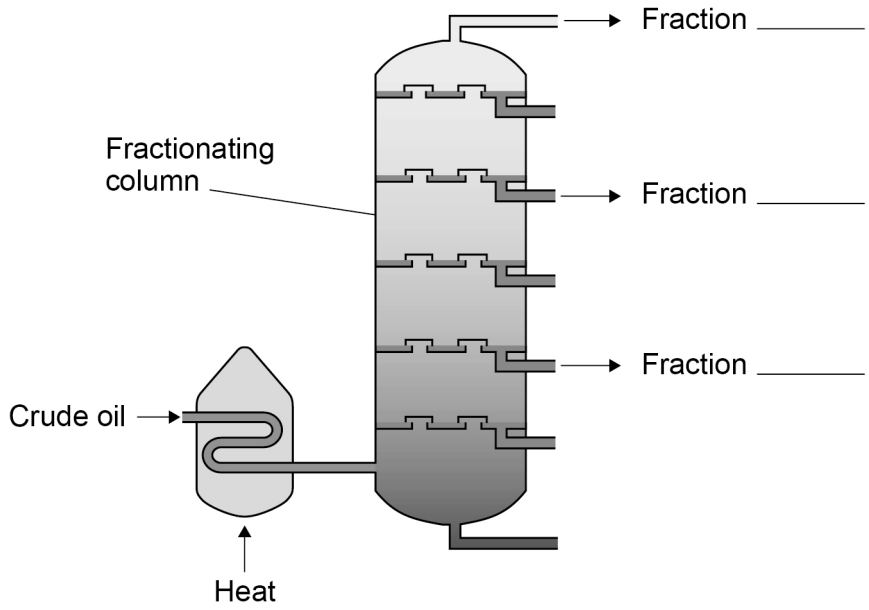
0 2 . 1 **Table 2** shows information about three fractions obtained from crude oil.

Table 2

Fraction	Boiling point range in °C
A	200–300
B	100–150
C	Below 30

Figure 1 shows the fractionating column used to separate fractions **A**, **B** and **C**.

Figure 1



The temperature of the fractionating column is:

- 30 °C at the top
- 400 °C at the bottom.

Complete **Figure 1** to show where fractions **A**, **B** and **C** are collected.

[1 mark]

4.7.1.2 Fractional distillation and petrochemicals

Question 19 · continued

0 2 . 2 **Table 3** shows information about three fractions obtained from crude oil.

Table 3

Fraction	Range of number of carbon atoms in each molecule
Petrol	5–12
Diesel oil	15–19
Heavy fuel oil	20–40

Complete the sentences.

Choose answers from the box.

[2 marks]

lower	the same	higher

Compared to petrol, the viscosity of heavy fuel oil is _____.

Compared to petrol, the flammability of diesel oil is _____.

Question 2 continues on the next page

Question 19 · continued

Table 4 shows the percentage of two fractions obtained from two different sources of crude oil.

Table 4

Source	Percentage (%) of fraction	
	Kerosene	Heavy fuel oil
J	13	30
K	4	44

0 2 . 3 Complete **Figure 2**.

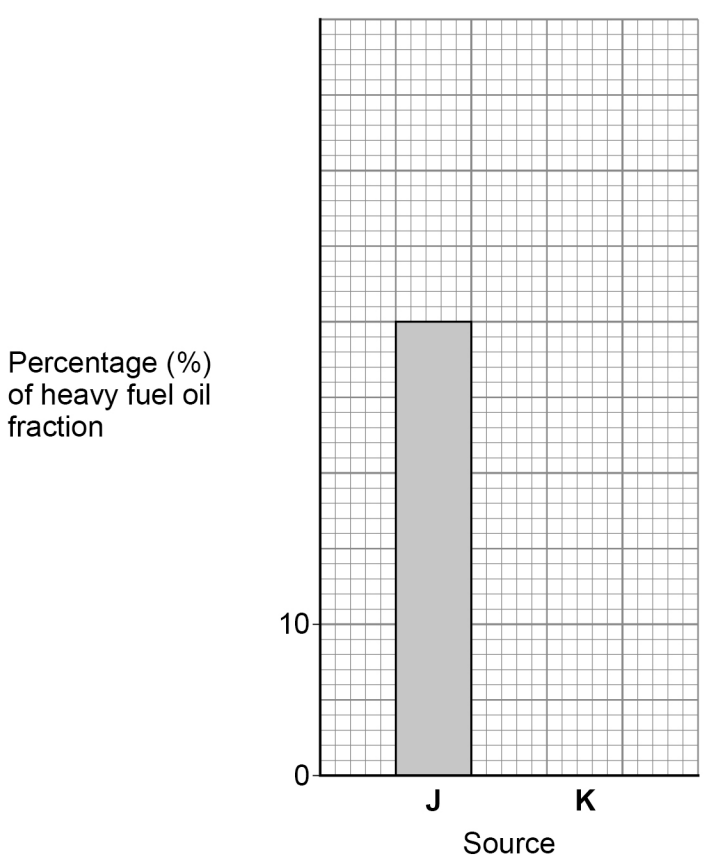
You should:

- complete the *y*-axis scale
- plot the percentage of the heavy fuel oil fraction obtained from source **K**.

Use **Table 4**.

[2 marks]

Figure 2



4.7.1.2 Fractional distillation and petrochemicals

Question 19 · continued

0 2 . 4 Kerosene is in higher demand than heavy fuel oil.

Suggest why crude oil from source **J** is in higher demand than crude oil from source **K**.

Use **Table 4**.

[1 mark]

Large hydrocarbon molecules can be cracked to produce smaller hydrocarbon molecules including alkanes.

0 2 . 5 Which **two** of the following can be used to crack large hydrocarbon molecules?

[2 marks]

Tick (✓) **two** boxes.

- A catalyst ☐
- A fertiliser ☐
- Air ☐
- Ozone ☐
- Steam ☐

0 2 . 6 Alkanes have the general formula C_nH_{2n+2}

Complete the formula of the alkane molecule containing 11 carbon atoms.

[1 mark]

$C_{11}H$___

4.7.1.2 Fractional distillation and petrochemicals

Question 19 · continued

0 2 . 7 C_2H_6 is an alkane.

Which type of bond is found in a C_2H_6 molecule?

[1 mark]

Tick (✓) **one** box.

A double bond between two carbon atoms. ☐

A double bond between two hydrogen atoms. ☐

A single bond between two carbon atoms. ☐

A single bond between two hydrogen atoms. ☐

0 2 . 8 Which **two** substances are produced when alkanes completely combust?

[2 marks]

Tick (✓) **two** boxes.

Carbon ☐

Carbon dioxide ☐

Carbon monoxide ☐

Hydrogen ☐

Water ☐

12

4.7.1.2 Fractional distillation and petrochemicals

Question 20

June 2023 | 8462/2F | Original Q2

0 2 This question is about glass and polymers.

Beakers can be made from borosilicate glass or poly(propene).

Table 1 shows information about materials used to make beakers.

Table 1

	Material used to make beakers	
	borosilicate glass	**poly(propene)**
Temperature at which melting begins in °C	850	160
Flammability	does not burn	burns
Resistance to impact	shatters	tough
Cost of 100 cm^3 beaker in £	1.50	2.00

0 2 . 1 Suggest **two** reasons why a Bunsen burner should **not** be used to heat a liquid in a poly(propene) beaker.

Use **Table 1**.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 2 Poly(propene) beakers are more expensive than borosilicate glass beakers.

Suggest **one** reason why using poly(propene) beakers instead of borosilicate glass beakers could save money.

Use **Table 1**.

[1 mark]

_____

_____

4.7.1.2 Fractional distillation and petrochemicals

Question 20 · continued

0 2 . 3 Which is a raw material used to make borosilicate glass?

[1 mark]

Tick (✓) **one** box.

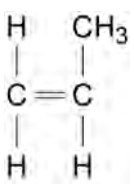
Boron trioxide ☐

Clay ☐

Limestone ☐

Poly(propene) is produced from propene.

The displayed structural formula of propene is:



0 2 . 4 **Table 2** shows some information about the elements in one molecule of propene.

Table 2

Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C		
H		

Complete **Table 2**.

[2 marks]

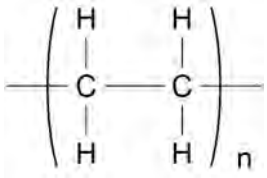
4.7.1.2 Fractional distillation and petrochemicals

Question 20 · continued

0 2 . 5 Which structure is the repeating unit of poly(propene)?

[1 mark]

Tick (✓) **one** box.



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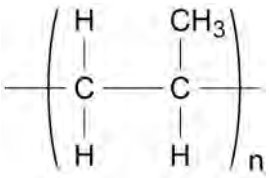

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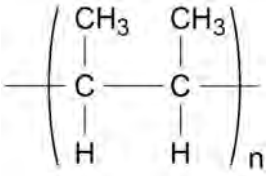

☐

0 2 . 6 Poly(propene) is produced in three stages:

- **Stage 1:** separating large alkane molecules from crude oil
- **Stage 2:** producing propene molecules from large alkane molecules
- **Stage 3:** joining many propene molecules together.

Name **Stage 1**, **Stage 2** and **Stage 3**.

Choose answers from the box.

[3 marks]

cracking	**fermentation**	**fractional distillation**
polymerisation	**reverse osmosis**	

Stage 1 is _____.

Stage 2 is _____.

Stage 3 is _____.

4.7.1.2 Fractional distillation and petrochemicals

Question 20 · continued

0 2 . 7 A molecule of hexene contains a double carbon–carbon bond.

Many hexene molecules join together to form poly(hexene).

Which **two** words describe a hexene molecule in this process?

[2 marks]

Tick (✓) **two** boxes.

- Alkene ☐
- Catalyst ☐
- Composite ☐
- Element ☐
- Monomer ☐

12