AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.6.1.4

Catalysts

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**31**
Available paper years	**2007–2024**

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.

4.6.1.4 Catalysts

Answer 01 · Mark scheme March 2007 | CHY1B | Original Q4 | Legacy

Four	**A**	bromine	**2**
	B	hydrogen	**3**
	C	nickel	**4**
	D	water	**1**

Answer 02 · Mark scheme March 2007 | CHY1B | Original Q6 | Legacy

Six	**A**	hydrocarbons undergo thermal decomposition	**3**
	B	hydrocarbons are heated	**1**
	C	hydrocarbons vaporise	**2**
	D	small hydrocarbon molecules	**4**

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

Answer 03 · Mark scheme June 2007 | CHY1B | Original Q1 | Legacy

Question	***Key***		
One	**A**	an additive	**3**
	B	a catalyst	**4**
	C	an emulsion	**2**
	D	a mixture	**1**

4.6.1.4 Catalysts

Answer 04 · Mark scheme

Question 4

question	answers	extra information	mark
(a)(i)	monomers		1
(a)(ii)	crude oil		1
(b)	any **three** from: • metal may not corrode away / remains • plastic remains / does not break down (decay) / not affected by microorganisms • should recycle / conserve resources / mend the kettle / burn (plastic) as a fuel • landfill sites are limited / filling up • water pollution	accept non-biodegradable accept it is a waste of materials / resources ignore harms wildlife / habitats **or** problems caused by burning the kettle	3
total			5

4.6.1.4 Catalysts

Answer 04 · Mark scheme

January 2008 | CHY1F | Original Q4 | Legacy

CHY1F

4.6.1.4 Catalysts

Answer 05 · Mark scheme

Question 3

question	answers	extra information	mark
(a)(i)	burette		1
(a)(ii)	conical flask	accept conical / flask	1
(b)(i)	an indicator		1
(b)(ii)	changed colour		1
(b)(iii)	titration		1
(c)	3	correct answer = **2** marks (1 × 3) or (1 × 750/250) = **1** mark	2
(d)(i)	hydrogen		1
(d)(ii)	is partially ionised		1
total			9

4.6.1.4 Catalysts

Answer 05 · Mark scheme January 2008 | CHY3F | Original Q3 | Legacy

CHY3F

Answer 06 · Mark scheme March 2008 | CHY1BP | Original Q4 | Legacy

Four	**A**	alkanes	**2**
	B	alkenes	**1**
	C	catalysts	**4**
	D	polymers	**3**

Answer 07 · Mark scheme June 2008 | CHY1AP | Original Q9 | Legacy

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

Answer 08 · Mark scheme June 2008 | CHY1BP | Original Q6 | Legacy

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

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

Answer 09 · Mark scheme June 2008 | CHY2F | Original Q1 | Legacy

question	answers	extra information	mark
1(a)(i)	(phosphoric) acid	allow phosphoric acid	1
1(a)(ii)	hydrogen		1
1(b)(i)	faster / quicker / speeds it up (owtte)	allow answers based on activation energy ignore helps it to react	1
1(b)(ii)	most of the starting materials end up as useful products		1
1(b)(iii)	H_2O	allow HOH **or** OH_2	1
Total			**5**

4.6.1.4 Catalysts

Answer 10 · Mark scheme

November 2008 | CHY1BP | Original Q3 | Legacy

Three	**A**	argon	**1**
	B	bromine	**3**
	C	ethanol	**2**
	D	nickel	**4**

Answer 11 · Mark scheme

January 2010 | CHY2F | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	fertilisers		1
2(b)	air		1
2(c)(i)	water **and** carbon monoxide on correct side of equation	accept H_2O for water and CO for carbon monoxide	1
2(c)(ii)	speeds up the reaction (owtte)	accept lowers the activation energy	1
2(d)	reversible reaction		1
2(e)(i)	10		1
2(e)(ii)	sulfuric water	accept H_2SO_4 accept H_2O / hydrogen oxide	1 1
Total			**8**

4.6.1.4 Catalysts

Answer 11 · Mark scheme

January 2010 | CHY2F | Original Q2 | Legacy

CHY2F

4.6.1.4 Catalysts

Answer 12 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)(i)	increase		1
5(a)(ii)	energy is given out to the surroundings		1
5(b)(i)	NO	allow 2NO ignore nitrogen oxide do **not** allow equations	1
5(b)(ii)	harmful / poisonous (owtte)	allow dangerous ignore reference to pollution / global warming do **not** accept references to ozone layer	1
5(c)	a catalyst can speed up a chemical reaction different reactions need different catalysts		1 1
5(d)(i)	smaller	accept less / tiny / very small allow 10^{-9} do **not** allow small unless qualified	1
5(d)(ii)	reduce cost (owtte) **or** save resources / raw materials (owtte)	ignore references to energy	1
Total			**8**

4.6.1.4 Catalysts

Answer 12 · Mark scheme January 2011 | CHY2F | Original Q5 | Legacy

CHY2F

Answer 13 · Mark scheme March 2011 | CHY1BP | Original Q4 | Legacy

Four	**A**	bromine	**2**
	B	hydrogen	**3**
	C	nickel	**4**
	D	water	**1**

4.6.1.4 Catalysts

Answer 14 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)(i)	NH_3		1
1(a)(ii)	electrons		1
1(a)(iii)	covalent		1
1(b)(i)	air natural gas		1 1
1(b)(ii)	reversible		1
1(b)(iii)	iron		1
1(c)	nitric acid		1
1(d)(i)	any **one** from: • lost jobs / unemployment • meant that they had to move away from Humberstone **or** no one lives there • loss of income (owtte)	 allow closed down the town ignore it closed the mine unless it is further qualified by some effect of this on the local community	1

Question 1 continues on the next page

4.6.1.4 Catalysts

Question 1 continued

question	answers	extra information	mark
1(d)(ii)	any **two** from: • less transport (costs) • less pollution / greenhouse gases / global warming <u>from transport</u> • cheaper to make in country than to import • not dependent on Chile for nitrate supplies **or** reliable source • provides employment to workers in Britain • good for British economy • raw materials readily available • continuous process	ignore reference to environment / ecofriendly allow smaller carbon footprint ignore reference to quicker	2
Total			**11**

4.6.1.4 Catalysts

Answer 14 · Mark scheme

June 2011 | CHY2F | Original Q1 | Legacy

CHY2F

4.6.1.4 Catalysts

Answer 15 · Mark scheme

June 2012 | CH2FP | Original Q1 | Legacy

Question 1

question	Answers	extra information	mark
1(a)	oxygen **and** water	both needed for mark allow hydrogen oxide for water in any order ignore formulae	1
1(b)(i)	best fit line, omitting point at 10s	straight line drawn through all correct points	1
1(b)(ii)	circle around point at 10 s	allow any indication	1
1(b)(iii)	7.5	allow ecf from candidate's line	1
1(b)(iv)	increases (with time)	accept goes from 0 to 12.5	1
1(c)(i)	higher		1
1(c)(ii)	more concentrated		1
1(d)(i)	share		1
1(d)(ii)	covalent		1
1(d)(iii)	simple molecules		1
1(e)	Water has a boiling point of 100°C Water has a melting point lower than room temperature		1 1
Total			**12**

.....

4.6.1.4 Catalysts

Answer 15 · Mark scheme

June 2012 | CH2FP | Original Q1 | Legacy

CH2FP

4.6.1.4 Catalysts

Answer 16 · Mark scheme

June 2012 | CH2FP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	79 79		1 1
2(b)	hundred		1
2(c)(i)	electron(s)		1
2(c)(ii)	three		1
2(d)	changes rate of reaction **or** speeds up / slows down reaction	accept lowers activation energy accept reduces costs	1
2(e)(i)	melt		1
2(e)(ii)	crosslinking **or** (covalent) bonds between polymers / chains	allow answers on diagram allow bonds between layers do **not** allow intermolecular	1
Total			**8**

4.6.1.4 Catalysts

Answer 16 · Mark scheme

June 2012 | CH2FP | Original Q2 | Legacy

CH2FP

4.6.1.4 Catalysts

Answer 17 · Mark scheme

January 2013 | CH2FP | Original Q4 | Legacy

question	answers	extra information	mark
4(a)	would melt	accept they have a low melting point allow lose their shape ignore would soften when hot ignore boiling point	1
4(b)	to speed up the reaction	accept can use a lower temperature accept less energy needed	1
4(c)(i)	mass spectrometer	allow mass spectroscopy	1
4(c)(ii)	any **one** from: • accurate • sensitive • rapid / quicker • small amount of sample	ignore reliable ignore more precise	1
4(d)	any **two** from: • pressure • temperature • catalyst **or** initiator • solvent	allow concentration	2
Total			**6**

4.6.1.4 Catalysts

Answer 17 · Mark scheme

January 2013 | CH2FP | Original Q4 | Legacy

January 2013

CH2FP

4.6.1.4 Catalysts

Answer 18 · Mark scheme

June 2014 | CH1FP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7(a)(i)	reaction with water / steam	allow add water / steam *(to produce ethanol)* *allow H_2O or hydrogen oxide for water* *ignore mix*	1	1 / 1.5.3a	E
7(a)(ii)	filter / decant (to remove the yeast)	*allow answers in either order* *accept description of decanting* *ignore sieve*	1	2 / 1.5.3b	E
	(fractional) distillation / distil	*accept evaporation then condensation*	1		

Answer 18 · Mark scheme

<table>
<tr><td colspan="4">7(b) 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.</td><td>1+2+3 / 1.4.3e</td><td>E</td></tr>
<tr><td>0 marks</td><td>Level 1 (1–2 marks)</td><td>Level 2 (3–4 marks)</td><td>Level 3 (5–6 marks)</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>No relevant content</td><td>There is a stated advantage or disadvantage of using biodiesel or petroleum diesel.</td><td>There is a stated advantage or disadvantage of using biodiesel or petroleum diesel with a linked consequence.</td><td>There is at least one stated advantage and at least one stated disadvantage of using biodiesel or petroleum diesel with a linked consequence for each.</td></tr>
<tr><td colspan="4">Examples of points made in the response could include:
Advantages of biodiesel:
• Produces less carbon dioxide
• Produces no sulfur dioxide
• Produces less particulates
• Sustainable / renewable
• Growing crops absorb carbon dioxide
• Carbon neutral
• Produces less acid rain
• Conserves the limited amount of petroleum diesel
Disadvantages of biodiesel:
• Produces more nitrogen oxides
• Deforestation for land
• Destruction of habitats for land
• Uses land that could be used for food crops
• Creates food shortages
• Crops are not reliable</td><td></td><td></td></tr>
</table>

Total			**9**

4.6.1.4 Catalysts

Answer 19 · Mark scheme

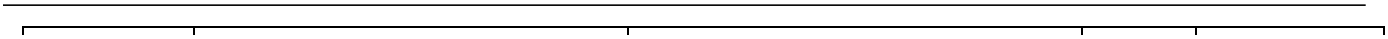
June 2015 | CH2FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	the higher the temperature, the greater the rate **or** at 40 °C rate is faster than at 20 °C	accept the higher the temperature, the faster the reaction	1	**AO3** 2.4.1c
5(a)(ii)	40 °C curve is steeper **or** correct comparison of data from the graph	accept the 40 °C line becomes horizontal sooner accept at higher temperatures the reaction finishes sooner accept reaction finishes sooner at 40 °C accept at higher temperatures the gas is produced faster	1	**AO3** 2.4.1c
5(a)(iii)	2		1	**AO2** 2.4.1a
5(b)(i)	Concentration of acid Mass of marble chips		2	**AO3** 2.4.1e
5(b)(ii)	increases rate (because of) more frequent collisions (between particles)	incorrect reference to energy = max **1** accept particles are more likely to collide ignore more collisions ignore more successful collisions	1 1	**AO1** 2.4.1f
5(c)	any **one** from: • increases rate of reaction • reduces energy required • lower temperature can be used • catalyst is not used up		1	**AO1** 2.4.1g,h
Total			**8**	

4.6.1.4 Catalysts

Answer 19 · Mark scheme

June 2015 | CH2FP | Original Q5 | Legacy



4.6.1.4 Catalysts

Answer 20 · Mark scheme

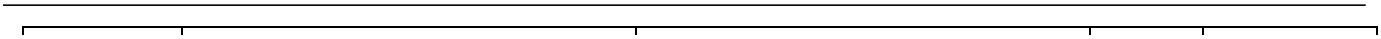
June 2015 | CH3FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	natural gas	allow correct answer shown in box if answer line blank	1	**AO1** 3.5.1.a
4(b)(i)	450	allow correct answer shown in box if answer line blank	1	**AO1** 3.5.1.b
4(b)(ii)	iron	allow correct answer shown in box if answer line blank	1	**AO1** 3.5.1.b
4(b)(iii)	The catalyst lowers the activation energy.		1	**AO1** 3.3.1.h
4(c)	(the gases are) cooled ammonia condenses nitrogen and hydrogen are recycled	 allow ammonia liquefies if no other mark awarded allow ammonia is separated for **1** mark	1 1 1	**AO1/ AO2** 3.5.1.b
Total			**7**	

4.6.1.4 Catalysts

Answer 20 · Mark scheme

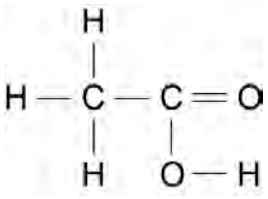
June 2015 | CH3FP | Original Q4 | Legacy



4.6.1.4 Catalysts

Answer 21 · Mark scheme

June 2016 | CH3FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
5(a)(i)	fizz / effervescence / bubbles	allow calcium carbonate decreases in size or dissolves	1	AO2/AO3 3.4.1d, 3.6.2b
	because carbon dioxide produced / released	allow because gas produced / released	1	
	limewater turns cloudy / milky / white		1	
	because (a precipitate of or solid) calcium carbonate forms	allow because of carbon dioxide if not already credited	1	
5(a)(ii)		allow –OH do not allow lower case 'h'	1	AO1 3.6.2a
5(a)(iii)	acid	must be in this order ignore any name of an acid	1	AO1 3.6.2b
	ester(s)		1	
5(b)	white (precipitate) no change no change no change	all four correct 2 marks any two correct 1 mark	2	AO2 3.4.1e,f
5(c)(i)	lilac red	must be in this order allow purple	1 1	AO1 3.4.1a
5(c)(ii)	colours are masked / changed by each flame colour		1	AO3 3.4.1a
Total			12	

4.6.1.4 Catalysts

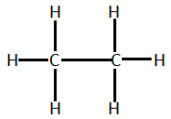
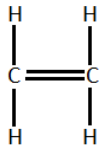
Answer 21 · Mark scheme

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / SpecRef</th></tr>
<tr><td>6</td><td></td><td></td><td>6</td><td rowspan="6">2AO1 / 3AO2 / 1AO3 3.4.1g</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="4"><table>
<tr><th>0 marks</th><th>Level 1 (1–2 marks)</th><th>Level 2 (3–4 marks)</th><th>Level 3 (5–6 marks)</th></tr>
<tr><td>No relevant content.</td><td>There is a simple description of using some of the apparatus.</td><td>There is a description of an experimental method including addition of acid to alkali which may include an indicator or colour change and may include a measurement of volume.</td><td>There is a description of titrations that would allow a comparison to be made between the two solutions of hydrochloric acid.</td></tr>
</table></td></tr>
<tr><td colspan="4">examples of chemistry points made in the response could include:
• acid in burette or flask
• alkali/sodium hydroxide or acid in burette or flask
• volume of acid or alkali measured using the pipette
• indicator in flask
• white tile under the flask
• slow addition
• swirling/mixing
• colour change of indicator
• burette volume measured</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Total</td><td></td><td></td><td>6</td><td></td></tr>
</table>

4.6.1.4 Catalysts

Answer 22 · Mark scheme

June 2017 | CH1FP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	electronic structure drawn	allow any representation of an electron allow 2,4	1	AO2 1.1.1h
6(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
6(b)	(a hydrocarbon is) made up of hydrogen and carbon (atoms) only	do **not** allow mixture	1	AO1 1.4.1a;c
6(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
6(c)(ii)	as the number of carbon atoms increases the boiling point increases	allow converse ignore alkene	1	AO3 1.4.2c

4.6.1.4 Catalysts

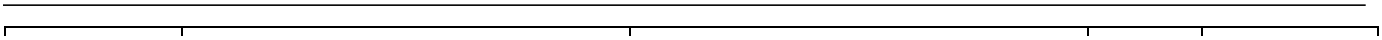
Answer 22 · Mark scheme

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

4.6.1.4 Catalysts

Answer 22 · Mark scheme

June 2017 | CH1FP | Original Q6 | Legacy



4.6.1.4 Catalysts

Answer 23 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	a smooth curve through or close to all points except (30,12)		1	AO2 2.4
5(a)(ii)	correct reading from the curve in 1(a)(i) (cm^3)	allow a tolerance of +/- 0.5 cm^3	1	AO2 2.4
5(a)(iii)	45-50 (seconds)		1	AO3 2.4
5(a)(iv)	line becomes less steep because gas is produced more slowly	ignore line levels out or plateaus allow examples with figures, eg 12 cm^3 gas from 0 to 20s but 1.5 cm^3 gas in last 20s ignore reaction has stopped or no more gas produced	1 1	AO3 2.4
5(a)(v)	0.6 (cm^3 per second)	allow 0.55 to 0.65	1	AO2 2.4
5(b)(i)	 temperature volume (of hydrogen peroxide)	concentration of hydrogen peroxide = max **1** ignore amount (of hydrogen peroxide)	 1 1	AO3 2.4
5(b)(ii)	 rate increases because more particles (in the same volume) so frequency of collisions increases	incorrect reference to energy = max **2** accept particles closer together allow greater chance of collisions ignore more collisions	 1 1 1	AO1 2.4.1e

4.6.1.4 Catalysts

Answer 23 · Mark scheme

5(c)	(increasing the amount of catalyst) increases rate same final volume of gas	accept steeper graph or graph levels off earlier	1 1	**AO2** 2.4.1g
Total			**13**	

4.6.1.4 Catalysts

Answer 23 · Mark scheme

June 2017 | CH2FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6			6	AO1 2.1.1h 2.2.4b,c 2.2.5a,b

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 information given	a statement about the structure or a property of a metal **or** a statement about the structure or a property of a polymer	a statement about the structure or a property of a metal **and** a statement about the structure or a property of a polymer	a statement about the structure or a property of a metal **and** a statement about the structure or a property of a polymer **and** at least one statement linking structure and property

Statements shown as HT only are credited on both FT and HT.
However, HT only means that these statements are not expected in a FT answer.

Examples of chemistry points made in response

Metal:

Properties

- shiny
- hardness
- (tensile) strength
- melting point/boiling point
- density
- malleable/flexible
- ductile
- conduct electricity or thermal energy

4.6.1.4 Catalysts

Answer 23 · Mark scheme

Structure • metals contain atoms /((positive) ions HT only) • (the atoms/(positive) ions/particles are) closely packed / in a regular pattern / in a giant structure/in layers / in a lattice • strong bonds/(electrostatic attractions HT only) • (metal has delocalised electrons HT only) **Polymer:** **Properties** • flexible • melting/boiling point • density • can be shaped/moulded • poor conductor of electricity or thermal energy **Structure** • polymer consists of chains • polymer chains may be tangled • polymer has no cross links. • (polymer has weak intermolecular forces HT only) **Level 3:** **Examples of linked statements:** • metal can be bent and shaped because the layers can slide • some metals are soft because layers can slide • some metals are hard because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal has high melting/boiling point because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal is strong because of strong bonds • some metals are dense because the atoms are closely packed • (metal can conduct thermal energy and electricity because metal has delocalised electrons HT only) • thermosoftening polymer melts when heated because it has no cross-links (or has weak intermolecular forces HT only) • thermosoftening polymer is flexible because the chains can move over each other			

Total			**6**

4.6.1.4 Catalysts

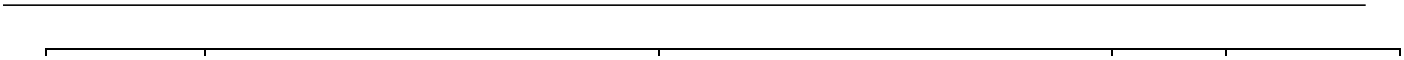
Answer 24 · Mark scheme June 2017 | CH3FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	air	allow air circled in the box	1	**AO1** 3.5.1.a
3(a)(ii)	tick (✓) by: lowers the activation energy		1	**AO1** 3.3.1h
3(a)(iii)	(gases) cooled (ammonia) condensed	 ignore turn to a liquid if no other mark, allow fractional distillation for 1 mark	1 1	**AO1** **AO2** 3.5.1b
3(b)	hydrogen ammonia	must be in correct order	1	**AO1** 3.5.1b
3(c)(i)	all points correctly plotted	allow 1 mark for **3** correct points allow +/- one small square	2	**AO2** 3.5.1b
3(c)(ii)	correctly drawn line		1	**AO2** 3.5.1b
3(c)(iii)	line extrapolated to at least 300°C 0.50 - 0.60		1 1	**AO2** 3.5.1b
3(c)(iv)	increases		1	**AO2** 3.5.1b
Total			**11**	

4.6.1.4 Catalysts

Answer 24 · Mark scheme

June 2017 | CH3FP | Original Q3 | Legacy

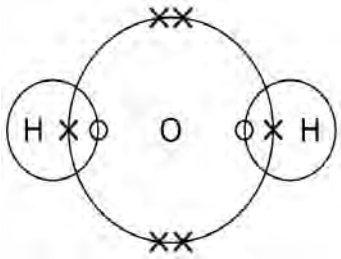


4.6.1.4 Catalysts

Answer 25 · Mark scheme

June 2019 | 8462/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	H_2O_2		1	AO2 4.1.1.1 4.2.1.4
02.2	covalent		1	AO1 4.2.1.4
02.3	transition metals		1	AO1 4.1.3.2
02.4	B		1	AO1 4.5.1.2
02.5	A		1	AO2 4.5.1.2
02.6	exothermic		1	AO1 4.5.1.1
02.7	1 bonding pair of electrons in the right hand overlap 4 non-bonding electrons on oxygen	 scores **2** marks allow dots, crosses, circles or $e^{(-)}$ for electrons do **not** accept any change to the number of electrons in the left hand overlap do **not** accept non-bonding electrons on hydrogen ignore inner shell electrons drawn on oxygen	1 1	AO1 4.2.1.4
Total			**8**	

4.6.1.4 Catalysts

Answer 26 · Mark scheme

June 2019 | 8462/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(equation contains a) ⇌ (symbol)	allow description of arrow / symbol	1	AO1 4.6.2.1
03.2	exothermic		1	AO1 4.6.2.2
03.3	to reduce costs to use less energy		1 1	AO3 4.6.1.4
03.4	(the world production of ammonia) increased (the increase was) not steady / linear	 do **not** accept decreases ignore levels off	1 1	AO2 4.10.4.1
03.5	the demand for food changed the world population changed		1 1	AO2 AO3 4.10.4.2
03.6	**C** and **D**		1	AO3 4.10.4.2
03.7	**D**		1	AO3 4.10.4.2
Total			**10**	

4.6.1.4 Catalysts

Answer 27 · Mark scheme

June 2019 | 8462/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	a glowing splint		1	AO1 4.8.2.2
07.2	student **A** should measure the mass of manganese dioxide.		1	AO3 4.6.1.1 4.6.1.2
07.3	calculate a mean but do not include any anomalous results.		1	AO3 4.6.1.1 4.6.1.2
07.4		an answer of 0.173 (cm^3/s) scores **4** marks		AO2 4.6.1.1
	(volume of oxygen formed =) (58 - 20 =) 38 (cm^3)	allow values between 36 (cm^3) and 40 (cm^3) inclusive	1	
	(time taken = 250 – 30 =) 220 (s)		1	
	$\frac{38}{220}$ **or** 0.1727 (cm^3/s)	allow a correct calculation using an incorrectly determined value for volume and / or time	1	
	= 0.173 (cm^3/s)	allow a correctly calculated answer given to 3 significant figures from an incorrect attempt at the rate equation	1	
07.5	line starts at the origin **and** steeper than existing line final volume same as existing line	allow a tolerance of ± ½ a small square	1 1	AO2 4.6.1.1
07.6	fine manganese dioxide powder has a larger surface area		1	AO3 4.6.1.2 4.6.1.3
Total			**10**	

4.6.1.4 Catalysts

Answer 28 · Mark scheme

November 2020 | 8462/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(the reaction is) reversible	allow description of a reversible reaction	1	AO1 4.6.2.1 4.10.4.1
01.2	iron		1	AO1 4.10.4.1
01.3	activation energy with a catalyst		1	AO1 4.6.1.4 4.10.4.1
01.4	bar to 22 (%) labelled phosphorus / P bar to 25 (%) labelled potassium / K	allow a tolerance of ± ½ a small square if no other mark is awarded, allow **1** mark for two bars drawn to 22% and 25%	1 1	AO2 4.10.4.2
01.5	there are other elements in the fertiliser (besides phosphorus and potassium) **or** there is nitrogen in the fertiliser	allow there are other substances in the fertiliser (besides phosphorus and potassium)	1	AO3 4.10.4.2

4.6.1.4 Catalysts

Answer 28 · Mark scheme

Question 1 (continued)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	B		1	AO3 4.10.4.2
01.7	B		1	AO2 4.10.4.2
Total			8	

4.6.1.4 Catalysts

Answer 29 · Mark scheme

June 2022 | 8462/1F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	coarse particle		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(volume =) 2^3	allow (volume =) 2×2×2	1	AO2 4.2.4.1
	= 8 (nm^3)		1	
	(surface area : volume) = 24 : 8	allow correct use of an incorrectly calculated volume	1	
	(simplest ratio) = 3 : 1		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	high(er) / large(r)		1	AO1 4.2.4.1
	lower / less / smaller		1	

4.6.1.4 Catalysts

Answer 29 · Mark scheme

June 2022 | 8462/1F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(advantage) any **one** from: • stops (unpleasant) smells • can stop (foot) infections	 allow specific (foot) infections allow silver can kill bacteria	1	AO3 4.2.4.2
	(disadvantage) any **one** from: • high cost (of socks) • could be harmful if breathed in	 allow silver is (very) expensive	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	100 times		1	AO2 4.1.1.5 4.2.4.1

Total Question 7		10

4.6.1.4 Catalysts

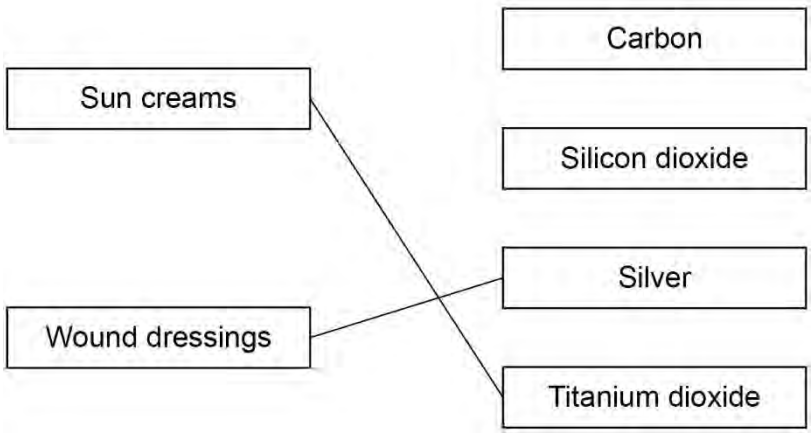
Answer 30 · Mark scheme

June 2024 | 8462/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	a few hundred atoms		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	iron		1	AO3 4.1.3.2

Question	Answers	Mark	AO / Spec. Ref.
04.3	**Use** **Substance**  do **not** accept more than one line from a box on the left	1 1	AO3 4.2.4.2

4.6.1.4 Catalysts

Answer 30 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(surface area =) 6×4^2		1	AO2 4.2.4.1
	= 96 (nm^2)		1	
	(volume =) 4^3		1	
	= 64 (nm^3)		1	
	(ratio =) 96 : 64	allow correct use of incorrectly determined area and/or volume	1	
	= 3 : 2	allow correct use of an incorrectly determined ratio	1	

Total Question 4	**10**

4.6.1.4 Catalysts

Answer 31 · Mark scheme

June 2024 | 8462/2F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	to recycle (remaining) nitrogen and hydrogen	allow to recycle unreacted gases allow to return nitrogen and hydrogen to the reactor	1	AO1 4.10.4.1

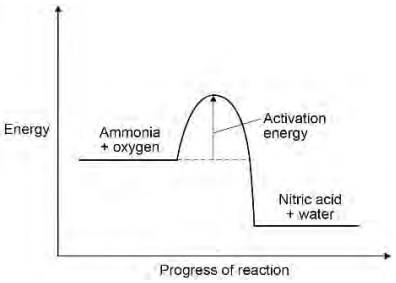
Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	iron	allow Fe	1	AO1 4.6.1.4 4.10.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	(test) glowing splint (result) (splint) relights	 MP2 is dependent upon MP1 being awarded	 1 1	AO1 4.8.2.2

4.6.1.4 Catalysts

Answer 31 · Mark scheme

June 2024 | 8462/2F | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	labelled vertical arrow from dotted line to peak ammonia **and** oxygen on left **and** nitric acid **and** water on right	ignore arrow heads allow NH_3 for ammonia allow O_2 for oxygen allow HNO_3 for nitric acid allow H_2O for water an answer of  scores **2** marks	1 1	AO2 4.6.1.4 4.10.4.1 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	the line would reach a higher peak		1	AO1 4.6.1.4 4.10.4.1 4.10.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	fertilisers	allow explosives allow sports injury packs	1	AO3 4.10.4.1 4.10.4.2

Total Question 9	**8**

4.6.1.4 Catalysts

Answer 25 · Examiner comments — June 2019 | 8462/1F | Original Q2

Question 2 (low demand)

02.1 Over 85% of students identified the correct formula of hydrogen peroxide.

02.2 Approximately 70% of students identified covalent bonding as the bonding in a hydrogen peroxide molecule.

02.3 Students found this question about elements as catalysts difficult. The 3 options were chosen in similar proportions.

02.4 Approximately three-quarters of students correctly identified the activation energy on the reaction profile diagram.

02.5 This question proved more difficult with approximately 45% of students being able to identify the energy of hydrogen peroxide on the reaction profile diagram.

02.6 Approximately 80% of students identified the reaction as exothermic, having been given a description.

02.7 Approximately 55% of students were able to score both marks for completing the dot and cross diagram.

The mark for the bonding electrons was scored more often than the mark for the non-bonding electrons.

Answer 29 · Examiner comments — June 2022 | 8462/1F | Original Q7

Question 7 (Low and standard demand)

07.1 Nearly two-thirds of students correctly identified the coarse particle as the largest, with the fine particle being the more commonly selected of the two distractors.

07.2 Most students could calculate the volume correctly. Some attempted to calculate the surface area of the cube from scratch, failing to use the value given in the question. Nearly a half of students did obtain full marks for the question, though many failed to show their working for each step and just gave the two answers.

07.3 Fewer than a quarter of the students realised that the surface area to volume ratio of nanoparticles is greater so less of the substance needs to be used. Fewer than half gained any credit at all.

07.4 This was very well answered, with nearly all students gaining at least one mark and more than two-thirds gaining both. However, some students thought that a disadvantage could be that feet would smell, not recognising that unpleasant smells would be prevented by the silver. Another misunderstanding was that the socks could cause infections, rather than prevent them.

07.5 About a half of students could work out that the radius was 100 times larger, with 2 times larger being the most commonly chosen distractor.

4.6.1.4 Catalysts

Answer 30 · Examiner comments — June 2024 | 8462/1F | Original Q4

Question 4 (low and standard demand)

04.1 Fewer than one in eight students knew that a nanoparticle is only a few hundred atoms, despite this being clearly stated in the specification. The correct answer was a less popular option than all three distractors. The most popular answer was a few million atoms.

© 2024 AQA and its licensors. All rights reserved.

Answer 30 · Examiner comments — June 2024 | 8462/1F | Original Q4

04.2 Fewer than a third of students could apply their knowledge that transition metals make good catalysts and select iron as the most likely element. By far the most popular distractor was magnesium.

04.3 More than four fifths of students scored both marks. Nearly all students identified the use of titanium dioxide for sun creams, and most also identified silver for wound dressings. There was no apparent pattern to incorrect responses.

04.4 Two fifths of students scored all six marks, with well over four fifths scoring at least 1 mark. The most common error was in the surface area, where the answer was often given as 6 times the volume, ie 384 nm^3. Most students were able to cancel down their numbers to give the simplest whole number ratio and gained credit for doing so.

Answer 31 · Examiner comments — June 2024 | 8462/2F | Original Q9

Question 9 (standard demand)

09.1 The role of the condenser and the importance of recycling unreacted gases in the Haber process is poorly understood with just over 5% of students gaining credit in this question. A large number of students stated that the ammonia or excess gases or gases alone were returned to the reactor. In addition, a number of students focused their answer on the condenser part of the flow chart and responded with the idea that uncondensed gases needed to be recycled.

09.2 Less than 25% of students correctly identified the catalyst used in the Haber process as iron, with copper, ammonia and hydrogen being frequently seen incorrect responses.

09.3 The test for oxygen gas is poorly understood with less than 25% of students being able to recall the correct test and its result. Many students referred to the splint being lit and then blown out or

© 2024 AQA and its licensors. All rights reserved.

4.6.1.4 Catalysts

Answer 31 · Examiner comments

attempted to describe a glowing splint as a small or dying flame. A correct test was needed to allow award of a mark for the test result. The correct test and result for hydrogen gas was frequently seen.

09.4 Over 25% of students either correctly labelled the products and reactants or correctly drew an arrow, labelled the activation energy, and gained one mark. A further 10% of students gained two marks by doing both correctly.

There were many variations of drawing and labelling the arrow for the activation energy. Some students mistakenly labelled the peak as being the activation energy or despite the dotted line drew the arrow too short or at an angle.

Many students incorrectly identified the reactants and products from the equation or used nitrogen, hydrogen, and ammonia from the previous question. Other students were unsure where the reactants and products would be located on a reaction profile diagram.

09.5 One in five students correctly identified that if there was no catalyst used in the reaction the peak would be higher. Many students misread the question and incorrectly answered that the peak would be lower.

09.6 One in six students were able to identify the use of ammonium nitrate in a fertiliser or NPK fertiliser. A small minority stated that it was used in farming or agriculture unqualified. Only a handful of students identified its use in explosives or sports injury packs. Many students misread the question and took salt from the stem of the question and answered in terms or flavouring or preserving food or using salt to de-ice roads.