AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.7.1.1

Crude oil, hydrocarbons and alkanes

Mark schemes and examiner comments

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

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 01 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	condenses		1	AO1 5.7.1.2
01.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
01.3	propane	do **not** accept propene	1	AO2 5.7.1.1
01.4	C_nH_{2n+2}		1	AO1 5.7.1.1
01.5	CH_4 + **2** $O_2 \rightarrow CO_2$ + **2** H_2O	allow multiples	1	AO2 5.1.1.1 5.7.1.3
01.6	bromine water		1	AO1 5.7.1.4
01.7	to assess the environmental impact (of the stages in the life of a product)	allow to see the effect / harm / damage on the Earth / environment / planet ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability	1	AO1 5.10.2.1

5.7.1.1 Crude oil, hydrocarbons and alkanes

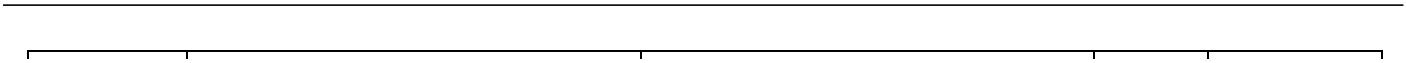
Answer 01 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
01.8	**Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.	3–4	AO3
	Level 1: Relevant features are identified and differences noted.	1–2	AO2
	No relevant content	0	
	Indicative content • burning 10 000 bags produces 10 kg more of carbon dioxide than landfill • putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning. • putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning • burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces15 kg • putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg • landfill produces less carbon dioxide than burning • landfill produces more solid residue than burning • burning produces less sulfur dioxide than landfill		5.10.2.1 5.10.2.2 5.9.2.2
Total			**11**

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 01 · Mark scheme

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



5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 02 · Mark scheme June 2019 | 8464/C/2H | Original Q7

07.1		maximum of **3** marks if incorrect reference made to cracking ignore fractional distillation ignore fracking		AO1 5.7.1.2
	heat or vaporise (oil)		1	
	temperature gradient in column	allow column is cooler at the top or allow column is hotter at the bottom	1	
	(vapour) condenses (into fractions)		1	
	depending on boiling point of fraction	allow at different levels	1	

07.2	different amounts of oxygen available	allow complete combustion **and** incomplete / partial combustion	1	AO2 5.9.3.1

07.3	$2\ C_4H_{10} + 9\ O_2 \rightarrow 8\ CO + 10\ H_2O$	allow correct multiples / halves	1	AO2 5.7.1.3 5.9.3.1 5.1.1.1

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 02 · Mark scheme

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

07.4	short wavelength radiation which enters the atmosphere	because uv / ultra violet radiation which enters the atmosphere	1	AO1.1 5.9.2.1
	is absorbed by materials **and** re-emitted		1	
	as a longer wavelength radiation	as ir / infrared radiation	1	
	(the longer wavelength radiation is trapped by) a greenhouse gas / carbon dioxide / methane which stops radiation escaping (from the atmosphere)	allow so temperature increases	1	

Total			**10**

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 03 · Mark scheme November 2020 | 8464/C/2H | Original Q5

05.1	plankton	allow biomass allow (marine) animals / organisms ignore plants	1	AO1 5.7.1.1
	buried in mud	allow compressed under mud allow compressed in sedimentary rock ignore fossilised	1	
	over a long period of time **or** over millions of years		1	

05.2	crude oil heated		1	AO1 5.7.1.2
	(hydrocarbons / liquids) evaporate	allow (hydrocarbons / liquids) vaporise / boil	1	
	vapours / gases condense		1	
	fractions have different boiling points **or** fractions collect at different levels depending upon boiling point		1	

05.3	C_nH_{2n+2}		1	AO1 5.7.1.1

05.4		max **2** marks for incorrect reference to particles **/** bonds allow converse		
	the boiling point increases as the number of (carbon) atoms increases		1	AO1
	(because the weak) intermolecular forces increase **or** (because the weak) forces between the molecules increase		1	AO2 AO3
	(and these intermolecular forces increase) as the size of the molecules increases		1	5.2.2.4 5.7.1.3

05.5		MP2 dependent on correct response in MP1		AO3 5.7.1.3
	(as number of carbon atoms increase) the time increases		1	
	(because) the viscosity increases		1	

Total			**13**

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 03 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 04 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	particles collide		1	AO3 5.5.1.2
	(but at room temperature) particles have insufficient energy **or** (but) have energy less than the activation energy (so collisions are not successful)		1	
07.2	2120 (kJ/mol)		1	AO3 5.5.1.2 5.5.1.3
07.3		allow C–C for **X**		AO2 5.5.1.3
	(bonds broken = (8 × 410) + 2 **X** + (5 × 500) = 5780 + 2 **X**	allow (bonds broken = (8 × 410) + (5 × 500) = 5780	1	
	(bonds formed = (6 × 740) + (8 × 460) = 8120		1	
	(bonds broken – bonds formed = energy released) (5780 + 2 **X**) – 8120 = – 1640	allow correct use of incorrect values from step 1 and/or step 2	1	
	(2 **X** =) 700	allow correct use of incorrect value from step 3	1	
	(**X** =) 350 (kJ/mol)		1	
Total			**8**	

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	plankton **or** (ancient) biomass	allow microscopic plants / animals	1	AO1 5.7.1.1
02.2	propane	allow C_3H_8	1	AO1 5.7.1.1

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 05 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	4–6	AO3
	Level 1: Relevant features are identified and differences noted.	1–3	AO1 AO2
	No relevant content	0	
	Indicative content • methane has 1 carbon atom, hexane has 6 • methane has 4 hydrogen atoms, hexane has 14 • both contain C – H bonds • only hexane contains C – C bonds • both are hydrocarbons • hexane has a higher melting point than methane (or converse) • hexane has a higher boiling point than methane (or converse) • methane is a gas at room temperature • hexane is a liquid at room temperature • both are small molecules • hexane has larger molecules than methane • weak forces between molecules • forces between hexane molecules stronger than between methane molecules • hexane is more viscous than methane • both are flammable • methane is more flammable than hexane (or converse) • possible products of combustion from both are: carbon, carbon monoxide, carbon dioxide, water • neither conduct electricity		5.2.2.4 5.7.1.1 5.7.1.3

5.7.1.1 Crude oil, hydrocarbons and alkanes

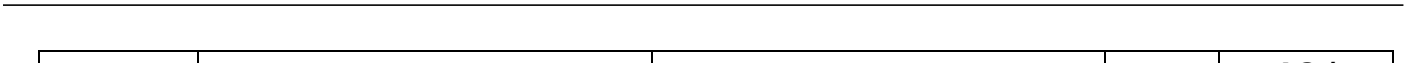
Answer 05 · Mark scheme

02.4	C_8H_{18}		1	AO2 5.3.1.1 5.7.1.4
02.5	bromine (water) turns (from orange / brown) to colourless	 MP2 is dependent on MP1 allow decolourises ignore clear	1 1	AO1 5.7.1.4
Total			**11**	

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 05 · Mark scheme

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



5.7.1.1 Crude oil, hydrocarbons and alkanes

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	butane		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(molecule) made up of carbon and hydrogen (atoms) only		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_2H_4 + C_2H_6$ **OR** $C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_3H_6 + H_2$ (2) **OR** $C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_2H_6 + C_2H_2$ (2)	allow **1** mark for $2\,C_2H_4$ allow **1** mark for C_2H_6 allow **1** mark for $2\,C_3H_6$ allow **1** mark for H_2 allow **1** mark for $2\,C_2H_6$ allow **1** mark for C_2H_2	2	AO2 5.1.1.1 5.3.1.1 5.7.1.4

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	C_2H_6 is useful as a fuel	allow smaller molecule so useful as a fuel	1	AO1 5.7.1.3 5.7.1.4
	(because more) flammable (than larger molecules)		1	
	OR			
	C_2H_4 / C_3H_6 / C_5H_{10} is used to make polymers (1)	allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make plastics allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make other chemicals		
	(because more) reactive (than alkanes) (1)			
		if a named product is given, allow **1** mark for a correct use and **1** mark for a correct linked reason		

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons is given.	5–6	AO3 5.9.2.2 5.10.1.1 5.10.2.1
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • production of plastic uses more hydrocarbons which are from non-renewable crude oil • production of plastic produces more greenhouse gases in the atmosphere which contributes to global warming • production of plastic produces more sulfur dioxide which causes acid rain • production of plastic produces more oxides of nitrogen which cause acid rain and respiratory problems • disposal of plastic produces more waste which increases landfill • burning plastic produces fumes which are toxic so cause respiratory problems • lifetime cost of plastic frames is less • plastic frames have lower costs for maintaining • the total energy consumption for plastic frames is greater than for wooden frames • judgement		

Total Question 4		**12**

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 07 · Mark scheme

June 2023 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$CH_4 + \mathbf{2}\,O_2 \rightarrow CO_2 + \mathbf{2}\,H_2O$		1	AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	hydrocarbon molecules in petrol have fewer carbon atoms than those in diesel petrol has a lower boiling point (range) than diesel	allow converse throughout allow petrol is more flammable than diesel allow petrol is less viscous than diesel	1 1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	oxygen		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	air	allow the atmosphere allow from volcanoes	1	AO1 5.9.1.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	global dimming		1	AO2 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	(carbon monoxide is) colourless **or** (carbon monoxide is) odourless	ignore clear	1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	(diesel) burns at a high temperature **or** (diesel) burns at a temperature greater than 100 °C		1	AO2
	(which is) above the boiling point of water		1	AO3 5.2.2.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	sulfur dioxide (is produced when diesel is burnt)		1	AO1 5.9.3.1 5.9.3.2
	(which causes) acid rain		1	
	(which results in) any **one** from: • damage to buildings / statues / bridges • damage to trees / plants • damage to aquatic life • acidification of lakes / rivers / soil • respiratory problems	allow (which affects) asthma	1	

Total Question 1	**12**

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 08 · Mark scheme

June 2023 | 8464/C/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(crude oil is a mixture but) not a useful product	allow (crude oil is) not designed for a specific purpose	1	AO2 5.7.1.1 5.8.1.2
	(and) not mixed in carefully measured quantities	allow not the same composition all the time	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(crude oil) is heated to vaporise (the hydrocarbons)	allow (crude oil) is heated to evaporate the hydrocarbons	1	AO1 5.7.1.2
	temperature (of column) decreases from bottom to top	allow the column gets cooler going up	1	
	(so) the fractions / hydrocarbons condense at different heights (in the column)		1	
	(because) the fractions / hydrocarbons have different boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(to make) smaller (hydrocarbon) molecules		1	AO1 5.7.1.4
	any **one** from: (which are) • more useful molecules • useful as fuels • starting materials	allow (which are) in higher demand allow (which are) alkenes for the production of other chemicals	1	

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(test) burning / lit splint (result) burns with a (squeaky) pop sound	MP2 is dependent upon MP1 being awarded allow flame do **not** accept glowing splint allow pops	1 1	AO2 AO1 5.8.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	C_2H_4		1	AO2 5.7.1.1 5.7.1.4

Total Question 3	11

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 09 · Mark scheme

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

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(molecules) made up of carbon and hydrogen (atoms only)		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	$C_{10}H_{22}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(crude oil) is heated		1	AO1 5.7.1.2
	(so some of the hydrocarbons) vaporise		1	
	the column has a temperature gradient	allow the column gets cooler going up	1	
	(so) the hydrocarbons / fractions condense at different heights / temperatures in the column **or** (and) the hydrocarbons / fractions condense at their boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$C_{14}H_{30} \rightarrow C_8H_{18} + \mathbf{2}\,C_3H_6$		1	AO2 5.1.1.1 5.7.1.4

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 09 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	add bromine (water) (bromine water) changes (from orange) to colourless	 allow (bromine water) decolourises ignore clear MP2 is dependent on MP1 being awarded	1 1	AO1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	polymer	allow plastic allow hydrocarbon	1	AO1 5.2.1.4 5.7.1.4

Total Question 1	10

Answer 10 · Mark scheme

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	plankton (died)	allow (remains of) ancient biomass	1	AO1 5.7.1.1 5.9.1.4
	and were buried (in mud)	allow and were buried (by sediments)	1	
	and were compressed		1	
	over millions of years		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(some) fuels contain sulfur	allow a named fossil fuel for fuels	1	AO2 5.9.3.1
	(which) reacts with oxygen to produce sulfur dioxide		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	acid rain	allow a specific effect of acid rain	1	AO1 5.9.3.2
	respiratory problems (in humans)	allow named respiratory problem eg asthma	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	fuels are burnt	allow a named fossil fuel for fuels	1	AO2 5.9.3.1
	in insufficient / limited oxygen	allow (carbon monoxide is) produced by incomplete combustion	1	

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 10 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$4\,CO + 2\,NO_2 \rightarrow N_2 + 4\,CO_2$	allow for **1** mark $CO + NO_2 \rightarrow N_2 + CO_2$ with no / incorrect balancing numbers	2	AO2 5.1.1.1 5.9.3.1 5.9.3.2

Total Question 3	**12**

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 11 · Mark scheme

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

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$C_{12}H_{26}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **one** from: • (a water bath) will control the temperature • (a water bath) will not set dodecane on fire	 allow dodecane is flammable	1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	volume of dodecane		1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	line extrapolated to 75 °C value at 75 °C read from extrapolated line	 allow a tolerance of ± ½ a small square	1 1	AO3 AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	as the temperature increases the time taken decreases (so) the viscosity decreases	ignore references to rate	1 1	AO3 5.7.1.3

Total Question 1	7

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 12 · Mark scheme

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

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(a resource that) will run out	allow (a resource that) is non-renewable	1	AO1 5.7.1.1 5.10.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(a compound / molecule) made up of carbon and hydrogen (atoms) only		1	AO1 5.7.1.1

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(volume of petrol =) $90 \times 159 \times \frac{31.3}{100}$ **or** (volume of petrol =) $14310 \times \frac{31.3}{100}$ **or** (volume of petrol =) 90×49.767 **or** (volume of petrol =) 28.17×159	allow **1** mark for 90×159 **or** $159 \times \frac{31.3}{100}$ **or** $90 \times \frac{31.3}{100}$	2	AO2 5.7.1.1 5.7.1.2
	= 4479.03		1	
	= 4480 (dm^3)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses 90 barrels, 159 dm^3 and a fraction percentage	1	

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	lubricants		1	AO1 5.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	steam cracking		1	AO1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(test) add bromine water (result) (bromine) changes (from orange) to colourless	 allow (bromine) is decolourised	 1 1	AO2 5.7.1.4

Total Question 3	**10**

Question 1 (standard demand)

01.1 83% of students achieved this mark. None of the other three possible answers proved to be dominant.

01.2 79% of students achieved this mark. 'The fractions have different melting points' proved to be dominant wrong answer.

01.3 49% of students gained credit, recognising the alkane to be propane. Most popular incorrect answer was butane. Some students gave a formula even though the question asked for the name of the alkane.

01.4 The correct answer of C_nH_{2n+2} was the most commonly selected response by students (77%) although C_nH_{2n} proved to be the most effective distractor.

01.5 56% of students successfully balanced equation for the combustion of methane. Multiples were regularly seen, and credit accordingly given.

01.6 The correct answer of bromine water was chosen by 67% of students. Anhydrous copper sulfate proved to be the most effective distractor.

01.7 28% of students knew the definition from the specification or were able to give an equivalent statement. A large number of vague incorrect responses were seen encompassing issues such as pollution, sustainability, energy and carbon footprint.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 01 · Examiner comments June 2018 | 8464/C/2H | Original Q1

01.8 In this 'extended response' question students were asked to compare the two methods for the disposal of biodegradable plastic bags using information given in Table 1.

26% of students gained full marks on this question and a further 38% of students achieved marks at level 2. To access level 2, students were expected to 'note the magnitude' of the differences, as stated in the generic level descriptor in the mark scheme.

17% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from Table 1.

The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic or the benefits of burning plastic bags to generate electricity. Students writing these responses made little reference to the information in Table 1 and many of these students ignored the key command word, 'Compare'. However, the higher-attaining students had logically worked their way down the information in Table 1, comparing and calculating differences when constructing their answer.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 02 · Examiner comments

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

Question 7 (high demand)

07.1 This question produced a good spread of marks, with around 83% of students gaining some credit for their answer. A minority of students gained all four marks, whilst just over half of the students gained either 1 or 2 marks. Students most commonly did not include the idea that the fractionating column had a temperature gradient. Some students explained in detail what each of the fractions was used for and a few students incorrectly incorporated 'cracking' into their response.

07.2 Almost 60% students were able to correctly identify 'different amounts of oxygen' or state that 'the first reaction is complete combustion and the second is incomplete combustion'. Some students wrote 'carbon dioxide and water' which did not answer the question that was asked. Several students stated that 'in reaction one the hydrocarbon is an alkane and in the other reaction it is an alkene'.

07.3 Just over 43% of students successfully balanced the equation for the combustion of butane. Multiples were regularly seen, and full credit was available if these were correct.

07.4 Many students were unable to describe in detail the greenhouse effect in terms of long and short wavelength radiation. Responses were confused as to which type of wavelength would pass through the atmosphere; 'reflected' or 'bounced off' were not creditworthy alternatives to 'longer wavelengths being re-emitted'. About 32% of students gained one mark for identifying that the 'temperature increases'.

Approximately 10% of students made no attempt at this question.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 02 · Examiner comments

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

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 04 · Examiner comments

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

Question 7 (standard / high and high demand)

07.1 One mark was gained by approximately one fifth of students, usually for stating that particles collide. Very few appreciated that at room temperature the particles had insufficient energy to react.

07.2 Approximately two thirds of students gained this mark. They were able to deduce the trend in increase of energy released as the number of carbon atoms increased.

07.3 Approximately one third of students were able to score at least one mark but only a small number scored all five marks. Students had to calculate the energy required to break all bonds and also the energy released when all bonds are formed. However, many made mistakes in these calculations. Few then were able to subsequently evaluate the difference in bonds broken (including the two C-C bonds), bonds made, and the energy released (1640 kJ/mol).

Concluding Remarks

The demand of this paper was similar to those previously set for this specification. Students should note that two-mark questions, for example, require two answer points.

15% of marks are based upon the required practical activities; students should question 'what and why' is happening in each step of these procedures. Answers should be chemically accurate, e.g. crystals are produced from salt solutions when the solution is heated (partially evaporated to produce a more concentrated solution) and then left to crystallise, rather than implying that 'all the water was evaporated'.

In chemistry 20% are marks are for questions assessing mathematical skills. In these questions, students should show their working for each step. If an error is made, such as an incorrect evaluation of values in the question, credit is awarded for each correct step shown. In **01.5** not all students used all the data provided to evaluate the relative atomic mass, a weighted mean of the mass numbers. In **04.4** most students calculated the percentage and mass of the other elements. Fewer were able to use the ratio of percentages to evaluate the mass of iron. In **06.4** students found difficulty in converting moles to a formula or to simple whole number ratios in equations. In **07.3** the displayed formula was provided to help students calculate the energy required to break all the bonds and the energy released when all the bonds are formed. Many failed to link the energy released as the difference in bonds broken (including the two C-C bonds) and bonds made.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 04 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 05 · Examiner comments

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

Question 2 (standard demand)

Very few were able to correctly identify what is decomposed to form crude oil, many appeared to confuse “decomposition” with “composition” and gave hydrocarbons as their answer. However, the naming of alkanes was well known.

In the comparision of methane and hexane most students focused their attention on the comparison of the boiling points and the relative numbers of atoms in each molecule, using only the information provided. There was some confusion evident around the negative values of the melting points. A significant number of students stated that methane has a higher melting point than hexane. Better answers linked the information to the physical states of the hydrocarbons. Some excellent answers were seen where the students expanded upon the data, for example, to

Answer 05 · Examiner comments

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

explain why the molecules had different melting and boiling points in terms of the strength of their intermolecular forces or they deduced their physical states.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 06 · Examiner comments June 2022 | 8464/C/2H | Original Q4

Question 4

There is only a small section on organic chemistry in this specification. However in responses students do not appear to have consolidated the ideas of organic chemistry.

04.1 Just over half of the students were able to identify butane from the picture.

04.2 There were only 2 in 5 students who were able to correctly quote this definition.

04.3 Students found balancing the cracking equation quite challenging, often making up molecules that fitted rather than working out possible molecules from prior knowledge.

04.4 It was anticipated that students would choose one of their products or identify one as an alkane or an alkene and quote a use. This was very rare, and students were given some leeway in identifying a use. Explanations as to why the molecule was used were even rarer.

04.5 Students found the start of this question very accessible, comparing the data supplied. Direct comparisons only allowed access to level 1, however, and links to the problems caused were required to make further progress. Nearly 10% of students were able to reach level 3. A judgement (which many students gave) and comparisons of both economic and environmental factors was required to do this. On evaluate questions, students need to bring in some of their own knowledge to access the higher levels.

Answer 07 · Examiner comments June 2023 | 8464/C/2H | Original Q1

Question 1

01.1 Four in five students successfully balanced the equation.

01.2 Just over two in five students gained both marks for comparing petrol and diesel. A further third gained one mark. On this occasion, students needed to interpret what the table headings meant, so many weren't able to gain credit as they referred to the range of numbers of carbons, rather than the number of carbons and similarly, though more infrequent, for the boiling points.

01.3 Nearly nine in ten students identified oxygen as the common element in the compounds released from a car engine.

01.4 Just over a third of students were able to identify that nitrogen came from the air. Much more common suggestions were from the engine or the diesel fuel.

01.5 This question tested a little known part of the specification, with fewer than a quarter identifying global dimming as a consequence of particulates in the atmosphere. By far the most common incorrect response was for global warming.

01.6 Just below three quarters of students answered that carbon monoxide is either colourless or odourless. Many students gave both, despite being asked for one.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 07 · Examiner comments June 2023 | 8464/C/2H | Original Q1

01.7 Around one in ten gained two marks on this question, with a further quarter gaining one. The question was applying ideas from across the specification. Just a statement that water evaporates was insufficient for credit, as there needed to be a realisation that water is produced as a vapour, rather than turning into a vapour during the process.

01.8 Around half of students gained at least one mark on this question, usually for recognising that sulfur is responsible for acid rain. The consequences of acid rain were known by about a quarter, however, around than one in ten knew that sulfur enters the atmosphere as sulfur dioxide and so gained all marks. Again, global warming was the most common incorrect response here.

Answer 08 · Examiner comments June 2023 | 8464/C/2H | Original Q3

Question 3

03.1 This question required an application of the definition of a formulation, which students found difficulty with. Only a quarter of students gained at least one mark, usually for the idea that a formulation is made for a specific purpose. Few went on to give the idea that crude oil has a variable composition.

03.2 The steps in fractional distillation were not well known and often produced muddled sequencing. Two thirds of students gained at least one mark, usually for the idea that fractions have different boiling points (though some referred to melting points). Fewer than two in five went on with further descriptions, and one in five gained either three or four marks.

03.3 About one third of students gained two marks, with a further one in five getting one mark. This was usually for the idea that cracking produces smaller molecules. A specific use such as fuels or as a starting material for making polymers was credited for the second mark, whilst many students said that smaller molecules were more useful, were more in demand, or had more uses, all of which were creditworthy.

03.4 About half of students were able to describe the test for hydrogen, which had to be identified from the given equation. The gas tests are not well known and need to be learnt, so that they are expressed clearly.

03.5 Four in five students correctly identified the alkene.

Answer 09 · Examiner comments

Question 1 (standard demand)

01.1 About two thirds of students knew the definition of a hydrocarbon. Those who did not achieve the mark often used words such as 'atom' or 'mixture' instead of compound so were not credited. Similarly, students who gave answers in terms of carbon or hydrogen molecules (instead of atoms) were not given any marks.

01.2 Three-quarters of students achieved the mark for correctly determining the formula of decane. The most common incorrect response was $C_{10}H_{20+2}$.

01.3 This question has typically been targeted at high demand in previous years. However, this year it was set at standard demand, with the diagram containing more detail and the mark scheme for loosened a little to separate the first two marking points. Nearly all students on this tier were able to start the explanation of fractional distillation.

Four marks were available for this question. Most students who gained 1 mark did so for correctly identifying that the crude oil is heated. Some students indicated that the crude oil was heated once it was in the fractional distillation column itself, which was not creditworthy. Fewer students were able to explain that some of the hydrocarbons were vaporised/evaporated/boiled or turned into a gas for marking point 2. A third of students explained that there was a temperature gradient in the column. This could have been explained as a comparative statement, for example, the column is cooler at the top or by using sensible temperature values. Some students were able to explain that the hydrocarbons/fractions condensed or were able to give a clear description of condensation at different heights in the column or at different temperatures.

The most common responses that gained no marks referred to the different sizes and boiling points of the hydrocarbons/fractions.

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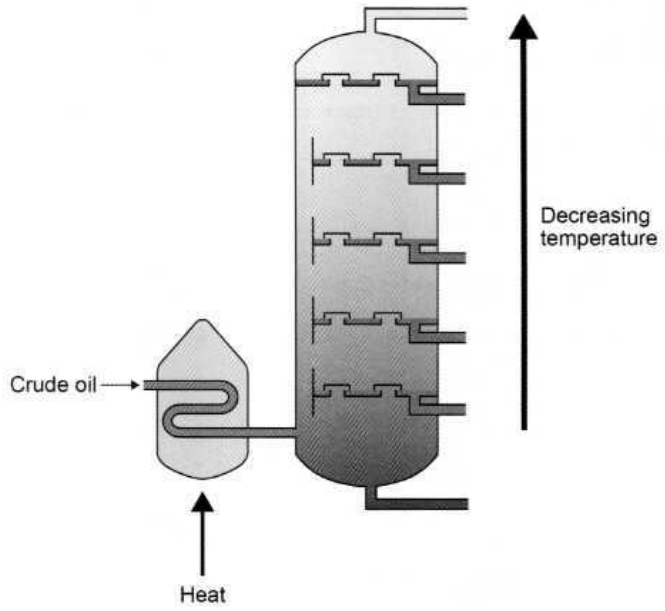
5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 09 · Examiner comments June 2024 | 8464/C/2H | Original Q1

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]

firstly, crude oil is heated until evaporated. Each fractions has different boiling points. The longer hydrocarbons reaches to the bottom fractions as they have very high boiling points, so the small hydrocarbons reaches the top fractions as they have low boiling points, so then at each fraction these condense.

This response gains the first two marking points in the first line. The student then describes the lengths of the hydrocarbons but the language used is very muddled, and is suggesting that the different heights in the column are the fractions. Because of this the mention of 'condense' is insufficient as it is linked to an incorrect interpretation of fraction. No further marks are gained.

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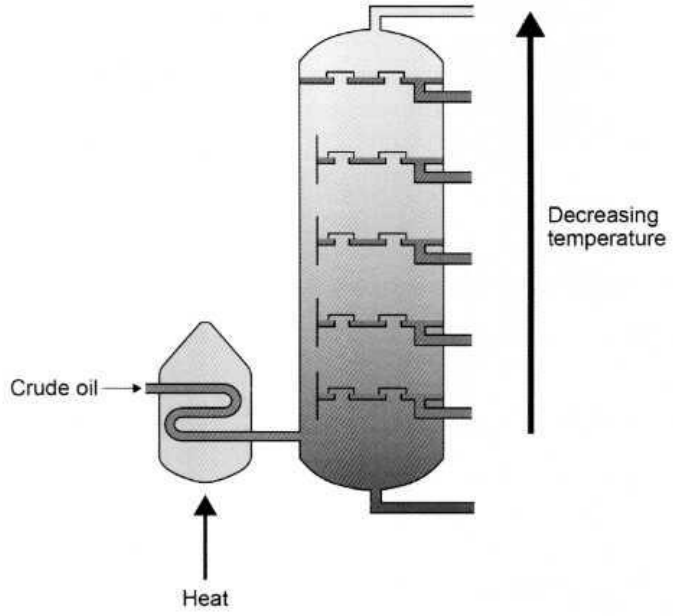
5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 09 · Examiner comments June 2024 | 8464/C/2H | Original Q1

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]

Crude oil is a mixture of different hydrocarbons with different boiling points. First the crude oil is heated to a very high temperature to ~~entirely~~ completely vaporise it, then its passed into a fractionating column which is hottest at the bottom, and coolest at the top. This means ~~hydrocarbons will continue~~ the gaseous hydrocarbons will rise until the temperature reaches their boiling points, causing them to ~~do~~ condense and collect in the trays. This means ~~crud~~ boiling Point is used to seperate Crude oil into fractions

There is nothing creditworthy in the first sentence. Marking points 1 and 2 are gained in the second sentence. The student then goes on to describe the temperature gradient on line 5: '… hottest at the bottom, and coolest at the top' for marking point 3. The description of the gaseous hydrocarbons condensing their boiling points is sufficient for marking point 4.

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5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 09 · Examiner comments June 2024 | 8464/C/2H | Original Q1

01.4 Most students correctly balanced the cracking equation.

01.5 Students find the recall of chemical tests challenging, with fewer than half of students gaining both marks on the test for an alkene.

01.6 Fewer than 20% of students applied their knowledge from paper 1 and the scaffolding provided to correctly identify the structure as a polymer, with the mark scheme also allowing hydrocarbon as an answer.

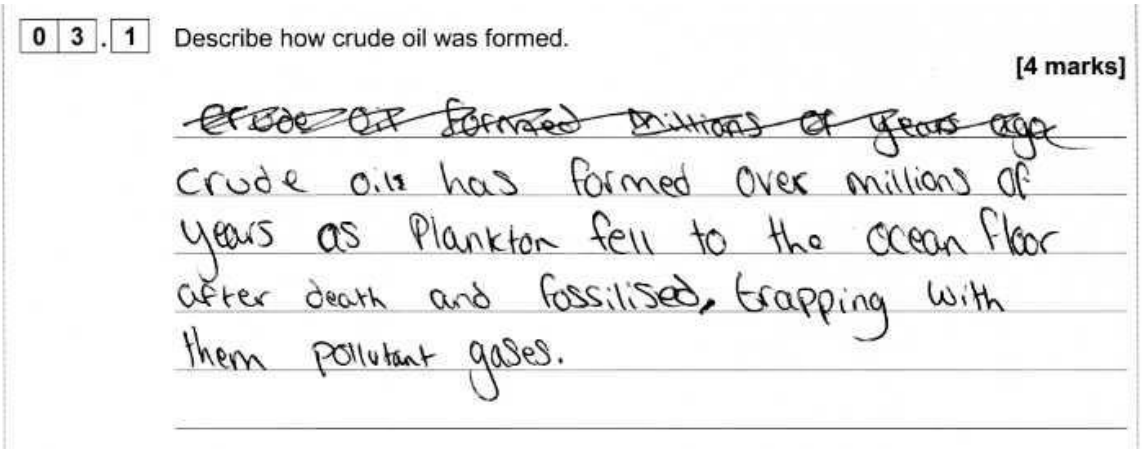
Answer 10 · Examiner comments

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

Question 3 (standard/high & high demand)

03.1 This question was answered well by most students. There was excellent recall about 'plankton' and the subsequent steps in the formation of crude oil. Some students missed out on full marks as they either omitted the correct time frame or offered a general response such as 'many years' or 'a long time ago'.

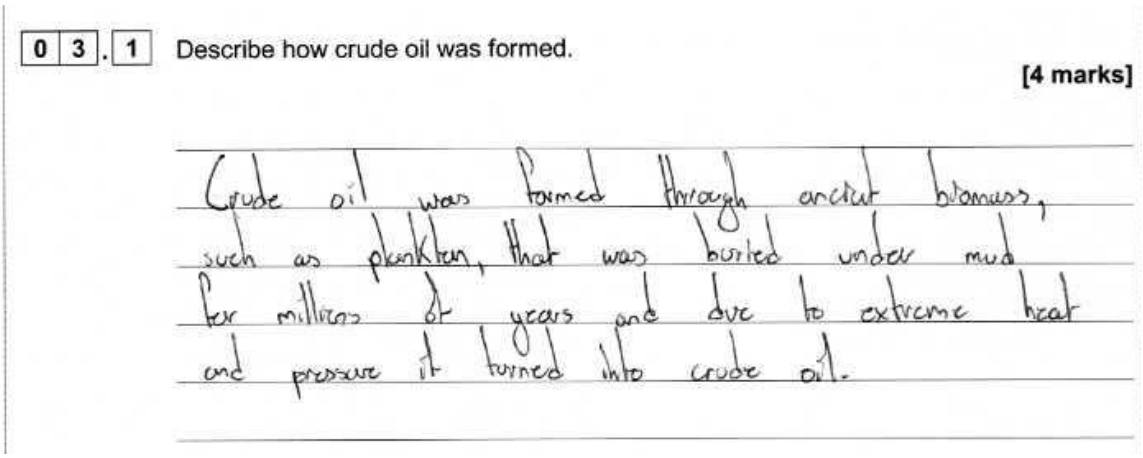
A few students misread the question and described the extraction of and separation of crude oil (part of which had been required for question 01.3).



0 3 . 1 Describe how crude oil was formed.

[4 marks]

~~Crude oil formed Millions of years ago~~
Crude oil has formed over millions of years as Plankton fell to the ocean floor after death and fossilised, trapping with them pollutant gases.



0 3 . 1 Describe how crude oil was formed.

[4 marks]

Crude oil was formed through ancient biomass, such as plankton, that was buried under mud for millions of years and due to extreme heat and pressure it turned into crude oil.

The first student gained 2 marks for the time scale and plankton dying.

The second student has given a very clear, concise response to the question scoring all 4 marks.

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5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 10 · Examiner comments June 2024 | 8464/C/2H | Original Q3

03.2 Very few students were able to achieve both marks on this question as the identification of sulfur as an impurity in (fossil) fuels was rarely seen. However, more students were able to successfully describe the oxidation of the sulfur to form sulfur dioxide.

03.3 Most students were able to give one problem. Acid rain was most often given as the initial creditworthy response. Those students that did not achieve the second marking point (for respiratory issues or asthma) often offered generalisations such as 'breathing difficulties', 'lung cancer', which was insufficient to gain credit.

03.4 More than 50% of students gained 1 mark. The link between carbon monoxide and incomplete combustion was regularly seen, although some students had difficulty in describing what exactly was being burnt, with many stating that it was the carbon monoxide in the fuel that was undergoing combustion. There were several excellent descriptions of carbon monoxide, its properties, its dangers and how it affects the human body, but this was not what was asked for in the question and these gained no marks.

03.5 This high-demand AO2 question proved to be the most challenging on the paper, with over 90% not receiving any credit. Many students could not give the formula for nitrogen gas and a significant proportion could not write the formulae of carbon monoxide or carbon dioxide. Students who knew the formulae could generally successfully balance the equation.

5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 11 · Examiner comments

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

Question 1 (Standard demand)

01.1 Many students were able to give the correct formula for dodecane, however a significant number failed to write the numbers as subscript therefore not being awarded the mark. Correct use of subscript and superscript is always required when writing chemical formulae.

01.2 Students found it difficult to explain why a water bath was used in preference to a Bunsen burner. Very few recognised that dodecane was flammable. Common incorrect responses included reference to speed of heating or the Bunsen being too hot. Only a quarter of students recognised the idea of the water bath controlling the temperature.

01.3 This question was attempted by the vast majority of students. Students were able to state the volume of dodecane as either 40 cm^3, 100 cm^3, just 'cm^3' alone, or simply 'volume'. The most common incorrect response was using the terminology of 'amount of dodecane', as amount is not equivalent to volume. Consequently, only just over half of responses gained this mark.

01.4 Students found the extrapolation of the line quite difficult. It was often horizontal or poorly drawn with many thick lines, double lines and feathery lines. They were better at reading the value from their line. A significant number however applied an incorrect scale when reading from their extrapolated line.

01.5 Students were often able to state the relationship between increase in temperature and time taken for the dodecane to flow using the graph to help them. They were less confident however in stating how this linked to viscosity. A significant number linked faster flowing to being more viscous.

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5.7.1.1 Crude oil, hydrocarbons and alkanes

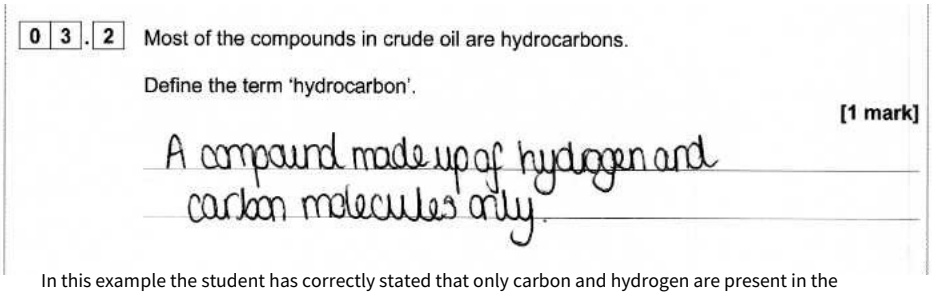
Answer 12 · Examiner comments

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

Question 3 (Standard and Standard /High demand)

03.1 The majority of students could explain that a finite resource is one that will run out. The most common incorrect responses were linked to either it 'taking a long time to make more' or 'using it up too fast', neither being sufficient for the mark.

03.2 While the majority of students correctly identified hydrogen and carbon, the mark could often not be credited because it was not made clear that these were the *only* atoms present. A significant number of students used the incorrect terminology for describing a compound/molecule or an atom. Subsequently only half of all students were credited the mark.



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

Define the term 'hydrocarbon'.

[1 mark]

A compound made up of hydrogen and carbon molecules only.

In this example the student has correctly stated that only carbon and hydrogen are present in the compound but have incorrectly called the particles 'molecules' rather than 'atoms', so the mark cannot be awarded.

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5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 12 · Examiner comments

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

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

Define the term 'hydrocarbon'.

[1 mark]

A mixture of hydrogen and carbon atoms

In this example the student has incorrectly used the terminology 'mixture' rather than 'compound' and have failed to state that hydrogen and carbon are the **only** atoms there, no marks were awarded.

03.3 The large majority of students attempted this question, and a variety of different approaches were seen, with over half of students gaining all four marks. Students not gaining full marks, were often able to identify which values they needed to use but were not so confident in using them correctly. A significant number failed to give their answer correctly rounded to 3 significant figures.

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]

159 × 90 = 14310 dm^3

0·313 × 14310 = 4479.03

Volume of petrol (3 significant figures) = 4480 dm^3

This example shows the most commonly used approach. Students generally showed good mathematical skills in this question. The total volume of oil in 90 barrels is first calculated, followed by then working out 31.3% of this value. The answer is then correctly rounded to 3 significant figures. 4 marks awarded.

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5.7.1.1 Crude oil, hydrocarbons and alkanes

Answer 12 · Examiner comments

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

03.4 By selecting lubricants, over half of students answered correctly. The most common incorrect response was fertilisers.

03.5 Less than half of students could recall the correct method. Students who did not gain credit generally confused other processes involving hydrocarbons and often referred to fractional distillation. A significant number just wrote 'steam' which is not a method and therefore did not gain credit.

03.6 Only half of all students gained credit in this question. The majority of students who could recall bromine water as the required test then went on to successfully state the correct colour change, to colourless. Bromine alone was insufficient for the mark, although students were allowed a mark for the correct result if they went down this path. A significant number of students were not able to recall the test and often confused it with limewater leading to a cloudy solution.