AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.7.1.1

Crude oil, hydrocarbons and alkanes

Past-paper questions

Tier	**Higher**
Question groups	**12**
Available paper years	**2018–2025**

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.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 01

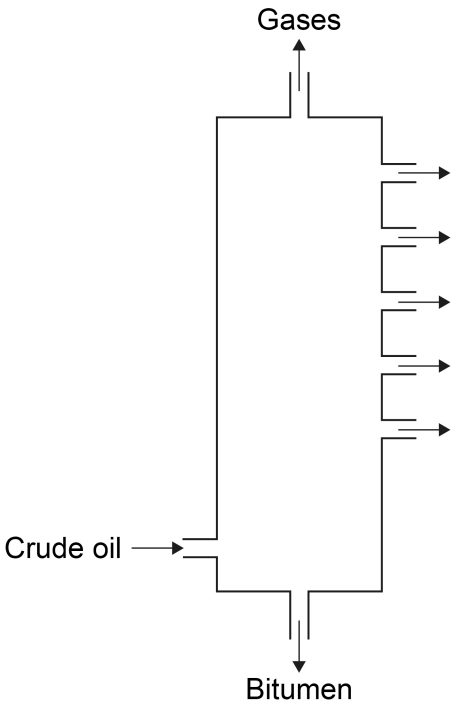
June 2018 | 8464/C/2H | Original Q1

0 1 Crude oil is a mixture of hydrocarbons.

0 1 . 1 The hydrocarbons in crude oil are separated into fractions by fractional distillation.

Figure 1 shows a fractional distillation column.

Figure 1



Crude oil vapour passes up the column.

Complete the sentence.

Choose the answer from the box.

[1 mark]

condenses	**dissolves**	**freezes**	**melts**

Each fraction _____ at a different level.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 01 · continued

0 1 . 2 Why do the fractions separate?

[1 mark]

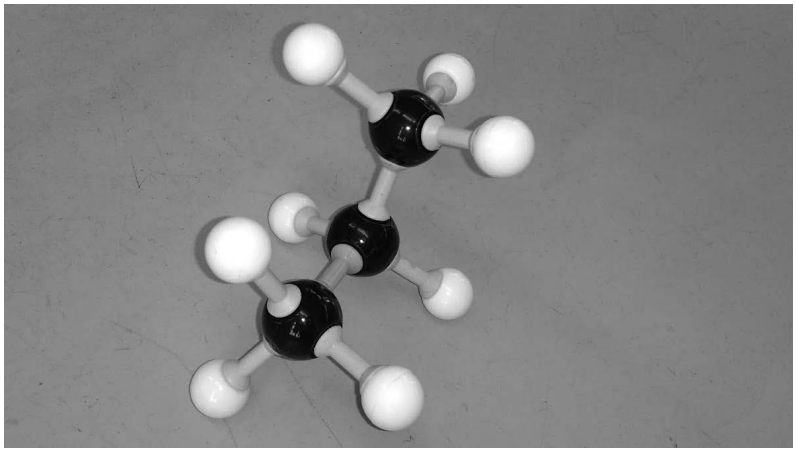
Tick **one** box.

- The fractions have different boiling points. ☐
- The fractions have different flammability. ☐
- The fractions have different melting points. ☐
- The fractions have different viscosity. ☐

Most of the hydrocarbons in crude oil are alkanes.

0 1 . 3 **Figure 2** represents an alkane molecule.

Figure 2



Name the alkane.

[1 mark]

_____

Question 1 continues on the next page

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 01 · continued

0 1 . 4 Methane (CH_4) is an alkane.

What is the general formula for alkanes?

[1 mark]

Tick **one** box.

- C_nH_n ☐
- C_nH_{2n} ☐
- C_nH_{2n-2} ☐
- C_nH_{2n+2} ☐

0 1 . 5 Alkanes burn in oxygen.

Balance the equation for methane burning.

[1 mark]

$$____ CH_4 + ____ O_2 \rightarrow ____ CO_2 + ____ H_2O$$

0 1 . 6 Ethene is an alkene.

Which reagent is used to test for alkenes?

[1 mark]

Tick **one** box.

- Anhydrous copper sulfate ☐
- Bromine water ☐
- Damp litmus paper ☐
- Limewater ☐

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 01 · continued

Table 1 shows data from a life cycle assessment (LCA) for the disposal of 10 000 biodegradable plastic bags.

Table 1

	Burning and using the energy to generate electricity	Landfill
Mass of carbon dioxide produced in kg	25	15
Mass of solid residue in kg	0.050	0.070
Mass of sulfur dioxide produced in kg	0.20	0.30

0 1 . 7 Why are life cycle assessments (LCA) done?

[1 mark]

0 1 . 8 Compare the **two** methods for the disposal of biodegradable plastic bags.

Use information from **Table 1**

[4 marks]

11

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 02

June 2019 | 8464/C/2H | Original Q7

0 7 This question is about hydrocarbons and crude oil.

0 7 . 1 Hydrocarbon fuels are produced from crude oil.

Describe how crude oil is separated into fractions.

[4 marks]

Butane is a hydrocarbon.

0 7 . 2 Two equations for the combustion of butane are:

- $2\,C_4H_{10} + 13\,O_2 \rightarrow 8\,CO_2 + 10\,H_2O$
- $2\,C_4H_{10} + 5\,O_2 \rightarrow 8\,C + 10\,H_2O$

Why are different products formed?

[1 mark]

0 7 . 3 One other product of the combustion of butane is carbon monoxide.

Balance the equation.

[1 mark]

____ C_4H_{10} + ____ O_2 → ____ CO + ____ H_2O

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 02 · continued

0 7 . 4 Carbon dioxide is a greenhouse gas.

Describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter.

[4 marks]

10

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 03

November 2020 | 8464/C/2H | Original Q5

0 5 This question is about crude oil and alkanes.

0 5 . 1 Describe how crude oil is formed.

[3 marks]

0 5 . 2 Describe how crude oil is separated into fractions by fractional distillation.

[4 marks]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 03 · continued

Table 2 shows the boiling points of three alkanes.

Table 2

Alkanes	Boiling point in °C
C_5H_{12}	36
$C_{10}H_{22}$	174
$C_{15}H_{32}$	271

0 5 . 3 What is the general formula for alkanes?

[1 mark]

0 5 . 4 Explain the trend in the boiling points of the alkanes.

[3 marks]

Question 5 continues on the next page

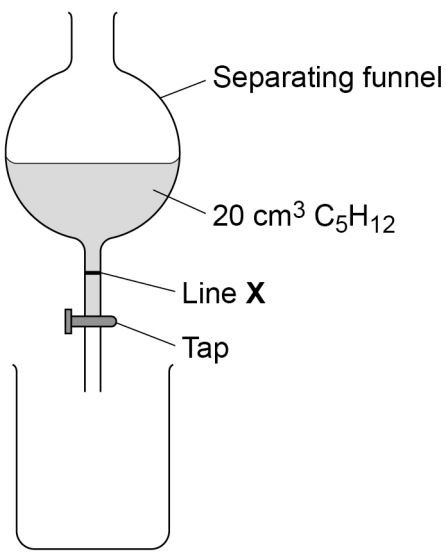
0 5 . 5 A student investigated one property of the alkanes C_5H_{12}, $C_{10}H_{22}$ and $C_{15}H_{32}$

This is the method used.

1. Pour 20 cm^3 of C_5H_{12} into a separating funnel.
2. Open the tap of the separating funnel and start a timer.
3. Stop the timer when the level of C_5H_{12} reaches line **X**.
4. Repeat steps 1 to 3 with $C_{10}H_{22}$ and $C_{15}H_{32}$

Figure 5 shows the apparatus used.

Figure 5



The level of C_5H_{12} takes 6.4 seconds to reach line **X**.

Predict the trend in times for the other two alkanes.

Give **one** reason for your answer.

[2 marks]

Trend _____

_____

Reason _____

_____

13

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 04

November 2021 | 8464/C/1H | Original Q7

0 7 Methane, ethane, propane and butane all react with oxygen to produce carbon dioxide and water.

0 7 . 1 Suggest why a mixture of methane and oxygen does **not** react at room temperature.

Answer in terms of particles.

[2 marks]

0 7 . 2 **Table 3** shows the energy released when methane, ethane and propane react with oxygen to produce carbon dioxide and water.

Table 3

	Compound reacted with oxygen		
	Methane	Ethane	Propane
Formula of compound	CH_4	C_2H_6	C_3H_8
Energy released in kJ/mol	680	1160	1640

Predict the energy released when butane (C_4H_{10}) reacts with oxygen to produce carbon dioxide and water.

[1 mark]

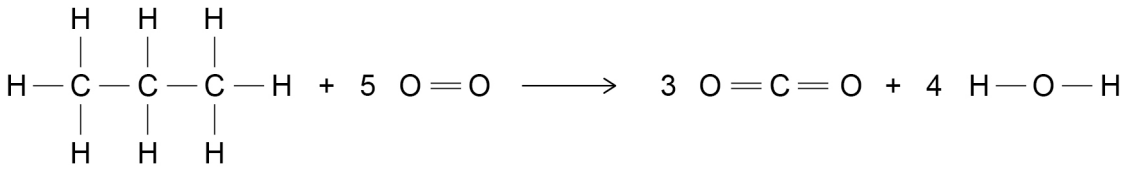
Energy released = _____ kJ/mol

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 04 · continued

0 7 . 3 Propane reacts with oxygen to produce carbon dioxide and water.

The displayed formula equation for the reaction is:



The reaction is exothermic.

In the reaction, the energy released when forming new bonds is 1640 kJ/mol greater than the energy needed when breaking bonds.

Table 4 shows bond energies.

Table 4

Bond	**H–C**	**C–C**	**O=O**	**C=O**	**O–H**
Bond energy in kJ/mol	410	**X**	500	740	460

Calculate the C—C bond energy (**X**).

[5 marks]

X = _____ kJ/mol

8

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 05

November 2021 | 8464/C/2H | Original Q2

0 2 Crude oil is a resource found in rocks.

Most of the compounds in crude oil are hydrocarbons.

0 2 . 1 Complete the sentence.

[1 mark]

Crude oil is formed by the decomposition of _____.

0 2 . 2 Alkanes are hydrocarbons.

Give the name of the alkane molecule that has three carbon atoms.

[1 mark]

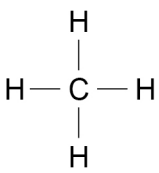
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Question 2 continues on the next page

0 2 . 3 **Figure 3** shows two alkane molecules.

Figure 3

Methane



Hexane

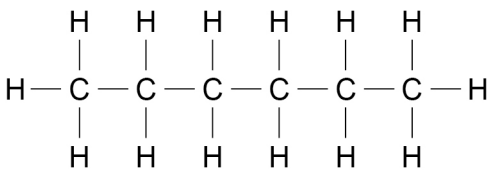


Table 2 shows the melting points and boiling points of methane and hexane.

Table 2

	Melting point in °C	Boiling point in °C
Methane	−183	−162
Hexane	−95	69

Compare the structure and properties of methane and hexane.

[6 marks]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 05 · continued

Hydrocarbons are cracked to produce more useful alkanes and alkenes.

0 2 . 4 Decane ($C_{10}H_{22}$) is cracked to produce **two** products.

Complete the equation for the reaction.

[1 mark]

$$C_{10}H_{22} \rightarrow _____ + C_2H_4$$

0 2 . 5 C_2H_4 is an alkene.

What is the test for alkenes?

Give the result of the test if an alkene is present.

[2 marks]

Test _____

_____

Result _____

_____

11

5.7.1.1 Crude oil, hydrocarbons and alkanes

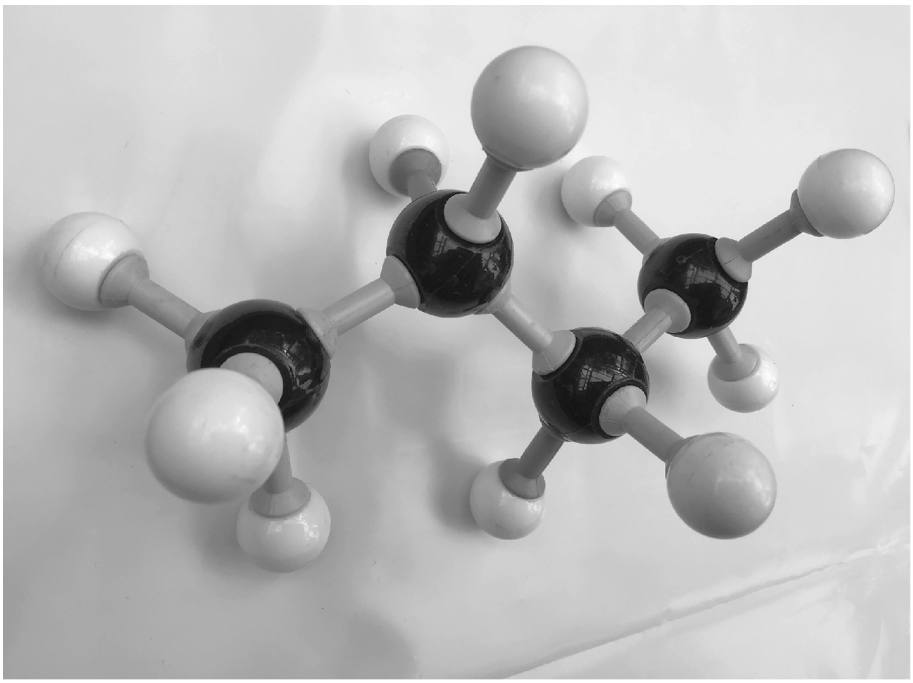
Question 06

June 2022 | 8464/C/2H | Original Q4

0 4 This question is about hydrocarbons and the uses of hydrocarbons.

0 4 . 1 **Figure 6** shows a model of an alkane.

Figure 6



What is the name of the alkane in **Figure 6**?

[1 mark]

0 4 . 2 What is a hydrocarbon?

[1 mark]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 06 · continued

Large hydrocarbon molecules are cracked.

0 4 . 3 When $C_{11}H_{24}$ is cracked, three products are formed.

Complete the equation for the reaction.

[2 marks]

$$C_{11}H_{24} \rightarrow C_5H_{10} + 2 \text{ _____} + \text{ _____}$$

0 4 . 4 Explain why **one** of the products of cracking is in high demand.

[2 marks]

Question 4 continues on the next page

0 4 . 5 Window frames can be manufactured from wood or from plastic.

Table 2 shows data from a life cycle assessment (LCA) for a wooden window frame and a plastic window frame.

Both window frames are the same size.

Table 2

	Wood	Plastic
Sources of hydrocarbons used for production in kg	5.37	18.23
Greenhouse gases released during production, use and disposal in kg equivalent of CO_2	457	487
Oxides of nitrogen and sulfur dioxide produced in arbitrary units	29.6	37.7
Waste materials in kg	16.5	28.8
Total energy consumption in production, use and disposal in MJ	9150	9713
Lifetime cost to customer to buy and maintain in £	147	102

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 06 · continued

Evaluate the sustainability of wooden and plastic window frames.

You should include environmental and economic factors.

[6 marks]

12

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 07

0 1 The combustion of fuels is a source of atmospheric pollutants.

0 1 . 1 Methane is a fuel.

Balance the equation for the combustion of methane.

[1 mark]

$$CH_4 + ____ O_2 \rightarrow CO_2 + ____ H_2O$$

0 1 . 2 Many fuels are mixtures.

Petrol and diesel are mixtures of hydrocarbons.

Table 1 shows properties of petrol and of diesel.

Table 1

	Petrol	**Diesel**
Range of number of carbon atoms in a hydrocarbon molecule	4 to 12	12 to 20
Range of boiling points in °C	40 to 205	250 to 350

Compare the properties of petrol and diesel.

Use **Table 1**.

[2 marks]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 07 · continued

0 1 . 3 The gases released when a fuel is burned in car engines may include:

- oxides of nitrogen
- carbon monoxide
- water vapour.

Which chemical element do all these gases contain?

[1 mark]

Tick (✓) **one** box.

Carbon ☐

Hydrogen ☐

Nitrogen ☐

Oxygen ☐

0 1 . 4 When diesel burns in car engines, oxides of nitrogen are produced.

Where does the nitrogen come from?

[1 mark]

0 1 . 5 When diesel burns, particulates may be produced.

What environmental effect do particulates from burning diesel cause?

[1 mark]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 07 · continued

0 1 . 6 Carbon monoxide may be produced when diesel burns.

Give **one** reason why carbon monoxide is difficult to detect.

[1 mark]

0 1 . 7 Explain why water vapour and **not** liquid water is produced when diesel burns.

[2 marks]

0 1 . 8 Sulfur is a common impurity in diesel.

Explain why this causes an environmental problem.

[3 marks]

12

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 08

0 3 Crude oil is a mixture of many different compounds.

0 3 . 1 Give **two** reasons why crude oil is **not** a formulation.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 2 Describe how crude oil is separated into fractions.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

0 3 . 3 The fractions from crude oil contain alkanes.

Explain why alkanes are cracked.

[2 marks]

_____

_____

_____

_____

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 08 · continued

Cracking produces a mixture of products.

0 3 . 4 An equation for cracking decane ($C_{10}H_{22}$) is:

$$C_{10}H_{22}(l) \rightarrow C_{10}H_{20}(l) + H_2(g)$$

Describe a test to identify the gas produced in the reaction.

[2 marks]

Test _____

_____

Result _____

_____

0 3 . 5 Alkenes are produced in cracking.

The general formula for the homologous series of alkenes is C_nH_{2n}

Which formula represents an alkene?

[1 mark]

Tick (✓) **one** box.

C_2H_2 ☐

C_2H_4 ☐

C_2H_6 ☐

C_3H_8 ☐

11

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 09

June 2024 | 8464/C/2H | Original Q1

0 1 Alkanes and alkenes are hydrocarbons.

0 1 . 1 Define the term 'hydrocarbon'.

[1 mark]

0 1 . 2 The general formula for alkanes is C_nH_{2n+2}

Determine the formula of the alkane with 10 carbon atoms.

[1 mark]

Formula = _____

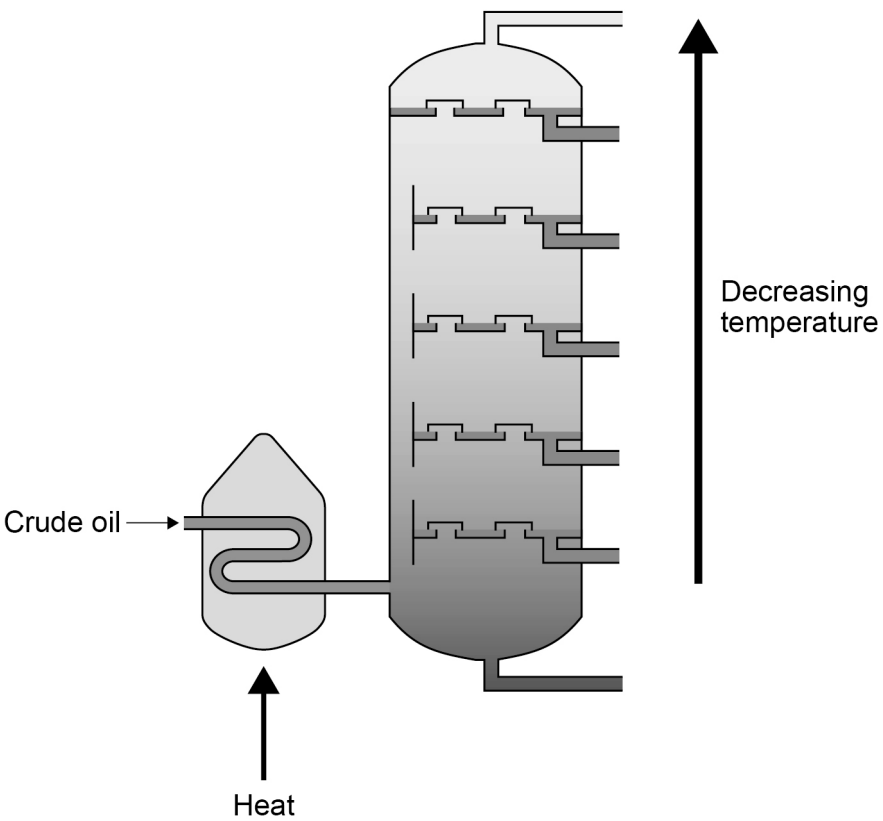
Question 1 continues on the next page

Question 09 · continued

0 1 . 3 Crude oil is a mixture of hydrocarbons.

Figure 1 represents industrial equipment used to separate crude oil into fractions.

Figure 1



Explain how crude oil is separated into fractions.

Use **Figure 1**.

[4 marks]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 09 · continued

0 1 . 4 The alkane molecule $C_{14}H_{30}$ can be cracked to produce smaller molecules.

Balance the equation for the reaction.

[1 mark]

$$C_{14}H_{30} \rightarrow C_8H_{18} + ____ C_3H_6$$

Question 1 continues on the next page

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 09 · continued

Propene (C_3H_6) is an alkene.

0 1 . 5 Describe the test for alkenes.

Give the result.

[2 marks]

Test _____

_____

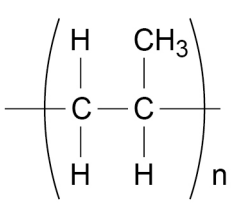
Result _____

_____

0 1 . 6 Poly(propene) is made from propene.

Figure 2 represents the repeating unit of poly(propene).

Figure 2



What type of substance is poly(propene)?

[1 mark]

_____

10

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 10

June 2024 | 8464/C/2H | Original Q3

0 3 Some fractions of crude oil are processed to produce fuel for transport.

0 3 . 1 Describe how crude oil was formed.

[4 marks]

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 10 · continued

Transport is a source of atmospheric pollutants.

0 3 . 2 Suggest how sulfur dioxide can be produced by transport.

[2 marks]

0 3 . 3 Give **two** problems caused by sulfur dioxide as an atmospheric pollutant.

[2 marks]

1

2

Question 3 continues on the next page

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 10 · continued

0 3 . 4 Describe how carbon monoxide can be produced by transport.

[2 marks]

0 3 . 5 Catalytic converters are fitted to car exhausts to reduce the amount of pollution from cars.

Carbon monoxide and nitrogen dioxide (NO_2) react in a catalytic converter.

Nitrogen and carbon dioxide are produced.

Write a balanced equation for the reaction.

[2 marks]

_____ + _____ → _____ + _____

12

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 11

June 2025 | 8464/C/2H | Original Q1

0 1 Dodecane is an alkane.

0 1 . 1 The general formula for alkanes is C_nH_{2n+2}

A molecule of dodecane has 12 carbon atoms.

Complete the formula of dodecane.

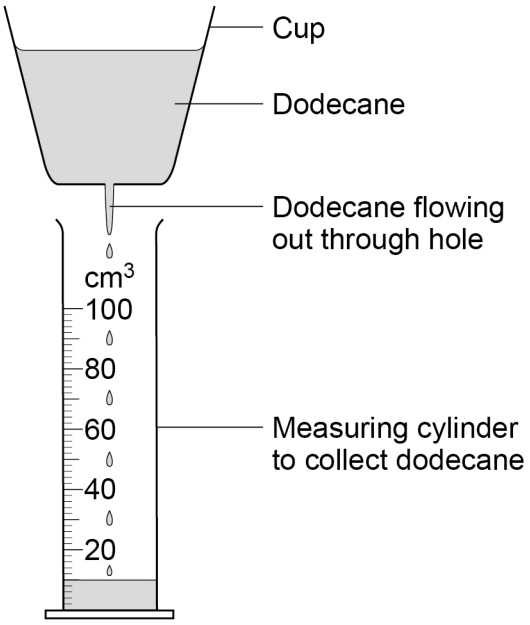
[1 mark]

C ____ H ____

A student investigated the effect of changing the temperature on the viscosity of dodecane.

Figure 1 shows the apparatus.

Figure 1



Question 11 · continued

This is the method used.

1. Add 100 cm^3 of dodecane at 25 °C to the cup.
2. Immediately start a timer.
3. Stop the timer when 40 cm^3 of dodecane has been collected in the measuring cylinder.
4. Record the time taken.
5. Repeat steps 1 to 4 using dodecane at different temperatures.

0 1 . 2 The student used a water bath to heat the dodecane.

Suggest **one** reason why the student used a water bath instead of a Bunsen burner to heat the dodecane.

[1 mark]

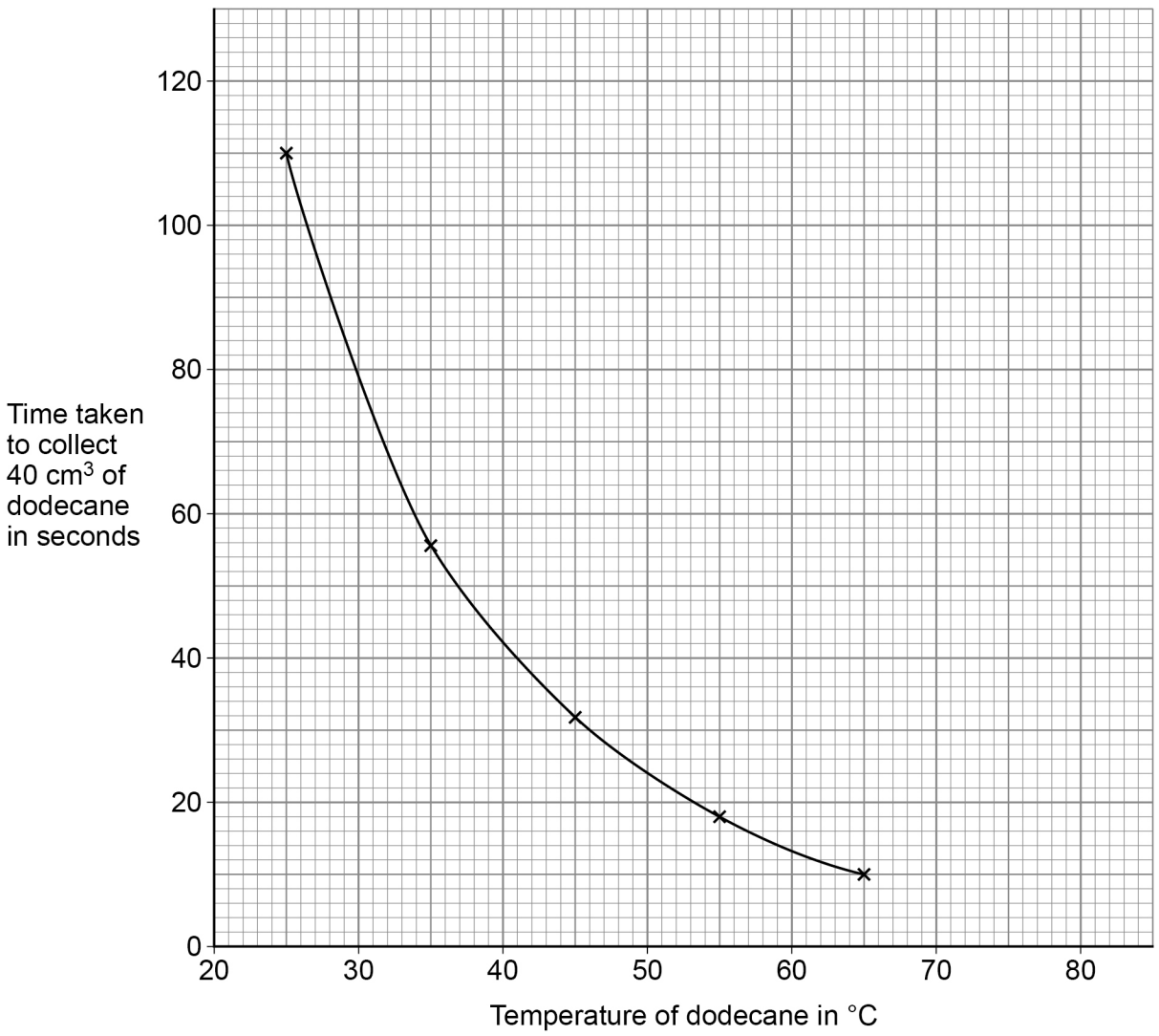
0 1 . 3 Give **one** control variable used in the investigation.

[1 mark]

Question 1 continues on the next page

Figure 2 shows the results.

Figure 2



0 1 . 4 Predict the time taken to collect 40 cm^3 of dodecane at 75 °C.

You should extend the line of best fit on **Figure 2**.

[2 marks]

Time taken = _____ s

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 11 · continued

0 1 . 5 The higher the viscosity, the slower dodecane flows.

Explain how the trend in **Figure 2** shows the effect of an increase in temperature on the **viscosity** of dodecane.

[2 marks]

7

Turn over for the next question

5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 12

June 2025 | 8464/C/2H | Original Q3

0 3 Crude oil is a finite resource found in rocks.

0 3 . 1 What is meant by a 'finite' resource?

[1 mark]

0 3 . 2 Most of the compounds in crude oil are hydrocarbons.

Define the term 'hydrocarbon'.

[1 mark]

0 3 . 3 Crude oil found in different areas has different compositions.

Table 2 shows the percentage (%) composition of crude oil from one area.

Table 2

Fraction	Percentage (%) of fraction
Petrol	31.3
Kerosene	13.4
Diesel oil	14.4
Heavy fuel oil	40.9

The volume of crude oil is measured in a unit called 'barrels'.

1 barrel = 159 dm^3

Calculate the volume of **petrol** in dm^3 in 90 barrels of crude oil.

Give your answer to 3 significant figures.

[4 marks]

Volume of petrol (3 significant figures) = _____ dm^3

0 3 . 4 Fractions from crude oil can be processed to produce many useful materials by the petrochemical industry.

Which is a useful material produced by the petrochemical industry?

[1 mark]

Tick (✓) **one** box.

- Alloys ☐
- Ceramics ☐
- Fertilisers ☐
- Lubricants ☐

0 3 . 5 Catalytic cracking is used to crack hydrocarbons.

Name **one** other method of cracking hydrocarbons.

[1 mark]

_____

0 3 . 6 Alkanes are produced by cracking.

Hydrocarbon **Z** is a different type of hydrocarbon to alkanes.

Hydrocarbon **Z**:

- is also produced by cracking
- can be used to produce polymers.

Describe a test for hydrocarbon **Z**.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

10