AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.1.3

Properties of hydrocarbons

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**63**
Available paper years	**2007–2025**

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.

4.7.1.3 Properties of hydrocarbons

Answer 01 · Mark scheme March 2007 | CHY1A | Original Q7 | Legacy

Seven	**3**	**2**	**4**	**2**

Answer 02 · Mark scheme June 2007 | CHY1A | Original Q6 | Legacy

Six	**4**	**4**	**3**	**3**

Answer 03 · Mark scheme June 2007 | CHY1A | Original Q8 | Legacy

Eight	**1**	**3**	**2**	**3**

Answer 04 · Mark scheme June 2007 | CHY1B | Original Q7 | Legacy

Seven	**1**	**3**	**3**	**2**

Answer 05 · Mark scheme June 2007 | CHY1H | Original Q5 | Legacy

The full source mark scheme begins on page 59. Follow original question 5 in that document.

Answer 06 · Mark scheme November 2007 | CHY1A | Original Q5 | Legacy

Five	**2**	**2**	**3**	**4**

4.7.1.3 Properties of hydrocarbons

Answer 07 · Mark scheme

November 2007 | CHY1B | Original Q9 | Legacy

Nine	**1**	**2**	**3**	**4**

Answer 08 · Mark scheme

January 2008 | CHY1H | Original Q6 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 09 · Mark scheme

March 2008 | CHY1AP | Original Q2 | Legacy

Two	**A**	Hydrocarbons in the crude oil turn to vapour	**1**
	B	Hydrocarbons collected as gases	**2**
	C	Hydrocarbons with high boiling points	**3**
	D	Hydrocarbons condense to form liquids	**4**

	A	**B**	**C**	**D**

Answer 10 · Mark scheme

March 2008 | CHY1AP | Original Q8 | Legacy

Eight	**2**	**2**	**1**	**1**

4.7.1.3 Properties of hydrocarbons

Answer 11 · Mark scheme March 2008 | CHY1BP | Original Q9 | Legacy

Nine	**2**	**1**	**1**	**3**

* This question is removed

Answer 12 · Mark scheme June 2008 | CHY1AP | Original Q2 | Legacy

Two	**A**	carbon monoxide	**3**	
	B	carbon particles	**4**	
	C	oxygen	**1**	
	D	carbon dioxide	**2**	
	A	**B**	**C**	**D**

Answer 13 · Mark scheme June 2008 | CHY1AP | Original Q4 | Legacy

Four	**2**	**4**	**2**	**2**

Answer 14 · Mark scheme June 2008 | CHY1BP | Original Q1 | Legacy

One	**A**	catalysis	**2**	
	B	polymerisation	**3**	
	C	combustion	**4**	
	D	thermal decomposition	**1**	

4.7.1.3 Properties of hydrocarbons

Answer 15 · Mark scheme June 2008 | CHY1H | Original Q2 | Legacy

question	answers	extra information	mark
2(a)	any **one** from: • gasoline / petrol / it contains short(er) chains / hydrocarbons **or** small(er) molecules **or** contains few(er) carbons • gasoline / petrol / it has weak(er) / small(er) intermolecular forces	 accept fuel oil contains long(er) chain length / large(r) molecules **or** contains many carbons ignore particles accept fuel oil has strong(er) / great(er) intermolecular forces	1
2(b)	any **two** from: • gasoline / petrol / it is in high demand • gasoline / petrol / it is in short supply • (high) tax / duty • cracking costs in terms of money / energy	only accept figures if used in a comparative statement accept fuel oil is in low demand accept fuel oil is plentiful accept answers such as 'gasoline / petrol / its supply is less than demand for **2** marks **or** gasoline / petrol / its percentage in crude oil is less than demand for **2** marks accept cracking expensive	2
2(c)	any **two** from: • (fuel oil / it) heated / vaporised • with catalyst • (to give / form / produce) short(er) chains / hydrocarbons **or** small(er) molecules **or** contains few(er) carbons	ignore particles accept a named catalyst if first two bullet points are not awarded 'cracking' gains **1** mark if wrong process named max **1** mark	2
Total			**5**

4.7.1.3 Properties of hydrocarbons

Answer 15 · Mark scheme June 2008 | CHY1H | Original Q2 | Legacy

COMPONENT NUMBER: CHY1H

COMPONENT NAME: Science B / Chemistry

STATUS: Final

DATE: June 2008

Answer 16 · Mark scheme November 2008 | CHY1AP | Original Q1 | Legacy

One	**A**	alkane **A**	**4**
	B	alkane **B**	**1**
	C	alkane **C**	**3**
	D	alkane **D**	**2**

Answer 17 · Mark scheme November 2008 | CHY1AP | Original Q3 | Legacy

Three	**4**	**2**	**3**	**3**

Answer 18 · Mark scheme November 2008 | CHY1AP | Original Q9 | Legacy

Nine	**1**	**2**	**3**	**4**

Answer 19 · Mark scheme November 2008 | CHY1BP | Original Q6 | Legacy

Six	**2**	**3**	**2**	**1**

4.7.1.3 Properties of hydrocarbons

Answer 20 · Mark scheme March 2009 | CHY1AP | Original Q1 | Legacy

One	**A**	Molecule **A**	**2**
	B	Molecule **B**	**1**
	C	Molecule **C**	**3**
	D	Molecule **D**	**4**

Answer 21 · Mark scheme March 2009 | CHY1AP | Original Q8 | Legacy

Eight	**2**	**2**	**4**	**1**

Answer 22 · Mark scheme March 2009 | CHY1BP | Original Q6 | Legacy

Six	**4**	**1**	**4**	**2**

Answer 23 · Mark scheme June 2009 | CHY1AP | Original Q1 | Legacy

One	**A**	Substance **A**	**1**
	B	Substance **B**	**2**
	C	Substance **C**	**3**
	D	Substance **D**	**4**

Answer 24 · Mark scheme June 2009 | CHY1AP | Original Q5 | Legacy

Five	**3**	**3**	**1**	**2**

Answer 25 · Mark scheme November 2009 | CHY1AP | Original Q9 | Legacy

Nine	**2**	**1**	**1**	**4**

4.7.1.3 Properties of hydrocarbons

Answer 26 · Mark scheme March 2010 | CHY1AP | Original Q1 | Legacy

One	**A**	Anaesthetic **A**	**2**
	B	Anaesthetic **B**	**4**
	C	Anaesthetic **C**	**3**
	D	Anaesthetic **D**	**1**

Answer 27 · Mark scheme March 2010 | CHY1AP | Original Q4 | Legacy

Four	**3**	**1**	**3**	**4**

Answer 28 · Mark scheme March 2010 | CHY1AP | Original Q5 | Legacy

Five	**3**	**3**	**1**	**3**

Answer 29 · Mark scheme June 2010 | CHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	nitrogen dioxide	**4**
	B	carbon monoxide	**3**
	C	carbon dioxide	**2**
	D	soot (carbon)	**1**

Answer 30 · Mark scheme June 2010 | CHY1AP | Original Q8 | Legacy

Eight	**2**	**4**	**2**	**2**

Answer 31 · Mark scheme November 2010 | CHY1AP | Original Q7 | Legacy

Seven	**2**	**3**	**1**	**4**

Answer 32 · Mark scheme November 2010 | CHY1BP | Original Q2 | Legacy

Two	**A**	Formula **A**	**4**
	B	Formula **B**	**1**
	C	Formula **C**	**2**
	D	Formula **D**	**3**

	A	**B**	**C**	**D**

Answer 33 · Mark scheme November 2010 | CHY1BP | Original Q6 | Legacy

Six	**4**	**3**	**3**	**1**

4.7.1.3 Properties of hydrocarbons

Answer 34 · Mark scheme

January 2011 | CHY1H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	crude oil / it is evaporated / vaporised vapours / gases / fractions cool and condense (different) vapours / gases / fractions (condense) at different temperatures	ignore heated accept named fraction(s) accept (different) vapours / gases / fractions have different boiling points max **2** marks for description of laboratory method **or** mention of cracking	1 1 1
2(b)(i)	any **one** from: • range of boiling points • range of carbon atoms		1
2(b)(ii)	greater the number (of carbon atoms) the higher the boiling point	do **not** accept molecules / particles	1
2(c)(i)	burning / combustion	allow oxidation / redox	1
2(c)(ii)	any **two** from: • cracking / (thermal) decomposition • heat / vaporise • catalyst / aluminium oxide	reaction with hydrogen gains max of **1** mark only allow porous pot ignore names of other catalysts	2
Total			**8**

4.7.1.3 Properties of hydrocarbons

Answer 34 · Mark scheme January 2011 | CHY1H | Original Q2 | Legacy

CHY1H

Answer 35 · Mark scheme March 2011 | CHY1AP | Original Q9 | Legacy

Nine	**3**	**2**	**1**	**4**

Answer 36 · Mark scheme March 2011 | CHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	Formula **A**	**2**
	B	Formula **B**	**3**
	C	Formula **C**	**1**
	D	Formula **D**	**4**

Answer 37 · Mark scheme June 2011 | CHY1AP | Original Q2 | Legacy

Two	**A**	CO			**1**
	B	CS_2			**4**
	C	C_2H_4			**2**
	D	C_3H_8			**3**
	A		**B**	**C**	**D**

Answer 38 · Mark scheme June 2011 | CHY1AP | Original Q4 | Legacy

Four	**4**	**2**	**2**	**2**

4.7.1.3 Properties of hydrocarbons

Answer 39 · Mark scheme June 2011 | CHY1AP | Original Q8 | Legacy

Eight	**4**	**3**	**3**	**1**

Answer 40 · Mark scheme June 2011 | CHY1BP | Original Q2 | Legacy

Two	**A** compound A			**3**
	B compound B			**4**
	C compound C			**1**
	D compound D			**2**
	A	**B**	**C**	**D**

4.7.1.3 Properties of hydrocarbons

Answer 41 · Mark scheme

June 2011 | CHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	complete diagram with 2 carbon atoms and 5 hydrogen atoms each C–C and each C–H linked by a single line (bond)		1
5(b)(i)	the greater the number of (carbon) atoms (in an alkane molecule) the greater its boiling point **or** vice versa	allow as the (carbon) chain gets longer the boiling point increases ignore melting points do **not** accept reference to greater number of molecules	1
5(b)(ii)	any **two** from: • low boiling point / volatile • low viscosity • high flammability • small molecules • burn completely	they = hydrocarbons from the graph it = $C_{30}H_{62}$ accept they are gases or liquids accept easier to burn / ignite accept short chains ignore number of carbon atoms ignore speed of burning	2
5(c)(i)	16 (CO_2) + 18 (H_2O)		1
5(c)(ii)	(carbon dioxide in the Earth's early) atmosphere	accept from volcanoes (millions of years ago) **or** from dead plants / animals allow dead sea creatures ignore shells	1

Question 5 continues on the next page . . .

4.7.1.3 Properties of hydrocarbons

Answer 41 · Mark scheme

CHY1H

Question 5 continued . . .

question	answers	extra information	mark
5(c)(iii)	increase in burning / use of fossil fuels		1
	locked up carbon (carbon dioxide) is released	allow carbon / carbon dioxide from millions of years ago is released accept extra carbon dioxide is not 'absorbed' (by the carbon cycle)	1
Total			**8**

4.7.1.3 Properties of hydrocarbons

Answer 42 · Mark scheme

June 2011 | CHY3H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	(brown / red / orange / yellow) goes colourless / decolourised	ignore discoloured / goes clear do **not** accept incorrect initial colour	1
6(a)(ii)	(carbon carbon) double bond	accept triple / multiple bonds do **not** allow incorrect double bond	1
6(b)	CO_2: 6.6/44 **or** 0.15(mole) H_2O: 2.7/18 **or** 0.15(mole) CH_2	 ignore multiples	1 1 1
Total			**5**

The AQA UMS Conversion Calculator is available on the Results statistics page of the AQA Website

4.7.1.3 Properties of hydrocarbons

Answer 43 · Mark scheme November 2011 | CHY1AP | Original Q2 | Legacy

Two	**A**	Hydrocarbons turn to vapour			**1**
	B	Hydrocarbons cool			**3**
	C	Hydrocarbons with low boiling points			**2**
	D	Hydrocarbons condense to form liquids			**4**
	A		**B**	**C**	**D**

Answer 44 · Mark scheme November 2011 | CHY1AP | Original Q3 | Legacy

Three	**3**	**1**	**2**	**3**

Answer 45 · Mark scheme November 2011 | CHY1AP | Original Q5 | Legacy

Five	**4**	**2**	**2**	**2**

4.7.1.3 Properties of hydrocarbons

Answer 46 · Mark scheme

January 2012 | CH1HP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	C_7H_{16}	mark answer line first answer may be given in the table	1
2(a)(ii)	C_nH_{2n+2}		1
2(b)(i)	carbon monoxide	do **not** accept carbon oxide do **not** accept water ignore CO	1
2(b)(ii)	because of partial / incomplete combustion (in reaction 2) **or** complete combustion (in reaction 1)	allow because there is less/insufficient oxygen (in reaction 2) **or** sufficient oxygen (in reaction 1) allow different amounts of oxygen used (in the reactions) **or** $19O_2$ (in reaction 1) **and** $13O_2$ (in reaction 2) ignore air	1
2(c)(i)	15 (%)	ignore units	1
2(c)(ii)	water (vapour) / steam	allow H_2O / OH_2 / hydrogen oxide	1
2(c)(iii)	<u>sulfur</u> in petrol / crude oil (reacts with oxygen)	it = sulfur dioxide	1
2(c)(iv)	because nitrogen **and** oxygen (are in the air and) react at high temperature (inside a petrol engine)	allow nitrogen **and** oxygen burn accept nitrogen + oxygen → nitrogen oxide **or** symbol equation ignore air allow heat/hot (engine)	1 1

Question 2 continues on the next page……..

4.7.1.3 Properties of hydrocarbons

Answer 46 · Mark scheme

CH1HP

Question 2 cont'd….

question	answers	extra information	mark
2(d)	because carbon dioxide / it causes global warming **or** because carbon dioxide / it has an impact on oceans because this carbon dioxide / carbon / it was 'locked up' (in fossil fuels) **or** because the percentage/amount of carbon dioxide/it in the atmosphere is increasing	allow because carbon dioxide/it causes greenhouse effect / climate change	1 1
Total			**11**

4.7.1.3 Properties of hydrocarbons

Answer 46 · Mark scheme

January 2012 | CH1HP | Original Q2 | Legacy

CH1HP

4.7.1.3 Properties of hydrocarbons

Answer 47 · Mark scheme

January 2013 | CH1HP | Original Q3 | Legacy

question	answers	extra information	mark
3(a)	heat to vaporise (the crude oil)	do **not** accept cracking / burning	1
	vapours condense		1
	at different temperatures	allow they have different boiling points	1
3(b)	(alkanes) are hydrocarbons **or** are compounds of hydrogen and carbon only		1
	alkanes are saturated **or** have only (carbon-carbon) single bonds	accept have no (carbon-carbon) double bonds accept general formula is C_nH_{2n+2} for **2** marks	1

4.7.1.3 Properties of hydrocarbons

CH1HP

question		mark
3(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.		6

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content.	There is a basic description of at least one advantage or one disadvantage of extracting petroleum products from oil sands.	There is a clear description of an advantage and a disadvantage of extracting petroleum products from oil sands.	There is a detailed description of both advantages and disadvantages of extracting petroleum products from oil sands.

examples of the chemistry/environmental/economic/social points made in the response

Advantages:

- the oil sands are needed because crude oil is running out
- this crude oil is needed because demand is increasing
- the oil sands contain a large amount of crude oil
- the oil sands could improve Canada's economy
- the oil sands provide employment for a lot of people
- the trees / forest are used for wood products / fuel

Disadvantages:

- destruction of environment / habitats
- fewer trees / forests to absorb carbon dioxide
- specified pollution, for example, visual, noise, atmospheric (including dust), water (including river or drinking) with cause, e.g. gases/particulates from burning diesel
- large amounts of methane(natural gas) are used to provide energy
- energy / fuel needed for cracking and fractional distillation
- burning fuel releases carbon dioxide
- crude oil / natural gas contains locked up carbon
- crude oil is non-renewable

Total			11

4.7.1.3 Properties of hydrocarbons

Answer 47 · Mark scheme

January 2013 | CH1HP | Original Q3 | Legacy

CH1HP

4.7.1.3 Properties of hydrocarbons

Answer 48 · Mark scheme

January 2013 | CH1HP | Original Q8 | Legacy

question	answers	extra information	mark
8(a)	methane		1
	because at the surface temperature of -179°C only methane has melted but has not boiled	accept a correct explanation using the boiling points(and melting points) of the gases **or** methane is a liquid **and** all the others are gases	1
8(b)	CH_4 is a hydrocarbon **or** methane / carbon monoxide contains carbon **or** carbon monoxide + hydrogen → hydrocarbon		1
	nitrogen **and** hydrogen are present in Titan's atmosphere **or** nitrogen + hydrogen → ammonia		1
	carbon monoxide contains oxygen **or** carbon monoxide + hydrogen / methane → water		1
	amino acids contain carbon, hydrogen, nitrogen + oxygen **or** amino acids can be made from (methane), hydrogen, carbon monoxide and nitrogen **OR** lightning / ultraviolet / electrical discharge / high energy needed for reaction		1
Total			**6**

UMS conversion calculator www.aqa.org.uk/umsconversion

4.7.1.3 Properties of hydrocarbons

Answer 49 · Mark scheme

June 2013 | CH1HP | Original Q7 | Legacy

Question 7

question	Answers	extra information	Mark
7(a)	ethanol is made up of only one type of molecule **or** ethanol is a compound	allow ethanol is pure	1
	diesel / petrol / rapeseed oil are mixtures	accept composition of diesel / petrol / rapeseed oil varies / changes allow different hydrocarbons have different melting points ignore diesel, petrol and rapeseed oil are impure	1
7(b)(i)	sugar is mixed with / dissolved in water	accept sugar cane for sugar	1
	yeast (is added)	allow enzymes are added if no other mark awarded, allow correct word or chemical equation for **1** mark	1
7(b)(ii)		accept carbon for carbon dioxide	
	(growing sugar cane / rapeseed) plants absorbs carbon dioxide	accept carbon dioxide is used for photosynthesis	1
	which is released (when the biofuel burns)	do **not** accept no carbon dioxide is released (when biofuels burn)	1
7(c)	nitrogen / N_2 **and** oxygen / O_2 (in the air)	do **not** accept fuels contain nitrogen	1
	react in the hot engine / at high temperature		1

Question 7 continues on the next page

Question 7 continued

question	Answers	extra information	Mark
7(d)	any **three** from: • ethanol needs a higher temperature to burn than petrol **or** ethanol has a higher flashpoint than petrol • ethanol releases less energy (per litre) than petrol • sugar is renewable **or** crude oil is non-renewable / will run out • sugar cane growth is unreliable / slow **or** crude oil is a reliable supply • ethanol is made by a batch / slow process **or** petrol is made by a continuous / fast process • ethanol is carbon neutral **or** petrol contains 'locked up' carbon dioxide • sugar / sugar cane should be used for food not for fuels	ignore references to melting point allow ethanol is not readily available **or** petrol is readily available accept idea of food shortages	3
	a justified conclusion that adds value	accept one **additional** point from the list above as long as one comparison of replacing petrol with ethanol is made	1
Total			**12**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.7.1.3 Properties of hydrocarbons

Answer 50 · Mark scheme June 2014 | CH1HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(a)(i)	2,4 drawn (as dots / crosses / e^-)		1	2 / 1.1.1h	E
1(a)(ii)	Water (vapour) / steam	allow hydrogen oxide / H_2O *do **not** accept hydroxide*	1	1 / 1.4.3b	G
1(b)	any **two** pairs from: carbon dioxide (1) causes global warming (1) **or** carbon (particles) / *soot* (1) causes global dimming (1) **or** carbon monoxide (1) is toxic (1) **or** sulfur dioxide (1) causes acid rain (1)	*allow greenhouse effect / climate change / sea level rise / melting of polar ice caps* *allow particulates* *allow blocks out sunlight / smog / prevents plant growth / causes breathing difficulties* *allow kills plants / erosion / acidifies water*	4	1 / 1.4.3a/c	E
Total			**6**		

4.7.1.3 Properties of hydrocarbons

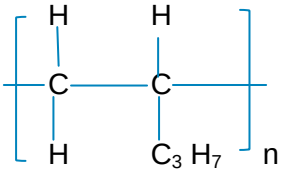
Answer 50 · Mark scheme

June 2014 | CH1HP | Original Q1 | Legacy



4.7.1.3 Properties of hydrocarbons

Answer 51 · Mark scheme June 2015 | CH1HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	any **four** from: • (crude oil is) heated • to evaporate/vaporise/boil (the substances/ hydrocarbons) • the column is hotter at the bottom or is cooler at the top • (vapours/fractions) condense • at their boiling points or at different levels	marks can be taken from a diagram max 3 marks for reference to cracking allow fractional distillation allow vapours (enter the column) allow temperature gradient or (vapours) cool as they rise allow description e.g. vapour turns to liquid) allow they have different boiling points	4	1 / 1.4.1a/b / 1.4.2b
5(b)	acid rain is caused by sulfur dioxide or oxides of nitrogen they react with/are neutralised by calcium carbonate or limestone **OR** global warming is caused by carbon dioxide carbon dioxide will react or dissolve in suspension of limestone	allow consequences of acid rain second marking point is dependent on first marking point allow greenhouse effect is caused by or allow consequences of global warming	1 1 1	2+3 / 1.4.3a/b/c/d / 1.2.1f
5(c)(i)	C_2H_4	must be formula ignore any name	1	2 / 1.1.3b/c / 1.5.1b
5(c)(ii)	a single bond between carbon atoms other four bonds linking hydrogen atoms and C_3H_7 group plus two trailing/connecting bonds n at the bottom right hand corner of the bracket	 would score 3 marks	1 1 1	2 / 1.5.2a

4.7.1.3 Properties of hydrocarbons

Answer 51 · Mark scheme

5(c)(iii)	has a shape memory or (a smart polymer) can return to original shape (when conditions change)		1	2 / 1.5.2b
Total			**12**	

4.7.1.3 Properties of hydrocarbons

Answer 51 · Mark scheme

June 2015 | CH1HP | Original Q5 | Legacy

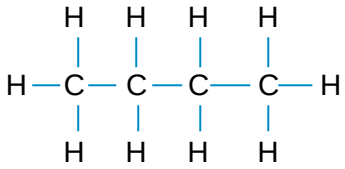


4.7.1.3 Properties of hydrocarbons

Answer 52 · Mark scheme

June 2016 | CH1HP | Original Q2 | Legacy

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	high temperature catalyst or steam	allow heating / hot / 250-900 °C allow named catalyst eg zeolite, Al_2O_3, silica, ceramic allow in the absence of air / oxygen ignore any references to pressure	1 1	AO1 1.5.1a
2(a)(ii)	colourless	allow decolourised ignore clear / discoloured	1	AO1 1.5.1d
2(a)(iii)			1	AO2 1.4.2a
2(b)(i)	20.3(0) (kJ)	if answer incorrect allow **1** mark for 24.36/1.2	2	AO2 1.4.3b
2(b)(ii)	use a lid reduce energy / heat loss	allow insulate beaker or use draught shield ignore references to thermometer or repeats or distance of flame or loss of water vapour allow stir (1) to distribute energy / heat (1) allow use a metal can (1) as it's a better conductor (1)	1 1	AO3 4.3.2b/c/d
2(b)(iii)	carbon/soot (produced by) incomplete combustion	ignore tar, smoke allow from a limited supply of oxygen/air	1 1	AO1+AO2 1.4.3a/b
2(b)(iv)	hexane gives out the greatest energy (per 1.0 g) hexane produces the least smoke / carbon / soot	ignore more energy allow has the cleanest flame ignore less smoke / carbon / soot	1 1	AO3 1.4.2c; 1.4.3a/b

QWC Mark Scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(c)			6	AO1+AO2+ AO3 1.1.3b; 1.4.1b/c; 1.4.3a/b/c/d ;1.7.2h/i

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content	Statements made from the information that indicate whether at least one statement is an advantage **or** a disadvantage **or** a linked advantage or disadvantage	Descriptions of an advantage **and** a disadvantage with some use of their knowledge to add value.	Descriptions of advantages **and** disadvantages that are linked to their own knowledge.

Examples of the added value statements and links made in the response could include:
Note that link words are in bold; links can be either way round.
Accept reverse arguments and ignore cost throughout.

Advantages of using hydrogen:

- Combustion only produces water **so** causes no pollution
- Combustion does not produce carbon dioxide **so** this does not contribute to global warming or climate change
- Combustion does not produce sulfur dioxide **so** this does not contribute to acid rain
- Incomplete combustion of petrol produces carbon monoxide **that is** toxic
- Incomplete combustion of petrol produces particulates **that** contribute to global dimming
- Petrol comes from a non-renewable resource **but** there are renewable/other methods of producing hydrogen
- Hydrogen releases more energy **so** less fuel needed or more efficient

Disadvantages of using hydrogen:

- Hydrogen is a gas **so** is difficult to store or transfer to vehicles
- Hydrogen gas is very flammable **so** leaks cause a greater risk of explosion
- Most hydrogen is produced from fossil fuels **which** are running out
- Cannot be used in existing car engines **so** modification / development or replacement is needed
- Lack of filling stations **so** difficult to refuel your vehicle

Total			18

4.7.1.3 Properties of hydrocarbons

Answer 53 · Mark scheme

June 2016 | CH1HP | Original Q4 | Legacy

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	add yeast		1	AO1
	and ferment **or** by fermentation	allow in a warm place **or** temperatures within the range 20-45^{o}C **or** with an airlock/absence of air	1	1.5.3b
4(a)(ii)	by hydration with steam	allow react with/addition of steam	1	AO1 1.5.3a
	in the presence of a catalyst	ignore names of catalyst and any other conditions allow a correctly named catalyst e.g. phosphoric acid	1	
4(b)		"it" = crude oil		AO1+AO2 1.4; 1.4.3e
		allow the link pairs in either order		
		ignore cost throughout		
	Advantages			
	crude oil is reliable source of ethanol	**or** produces pure ethanol	1	
	because it is not affected by weather conditions or plant growth is affected by weather condition	so purification/separation is not required	1	
	or does not cause food shortages	**or** quick / continuous process		
	because farmland not used	whereas fermentation takes a long time/is a batch process		
	Disadvantages			
	crude oil is a non-renewable / finite resource	allow production of ethanol from crude oil uses more energy or a higher temperature or burns more fossil fuels	1	
	so it will run out / plants grow again	so releases more carbon dioxide or causes global warming (or an effect)	1	

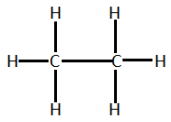
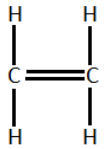
4.7.1.3 Properties of hydrocarbons

Answer 53 · Mark scheme

4(c)	heat (the mixture) ethanol has a lower boiling point than water **or** more ethanol than water vaporises **or** ethanol evaporates first or when the temperature reaches 78°C condense (the vapour)	 allow ethanol and water boil at different temperatures allow condense at different temperatures for the last two marking points if no other mark is awarded, allow repeat distillation or use fractional distillation apparatus for 1 mark	1 1 1	AO2 1.4.1 b; 1.5.3 b
Total			**11**	

4.7.1.3 Properties of hydrocarbons

Answer 54 · Mark scheme June 2017 | CH1HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	electronic structure drawn	allow any representation of an electron allow 2,4	1	**AO2** 1.1.1h
2(a)(ii)	six / 6 protons (protons) are positively charged	 do **not** allow electrons in nucleus otherwise ignore electrons do **not** allow nucleus is neutral allow (protons are) + / +1 / 1+ ignore statements about mass if no other mark awarded allow one mark for nucleus	1 1 1	**AO1** **AO2** 1.1.1c;d;e
2(b)	(a hydrocarbon is) made up of hydrogen and carbon (atoms) only	do **not** allow mixture	1	**AO1** 1.4.1a;c
2(c)(i)	 	ethane correctly drawn with another hydrogen on each carbon and another three single bonds ethene correctly drawn with a double bond between the carbon atoms	1 1	**AO1** 1.4.2a 1.5.1c
2(c)(ii)	as the number of carbon atoms increases the boiling point increases	allow converse ignore alkene	1	**AO3** 1.4.2c

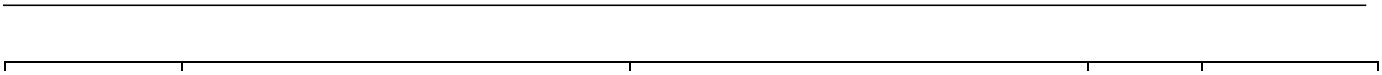
Answer 54 · Mark scheme

2(c)(iii)	the boiling points of alkanes are higher than the boiling points of alkenes that have the same number of carbon atoms **or** state a correct example	allow the boiling points of alkenes are lower than the boiling points of alkanes consequential on first marking point e.g. hexane has a higher boiling point than hexene **or** hexane boils at 69ºC hexene boils at 64ºC if no other mark awarded allow both alkanes and alkenes have the same pattern of the more carbon atoms the higher the boiling point for one mark	1 1	**AO2** 1.4.2b;c
2(d)	(alkane molecules are) cracked to produce small(er) molecules / alkanes / hydrocarbons and alkenes **or** a named alkene	allow break down / up **or** decompose **or** split up ignore separate allow short chain for small allow molecules that have a double bond **or** are unsaturated if no other mark awarded allow evaporate **or** boil for one mark ignore turns to gas	1 1 1	**AO1** **AO2** **AO3** 1.5.1a;b;d
Total			**13**	

4.7.1.3 Properties of hydrocarbons

Answer 54 · Mark scheme

June 2017 | CH1HP | Original Q2 | Legacy



4.7.1.3 Properties of hydrocarbons

Answer 55 · Mark scheme June 2018 | 8462/2H | Original Q7

Question	Answers	Extra information	Mark	AO/Spec. Ref.
07.1	incomplete combustion (because) insufficient / limited oxygen supply		1 1	AO1 4.9.3.1
07.2	any **two** from: • carbon monoxide toxic / poisonous • greater public concern / awareness about pollution • more cars so otherwise there would be more carbon monoxide entering atmosphere • improved engine technology • catalytic converters have been introduced	allow description of how carbon monoxide is toxic / poisonous ignore carbon monoxide is harmful / dangerous / deadly ignore comments about the effects of other pollutants ignore unspecified comments about carbon monoxide pollution	2	AO1 AO3 4.9.3.2
07.3	any **one** from: • (to reduce) health problems • (to reduce) global dimming	allow (to reduce) specified health problems eg breathing difficulties, asthma, lung cancer allow (to reduce) the effects of global dimming eg reduced light levels allow (to reduce) smog allow (to reduce) the formation of particulates ignore global warming do **not** accept to reduce soot	1	AO1 4.9.3.1 4.9.3.2

4.7.1.3 Properties of hydrocarbons

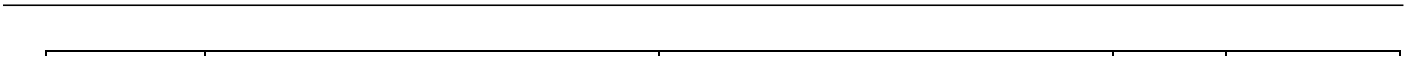
Answer 55 · Mark scheme June 2018 | 8462/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	nitrogen (from atmosphere) reacts with oxygen (from atmosphere) at high temperature (in engine) **or** with a spark (from spark plug)	 ignore heat / hot	1 1	AO1 4.9.3.1
07.5	**2** $NO_2 \rightarrow N_2$ + **2** O_2	allow multiples if incorrect, allow N_2 for **1** mark	2	AO2 4.1.1.1 4.3.1.1
07.6	any **two** from: • acid rain • respiratory problems • carbon monoxide • global dimming **or** smog	**max 1** mark if global warming mentioned allow specific effects of acid rain allow specific respiratory problems eg breathing difficulties, asthma	2	AO1 4.9.3.2
07.7	transition metals		1	AO2 4.1.3.2
Total			**12**	

4.7.1.3 Properties of hydrocarbons

Answer 55 · Mark scheme

June 2018 | 8462/2H | Original Q7



4.7.1.3 Properties of hydrocarbons

Answer 56 · Mark scheme

June 2019 | 8462/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	a temperature between 400 (°C) and 500 (°C) inclusive	allow a temperature range entirely within 400 (°C) and 500 (°C) inclusive	1	AO3 4.7.1.2
01.2	(diesel oil has a) lower boiling point / range than heavy fuel oil (but diesel oil has a) higher boiling point / range than kerosene	ignore quoted values for boiling points ignore references to melting points ignore references to intermolecular forces or chain length allow temperature of vaporisation / condensation for boiling points throughout allow the boiling range (of diesel oil) is between those of heavy fuel oil and kerosene for **2** marks.	1 1	AO2 4.7.1.2
01.3	any **two** from: • (too) viscous • not (very) flammable • boiling point (too) high	ignore references to cost allow references to difficulty of flow allow references to difficulty of ignition / burning do **not** accept bitumen takes more energy to burn allow not (very) volatile	2	AO2 4.7.1.3
01.4	C_6H_{14}		1	AO2 4.7.1.1

4.7.1.3 Properties of hydrocarbons

Answer 56 · Mark scheme June 2019 | 8462/2H | Original Q1

01.5	high temperature any **one** from: • steam • catalyst	ignore references to pressure allow a quoted temperature above 320 °C ignore hot / heat ignore name of catalyst allow alumina allow aluminium oxide allow porous pot allow zeolite	1 1	AO1 4.7.1.4
01.6	greater demand (for smaller molecules) any **one** from: (because smaller molecules are) • more useful • better fuels • used to make alkenes • used to make polymers	allow converse argument for larger molecules allow a named polymer ignore plastics	1 1	AO1 4.7.1.4
01.7	C_3H_6		1	AO2 4.1.1.1 4.7.1.4
Total			**11**	

4.7.1.3 Properties of hydrocarbons

Answer 57 · Mark scheme

June 2019 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	wood is renewable **or** (natural) gas is finite (burning) wood produces the same amount of carbon dioxide as the trees absorbed **or** (burning natural) gas increases the amount of carbon dioxide (in the atmosphere)	 allow wood is carbon-neutral allow wood does not add to global warming allow (burning natural) gas adds to global warming allow (burning natural) gas adds greenhouse gases (to the atmosphere) ignore references to energy / cost	1 1	AO3 4.9.2.2 4.10.1.1
05.2	not enough oxygen (so) incomplete combustion	allow not enough air do **not** accept no oxygen / air	1 1	AO1 4.9.3.1
05.3	$\mathbf{2}CH_4(g)+\mathbf{3}O_2(g)\rightarrow\mathbf{2}CO(g)+\mathbf{4}H_2O(g)$	allow correct multiples / fractions	1	AO2 4.9.3.1

4.7.1.3 Properties of hydrocarbons

Answer 57 · Mark scheme

June 2019 | 8462/2H | Original Q5

05.4	ratio of O_2 : CO_2 = 5 : 3 (oxygen needed = $\frac{3.60 \times 5}{3}$) = 6.0 (dm^3) (oxygen unreacted = 7.25 – 6.0) = 1.25 (dm^3) (oxygen unreacted = 1.25 × 1000) = 1250 (cm^3)	an answer of 1250 (cm^3 oxygen unreacted) scores **4** marks allow correct calculation using an incorrectly determined mole ratio allow correct subtraction of an incorrectly calculated volume of oxygen allow correct conversion to cm^3 anywhere in response **alternative approach for MP1 and MP2** moles CO_2 = 0.15 **and** moles O_2 = 0.25 (1) (0.25 x 24 =) 6.0 (dm^3 oxygen needed) (1)	1 1 1 1	AO2 4.3.5 4.7.1.3
Total			**9**	

4.7.1.3 Properties of hydrocarbons

Answer 58 · Mark scheme

November 2021 | 8462/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	all five points plotted correctly	allow a tolerance of ± ½ a small square allow **1** mark for three or four points plotted correctly	2	AO2 4.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	98 (°C)	allow a value in the range 92 to 104 (°C)	1	AO3 4.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	the boiling point is lower than 0 (°C)	allow the graph cannot show negative temperatures	1	AO3 4.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	gas	allow (g)	1	AO2 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	C_9H_{20}		1	AO2 4.7.1.1

4.7.1.3 Properties of hydrocarbons

Question 2 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(nonane) has a higher boiling point	allow converse for the other alkanes	1	AO2 4.7.1.2
	(so nonane) condenses where the column has a higher temperature	allow (so nonane) collects where the column has a higher temperature	1	

Total			8

4.7.1.3 Properties of hydrocarbons

Answer 59 · Mark scheme

November 2021 | 8462/2H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(steam / catalytic) cracking	allow thermal decomposition	1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	high temperature steam / catalyst	allow a temperature in the range 300 – 900 °C	1 1	AO1 4.7.1.4

Answer 59 · Mark scheme

Question 10 continued

Question	Answers	Mark	AO/ Spec. Ref
10.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2 4.6.1.3 4.6.2.4 4.6.2.6 4.6.2.7 4.7.2.2
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content **Rate** • higher temperature gives higher rate • because more frequent collisions • higher pressure gives higher rate • because more frequent collisions • a catalyst can be used to give a higher rate • because the activation energy is reduced **Yield** • higher temperature gives lower yield • because the reaction is exothermic • higher pressure gives higher yield • because there are more molecules on left hand side **Other factors** • higher temperatures use more energy so costs increase • higher pressures use more energy so costs increase • higher pressures require stronger reaction vessels so costs increase **Compromise** • chosen temperature is a compromise between rate and yield • chosen temperature is a compromise between rate and cost (of energy used) • chosen pressure is a compromise between rate and cost (of energy used) • chosen pressure is a compromise between yield and cost (of energy used)		

Question 10 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	fermentation	allow ferment(ing)	1	AO1 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	warm anaerobic (conditions)	allow a value in the range 25 °C to 45 °C allow without oxygen / air	1 1	AO2 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.6	(conversion) 200 km = 200,000 m (moles =) $\frac{200000 \times 1.95 \text{ (mol)}}{1300}$ = 300 (mol)	 allow correct use of incorrect / no conversion for distance	1 1 1	AO2 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.7	$C_4H_9OH + 6\,O_2 \rightarrow 4\,CO_2 + 5\,H_2O$	allow $C_4H_{10}O$ for C_4H_9OH allow multiples allow **1** mark for $C_4H_9OH + O_2 \rightarrow CO_2 + H_2O$ with incorrect / no multipliers ignore state symbols	2	AO2 4.1.1.1 4.3.1.1 4.7.2.3

Total			17

4.7.1.3 Properties of hydrocarbons

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	crude oil is heated to vaporise (the hydrocarbons)		1	AO1 AO2 4.7.1.2
	there is a temperature gradient in the (fractionating) column	allow a (fractionating) column is cooler going up	1	
	(so) the gases condense at different levels **or** (so) lubricating oil condenses below naphtha (and petroleum gases do not condense)		1	
	(because of their) different boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	detergents		1	AO1 4.7.1.2
	solvents		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$C_9H_{20} + 14\,O_2 \rightarrow 9\,CO_2 + 10\,H_2O$	allow multiples allow **1** mark for $C_9H_{20} + O_2 \rightarrow CO_2 + H_2O$ with incorrect / no multipliers	2	AO2 4.1.1.1 4.3.1.1 4.7.1.3

4.7.1.3 Properties of hydrocarbons

Answer 60 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(when burned sulfur impurities) produce sulfur dioxide		1	AO1 4.9.3.1 4.9.3.2
	(which) causes acid rain **or** (which) causes respiratory problems	allow specified effects of acid rain allow specified respiratory problems	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5		allow converse statements		AO2 4.7.1.3
	as molecular size increases viscosity increases		1	
	(and) heavy fuel oil has larger molecules (than kerosene)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(name of process) cracking		1	AO1 4.7.1.4
	(conditions) high temperature	allow a stated temperature in the range 300 to 900 °C	1	
	steam / catalyst		1	

4.7.1.3 Properties of hydrocarbons

Answer 60 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	C_7H_{14} and C_8H_{16}		1	AO2 4.7.1.4 4.7.2.1

Total Question 4		**16**

4.7.1.3 Properties of hydrocarbons

Answer 61 · Mark scheme

June 2024 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	high temperatures (cause) nitrogen (from air) and oxygen (from air) to react	ignore pressure	1 1	AO1 4.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2		ignore references to water vapour		
	less climate change	allow less global warming allow an effect of climate change for climate change	1	AO1
	(because) no carbon dioxide (produced)		1	AO3 4.7.1.3 4.9.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	more oxides of nitrogen (produced)		1	AO1
	(so) more acid rain **or** (so) more respiratory problems	allow an effect of acid rain for acid rain allow a named respiratory problem for respiratory problems MP2 cannot be linked to an incorrect gas from MP1	1	AO3 4.7.1.3 4.9.3.2

4.7.1.3 Properties of hydrocarbons

Answer 61 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(volume of oxygen = $3.50 \times \frac{1}{2}$ =) 1.75 (dm^3)		1	AO2 4.3.5 4.9.1.1
	(volume of air =) $1.75 \times \frac{100}{20}$	allow correct use of an incorrectly determined volume of oxygen	1	
	= 8.75 (dm^3)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	there is a temperature gradient in the (fractionating) column	allow the (fractionating) column gets cooler going up	1	AO1
	(so) kerosene condenses	allow (so) the hydrocarbons / vapours condense	1	AO2
	at the level (in the column) corresponding to kerosene's boiling point (range)	allow at the level (in the column) corresponding to the boiling point of the hydrocarbons / vapours for the award of 2 marks for MP2 and MP3, a reference to kerosene must be made	1	AO1 4.7.1.2

Total Question 5	**12**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	fractional distillation		1	AO1 4.1.1.2 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(heater) evaporation (column) condensation	allow liquid to gas allow boiling allow gas to liquid	1 1	AO1 4.2.2.1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	petrol		1	AO3 4.7.1.2

Question	Answers	Mark	AO / Spec. Ref.
02.4	heavy fuel oil ⟶ diesel oil ⟶ kerosene	1	AO3 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	C_4H_{10}		1	AO2 4.2.1.4 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	butane		1	AO1 4.7.1.1

4.7.1.3 Properties of hydrocarbons

Answer 62 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	C_3H_8 + 5 O_2 → **3** CO_2 + **4** H_2O	allow **1** mark for **3** CO_2 allow **1** mark for **4** H_2O	2	AO2 4.1.1.1 4.3.1.1 4.7.1.3

Total Question 2	**9**

4.7.1.3 Properties of hydrocarbons

Answer 63 · Mark scheme

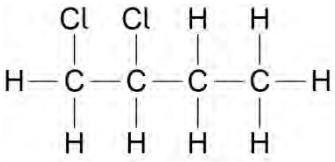
June 2025 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	– 6 (°C)	allow a value in the range (+)4 to –16 (°C)	1	AO2 4.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	ethanol	allow C_2H_5OH	1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(test) damp litmus paper (result) litmus paper is bleached **or** litmus paper turns white	 ignore litmus paper turns red ignore litmus paper turns red	1 1	AO1 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4			1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	propene		1	AO1 4.7.2.1

4.7.1.3 Properties of hydrocarbons

Answer 63 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(because of) incomplete combustion	ignore insufficient oxygen	1	AO1 4.7.2.2

Answer 63 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(conversion 24 dm^3 =) 24 000 cm^3	allow conversion of volume anywhere in method	1	AO2 4.3.1.2 4.3.2.1 4.3.5 4.7.2.1
	(M_r = (3 × 12) + (6 × 1) =) 42		1	
	(moles = $\frac{2.1}{42}$ =) 0.05	allow correct use of an incorrectly determined M_r	1	
	(volume =) 24 000 × 0.05	allow correct use of an incorrectly determined number of moles allow correct use of an incorrect / no conversion of volume	1	
	= 1200 (cm^3)		1	
	alternative approach			
	(conversion 24 dm^3 =) 24 000 cm^3 (1)	allow conversion of volume anywhere in method		
	(M_r = (3 × 12) + (6 × 1) =) 42 (1)			
	(ratio of mass = $\frac{42}{2.1}$ =) 20 (1)	allow correct use of an incorrectly determined M_r		
	(volume =) $\frac{24\,000}{20}$ (1)	allow correct use of an incorrect / no conversion of volume		
	= 1200 (cm^3) (1)			

Total Question 5	**12**

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Chemistry 4421

CHY1H Unit Chemistry 1

Mark Scheme

2007 examination - June series

4.7.1.3 Properties of hydrocarbons

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell, Director General.

4.7.1.3 Properties of hydrocarbons

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

4.7.1.3 Properties of hydrocarbons

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.7.1.3 Properties of hydrocarbons

CHY1H Question 1

	answers	extra information	mark
(a)	any **two** from: • nitrogen • carbon dioxide • water (vapour) / steam	 accept formulae N / N_2 accept formula CO_2 ignore CO accept formula H_2O	2
(b)	any **three** from: <u>limestone</u> • abundant / local • natural material **or** no 'processing' needed • relatively easy to cut • appearance better <u>concrete</u> • <u>raw materials</u> are abundant • can be reinforced (by steel rods) / strong(er) / supported (by steel rods) • concrete mixture can be poured / moulded / constructed on site • less reactive with acid rain / weathering / erosion	no mark for 'limestone' or 'concrete' on first line – mark advantages only ignore ideas of speed of production or easier to use accept 'can build higher' ignore density / extraction / quarrying / pollution / cost	3
total			5

4.7.1.3 Properties of hydrocarbons

CHY1H Question 2

	answers	extra information	mark
(a)(i)	$Cu_2S + 2O_2 \rightarrow 2CuO + SO_2$	accept fractions and multiples	1
(ii)	any **two** from: • sulfur dioxide • causes acid rain • consequence of acid rain eg kills fish / plants	 accept sulphur dioxide / sulphur oxide / SO_2 ignore other comments eg global warming / ozone / global dimming / greenhouse effect	2
(b)	any **two** from: • heat (copper oxide with carbon) • oxygen is removed by carbon **or** carbon monoxide / carbon dioxide is produced **or** carbon displaces copper • because carbon is more reactive than copper	 accept copper (oxide) loses oxygen **or** carbon gains oxygen accept carbon oxide accept a correct word or balanced symbol equation allow a correct comparison of reactivity	2
(c)(i)	electrolysis	accept electroplating	1
(ii)	(electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys **or** named alloys		1

Continued on next page

4.7.1.3 Properties of hydrocarbons

Question 2 continued

	answers	extra information	mark
(d)	any **three** explanations from: <u>for recycling</u> • less acid rain (pollution) • copper reserves last longer / conserved **or** do not run out • energy for extraction (saved) **or** less energy required • less mining / quarrying • less waste (copper) / electrical appliances dumped **or** less landfill <u>against recycling</u> • collection problems • transport problems • difficult to separate copper from appliances • energy used to melt the collected copper	ignore electrolysis / pollution ignore ideas about less machinery / plant ignore idea of cost	3
total			10

4.7.1.3 Properties of hydrocarbons

CHY1H Question 3

	answers	extra information	mark
(a)(i)	core		1
(ii)	plate (boundaries)	accept parts of the crust ignore crust alone	1
	sudden movement / colliding **or** normally move a few centimetres per year	accept movement but ignore movement apart accept continental drift	1
	convection currents / driven by heat from radioactive processes / decay	idea of source of energy for the movement	1
	the idea of uncertainty with an explanation eg scientists do not know (with any certainty) • what happens under the crust • where the forces / pressure are building up • we cannot measure the forces • when the forces reach their limit	ignore references to volcanoes	1
(b)(i)	78		1

Continued on next page

4.7.1.3 Properties of hydrocarbons

Question 3 continued

	answers	extra information	mark
(ii)	marks awarded for any 2 gases from the following 3 gases	max **3** marks from CO_2	
	any **four** from: carbon dioxide has decreased: • used by plants / bacteria (stromatolites) • during photosynthesis (must be linked to CO_2 decrease) • 'locked up' in (sedimentary) rocks / carbonates / fossil fuels • dissolved in oceans **and / or** oxygen has increased because: • released by plants / bacteria (stromatolites) • during photosynthesis (must be linked to O_2 increase) **and / or** nitrogen has increased because • ammonia reacted with oxygen (to release nitrogen) • nitrogen is released by bacteria	ignore references to respiration	4
total			10

4.7.1.3 Properties of hydrocarbons

CHY1H Question 4

	answers	extra information	mark
(a)	permitted additive / (added) chemicals **or** names / types of additives	accept the chemical name ignore food additive alone	1
(b)(i)	water and oil do not mix / are immiscible **or** don't dissolve each other	ignore density ignore emulsifier alone	1
(ii)	any **two** from: • emulsifier • forms an emulsion • holds the two components together • by lowering the surface tension	 accept description of an emulsion accept stops them separating / they mix allow bonds / binds for holds accept a description of how an emulsifier works for **two** marks eg 'tadpole' diagram or dispersal of oil drops	2
(c)(i)	(because they contain) a double (carbon carbon) bond	accept unsaturated ignore poly or mono	1
(ii)	results suggest sunflower oil is best **or** 'the one that took the least time' because (sunflower oil) has the highest amount of unsaturation / most double bonds / least saturated	 ignore uses up I_2 most quickly second mark is dependent on first	1 1

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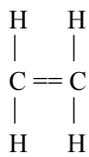
4.7.1.3 Properties of hydrocarbons

Question 4 continued

	answers	extra information	mark
(d)(i)	any **one** from: • have a higher melting point than (vegetable) oil • are solid at (room temperature) / hardened / harder	 accept useful as spreads **or** doesn't soak into bread ignore hard / soft(er)	1
(ii)	any **two** from: • hydrogen added • to carbon carbon double bond / to saturate • (nickel) catalyst / temperature 60 - 150°C	 do **not** accept 'water' wrong catalyst doesn't get this mark ignore high / warm temperature	2
total			10

4.7.1.3 Properties of hydrocarbons

CHY1H Question 5

	answers	extra information	mark
(a)(i)	by (fractional) distillation **or** fractionation	accept a description of the distillation process (heat and how separation works) eg heat **and** condense accept boil / vapourise etc for heat	1
(ii)	CO_2 H_2O	note the order of these products must be correct wrong way round = **1** mark	1 1
(b)(i)	(hexane) has been broken down (into smaller hydrocarbons / molecules)	accept (thermal) decomposition / cracked / split / broken up owtte	1
(ii)		accept $CH_2=CH_2$	1
(iii)	water / hydrogen oxide / steam	accept H_2O	1

Continued on next page

4.7.1.3 Properties of hydrocarbons

Question 5 continued

	answers	extra information	mark
(c)	candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks. if they do not then the maximum mark is three any **four** from: <u>advantages of using sugar</u> • country has no wealth to buy (large quantities of) crude oil • country has limited technological development **or** underdeveloped / third world country • able / suitable climate to grow sugar cane • enough land to grow sugar cane / land cannot be used to grow food / deforestation • sugar is a renewable source **or** crude oil is a non-renewable resource / finite resource / limited resources • CO_2 / carbon neutral <u>advantages of using alkanes:</u> • economic costs are low • continuous process • country has large oil resources • country has oil refineries / cracking plants • very pure product • faster process	not 'expensive' alone	4
total			10

Answer 55 · Examiner comments

June 2018 | 8462/2H | Original Q7

Question 7 (standard & standard / high demand)

07.1 This was generally well answered with 72% of students achieving one or two marks. The mark most commonly not achieved was for an insufficient or limited oxygen supply. This was usually because the students either did not mention oxygen or failed to say the supply was limited. However a number of students did not achieve the mark by stating that **no** oxygen was present. Global warming was a frequent response but was not creditworthy.

07.2 This was less well answered with 5% of students achieving both marks. Many students realised that CO is toxic in some way, but were too vague using words like 'harmful' or 'dangerous'. However this was the mark which was most frequently awarded.

Many students struggled to find a second reason. Again specific responses were required. Responses such as 'improved technology', 'more efficient cars' were not, on their own, sufficient to gain the 'improved engine technology' mark.

Although the question specifically mentioned new cars, responses comparing old cars to new cars did not normally contain creditworthy material.

07.3 This was not well answered with 11% of students achieving the mark. Most students did not appear to have realised that the question was asking about unburned hydrocarbons. Many who did were side-tracked into talking about wasting petrol / resources, or the flammability of unburned hydrocarbons. Again, global warming was a frequent response which did not gain credit.

07.4 There were a few good responses, but many that were not. 11% of students achieved both marks.

Students did not have to state where the oxygen and nitrogen came from, but when they did this needed to be correct. Nitrogen coming from the petrol or from combustion was not an acceptable response. The second mark was frequently not given because of the use of vague terms such as 'hot', rather than naming the conditions required ('high temperature')

07.5 This was generally well answered, although ‘2N’ was a common incorrect response. Students need to remember that gases such as nitrogen, hydrogen and oxygen normally exist as diatomic molecules. 61% of students achieved both the marks.

07.6 Again global warming and other associated responses were frequently seen, and in this case lost credit. Vague responses were also frequently seen. However most responses referred correctly to acid rain and one mark was often awarded. Some good responses included details about the pollutants that contribute to these effects. 56% of students were able to gain at least one mark.

07.7 61% of students knew that the transition metal block was the most likely source of catalysts.

4.7.1.3 Properties of hydrocarbons

Answer 58 · Examiner comments November 2021 | 8462/2H | Original Q2

Question 2 (standard demand)

02.1 This was very well attempted and three quarters of students gained both marks.

02.2 Most students were able to determine the boiling point of heptane.

02.3 Two thirds of students identified that the *y*-axis did not fall below 0°C.

02.4 Just over two-thirds of students identified the gaseous nature of butane at 20°C.

02.5 More than three-quarters of students were able to apply the general formula to nonane.

02.6 Many students were able to state that nonane has a higher boiling point than the other alkanes in the table, but far fewer could use this to explain the condensing location in the column.

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Answer 59 · Examiner comments November 2021 | 8462/2H | Original Q10

Question 10 (standard, standard / high and high demand)

10.2 More than two thirds of students knew one condition (high temperature) and more than one third knew two.

10.3 There was a very wide range of marks but many did not score above Level 1. The main failure to reach Level 2 was that the question focuses on economics so that an answer which fails to mention energy, cost or a compromise in reaction conditions does not meet the level descriptor for Level 2. Similarly, the requirements for Level 3 were not usually met if the references did not mention the impact of reaction conditions on both rate and yield. Only a handful of students gave a Level 3 answer.

10.4 Fermentation was well known.

10.5 Around half of students scored one mark by extending their knowledge of fermentation to this unfamiliar context, 'warm' was seen much more often than 'anaerobic'.

10.6 This was completely correct in the responses of nearly half of students. Where a mark was not obtained, this was usually caused by a failure to convert kilometres to metres.

10.7 A challenging concluding equation with no scaffolding which students found difficult.

Concluding Remarks

There is still some evidence that command words are misunderstood or ignored. This limits the marks awarded, especially in extended response questions. This is particularly true where a command word demands a reasoned judgement.

Students seemed well prepared for questions based on Organic Chemistry and Chemistry of the Atmosphere. In this series they seemed less equipped to deal with Chemical Analysis, Rate of Reaction and some aspects of Using Resources.

There were a number of instances of key reagents, techniques and colour changes still not being well known.

4.7.1.3 Properties of hydrocarbons

Answer 59 · Examiner comments

November 2021 | 8462/2H | Original Q10

Mark Ranges and Award of Grades

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

Answer 60 · Examiner comments

June 2022 | 8462/2H | Original Q4

Question 4 (Standard, standard/high and high demand)

04.1 The vast majority of students wrote detailed answers to this question and the full range of marks was awarded although relatively few answers were awarded full marks. About 1 in 10 students scored all four marks, while a quarter scored three. Students often neglected to state the crude oil must be heated to begin the separation process. Some students failed to score the second marking point in the mark scheme because their description of a temperature gradient was not in the context of gases rising through a fractionating column or fractionating tower. A handful of students illustrated this idea by referring to a labelled diagram.

The idea of fractions collecting at different levels in the fractionating column was well understood but many described the collection of fractions without mentioning condensing and so could not access this mark. Some students incorrectly suggested that petroleum gases would condense at the top of the column. The idea that the separation of crude oil is based on differences in boiling points was an accessible mark but many failed to mention boiling points or simply quoted boiling point ranges from the table.

04.2 Just over a third of students were able to score both of the marks available in this multiple choice question. This suggests that the feedstock concept in the specification is not well known.

04.3 Nearly half of the students scored both marks by being able to write a correctly balanced equation for the combustion of nonane. Many were able to pick up one mark for writing the correct formulae for oxygen, carbon dioxide and water. Some students failed to score any marks because they included hydrocarbon molecules in their equation, perhaps confusing this combustion reaction with cracking. Students should be advised to take care when writing numbers in equations. A quickly written 14 sometimes looked like 19 and 19 H_2O was occasionally written by students who had double-counted the oxygen atoms in water. Similarly, excessively large subscript numbers and excessively small capital letters (especially O) are likely not to gain credit.

4.7.1.3 Properties of hydrocarbons

Answer 60 · Examiner comments June 2022 | 8462/2H | Original Q4

04.4 This question was generally well answered but some students stated that the combustion of sulfur would cause damage to the car engine while others appeared to confuse the effects of burning sulfur with a lack of oxygen and named the products of incomplete combustion. Some seemed to think that sulfur would be released into the air as a toxic gas but these students could still be credited for a description of the problems caused by sulfur dioxide. These problems were well known; acid rain or respiratory problems were common answers. Around 30% of the students gained both marks.

04.5 Most students scored at least one mark for this question, usually by giving a statement that heavy fuel oil has larger molecules. A relatively small proportion scored the first marking point in the mark scheme for stating the general relationship between molecular size and viscosity. A statement about heavy fuel oil being more viscous than kerosene was insufficient for credit because this repeated information given in the question. Nearly 30% of the students gained both of the marks.

04.6 The full range of marks was awarded. The name of the process was well known but a large proportion of students failed to mention either the high temperature or the use of steam or a catalyst and so gained only two of the three marks. Marks were awarded independently so even students who could not name the process could pick up two marks for correctly describing the conditions. Nearly half of the students gained all three marks here.

4.7.1.3 Properties of hydrocarbons

Answer 61 · Examiner comments

June 2024 | 8462/2H | Original Q5

Question 5 (standard and standard / high demand)

05.1 This was not well understood. Some students knew that nitrogen and oxygen were reacting together. However, some thought that nitrogen came from the fuel and some that oxygen is a product of combustion. Only a minority mentioned high temperature although many said, 'very hot'. About 15% scored both marks.

05.2 Some students stated that no carbon dioxide is produced when hydrogen burns. However, many simply described what carbon dioxide does to the environment, rather than stating that burning hydrogen instead of methane **reduces** the rate of climate change. Many referred to the greenhouse effect without referencing the effect on the environment, ie climate change. Around 40% scored both marks.

05.3 Most realised that increased levels of nitrogen oxides would be produced. Although there were some good descriptions of what nitrogen oxides do to the environment, very few said that those effects would be increased by burning hydrogen instead of methane, ie **more** acid rain etc. Many thought that nitrogen oxides are greenhouse gases rather than a precursor of acid rain. Some suggested more nitrogen was released to the atmosphere, rather than oxides of nitrogen. Less than 10% of students scored both marks, although more than half scored one.

05.4 Over one-third of students gained all three marks. However, some students appeared to believe that the other 80% of the air was hydrogen. Some tried to involve the relative atomic masses, even though these were not provided. A few unnecessarily converted the volume of hydrogen to moles and then the moles of oxygen to volume, not realising that the mole ratio is the volume ratio for gases. This did score full marks if correct.

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Answer 61 · Examiner comments

June 2024 | 8462/2H | Original Q5

05.5 Most scored the mark for kerosene, or the vapours condensing, and many also described the temperature gradient correctly. Far fewer scored the mark for linking the height in the column to the boiling point and the condensation of kerosene. Most did not mention the height or level in the column, while others seem to think that a vapour only condenses at a temperature below, rather than at, its boiling point. A few students thought that kerosene was either a product of cracking, or a polymer. Just over 10% scored all the marks.

4.7.1.3 Properties of hydrocarbons

Answer 62 · Examiner comments June 2025 | 8462/2H | Original Q2

Question 2

02.1 Over 90% of students correctly identified fractional distillation.

02.2 More than 4 in 5 students gained both marks here. Incorrect answers gave the state alone, rather than the change.

02.3 Over 90% of students made the link between boiling point and position of production on the column. Petroleum gases was the most common incorrect response given.

02.4 Around three fifths of students correctly linked the boiling point and flammability in this multichoice question. The distractors were equally chosen.

02.5 Nearly 90% of students gained the mark for this item. The most common error was getting the number of atoms of carbon and hydrogen the wrong way round. Very few students did not gain the mark because the numbers were too big.

Answer 62 · Examiner comments June 2025 | 8462/2H | Original Q2

02.6 4 in 5 students correctly named the alkane. Some student responses were unclear between butane and butene, most often when the handwriting was very small and indistinguishable.

02.7 Over 90% of students gained both marks in balancing the equation. Most of the remainder scored one mark, usually for balancing the number of CO_2 produced.

Answer 63 · Examiner comments — June 2025 | 8462/2H | Original Q5

Question 5

05.1 Over four fifths of students correctly estimated the boiling point. Those that did not gain the mark were often giving values that were just outside of the range given in the mark scheme.

05.2 Fewer than half of the students correctly identified ethanol as the product of the reaction between ethene and steam. Many of those who did not gain this mark gave the product as alcohol, which was insufficient.

05.3 Over half of students gained both marks on this item. Where students gained one mark, about 20%, it was because 'damp' was omitted from the test and only litmus paper was given.

05.4 The product of the chlorination of butene was well known by over 90% of students.

05.5 Around three quarters of students correctly identified propene. The most common incorrect response was butene. Very few students did not identify an alkene.

05.6 Around two fifths of students knew that alkenes burn with a smoky flame due to incomplete combustion. Many of the incorrect answers seen referred to there being a double bond present, or that there was insufficient oxygen.

05.7 This multi-step calculation was well answered by over 40% of students who gained all five marks. The most common error was the omission of the volume conversion from dm^3 to cm^3. Some students divided by the volume, rather than multiplying. Equally, a number multiplied by the M_r to calculate the number of moles. In both instances, marks were awarded where clear working was shown for correct

Answer 63 · Examiner comments — June 2025 | 8462/2H | Original Q5

additional steps. when one mark alone was awarded, it was for the correct determination of the M_r.