AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.6.1.2

Factors which affect the rates of chemical reactions

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**23**
Available paper years	**2008–2025**

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.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 01 · Mark scheme January 2008 | CHY2F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
(a)	sensible line of best fit which goes through or close to all the points **except** the anomalous point	allow wobbly / short double lines ± ½ square	1
(b)	loss of gas / loss of CO_2	idea of gas produced / formed	1

Answer 02 · Mark scheme June 2008 | CHY2F | Original Q2 | Legacy

question	answers	extra information	mark
2(a)	any **two** from: • increases • until reaches maximum / levels off • quickly at first • then more slowly / rate decreases	 owtte allow 'goes up' owtte owtte allow reaction finished ignore rate increases	2
2(b)	use a more concentrated acid use zinc powder	list principle applies	2
Total			**4**

Answer 02 · Mark scheme June 2008 | CHY2F | Original Q2 | Legacy

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 03 · Mark scheme June 2009 | CHY2F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	a continuous straight line missing anomalous point	allow a line which does not start at zero / origin	1
7(a)(ii)	any **two** sensible errors eg • timing errors and / or example • measurement errors and / or example • apparatus errors and / or example • human / experimental / random error and / or example or 'did not do it right' • temperature fluctuation • anomalous point • results not recorded correctly • plotting error • rate calculated incorrectly	ignore systematic / zero error / weighing error **or** error unqualified could be two from **same** category eg two timing errors – watch not started at the same time plus difficulty in deciding when the cross has disappeared. accept outlier / wrong result ignore 'not repeated'	2
7(b)(i)	straight line **or** as concentration increases the rate goes up **or** converse	accept numerical example accept positive correlation accept same gradient ignore 'most points near / on line of best fit'	1

Question 7 continues on the next page…

CHY2F

Question 7 Continued

question	answers	extra information	mark
7(b)(ii)	more collisions	accept greater chance of collisions accept collide more successfully accept alternative versions of collide eg 'bump / hit' ignore references to energy / speed of particles / surface area	1
	more particles (in each volume of solution)(i.e. an attempt at defining concentration)	accept 'particles are closer together' allow ions / atoms / molecules for particles ignore reactants accept greater frequency of collisions **or** greater number of collisions per second for **2** marks	1
Total			**6**

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 03 · Mark scheme

June 2009 | CHY2F | Original Q7 | Legacy

CHY2F

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 04 · Mark scheme

June 2010 | CHY2F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	the glow stick is brighter (owtte)	accept glow stick is less bright **at low temperatures** (owtte) ignore references to rate / particles	1
3(b)	gave out light for less time	accept use of figures from table for comparison allow reference to speed / rate eg quicker / faster reaction	1
3(c)	the particles will collide more often the particles will move faster the particles will have more energy		1 1 1
3(d)	any **one** from: • repeat • measure brightness eg use light meter • more temperatures **or** wider range • improve precision	allow more glow sticks	1
Total			**6**

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 04 · Mark scheme

June 2010 | CHY2F | Original Q3 | Legacy

CHY2F

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 05 · Mark scheme

January 2013 | CH2FP | Original Q7 | Legacy

question	answers	extra information	mark
7(a)	because sulfur / S forms which is insoluble / a solid / a precipitate		1 1
7(b)(i)	32	correct answer with or without working gains **2** marks accept evidence of 31 + 33 / 2 for **1** mark allow 35 for **1** mark	2
7(b)(ii)	reaction rate increases because of more particles (per unit volume) and because there is an increase in frequency of collisions	if incorrect reference to energy = max **2** allow because particles are closer together accept because particles are more likely to collide **or** higher chance of collision ignore more (successful) collisions	1 1 1
Total			**7**

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 05 · Mark scheme

January 2013 | CH2FP | Original Q7 | Legacy

January 2013

CH2FP

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 06 · Mark scheme

June 2013 | CH2FP | Original Q6 | Legacy

Question 6

question	answers	extra information	Mark
6(a)	any **two** from: • effervescence / bubbles / fizzing • magnesium disappears / dissolves • heat given off / exothermic • change in pH	 allow gas / hydrogen is given off allow volume of gas allow magnesium floats allow change in mass of magnesium allow temperature change do **not** accept temperature decreases do **not** accept pH decreases	2

6(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.		6
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	A simple plan without reference to changing any variable but should include an attempt at measuring rate **or** an attempt at fair testing	A plan including change of concentration / 'volume' of acid **and** should include an attempt at measuring rate **and / or** an attempt at fair testing	A workable plan including change of concentration **and** measurement of rate **and** fair testing

examples of chemistry points made in the response could include:

Plan:

- add magnesium to acid
- time reaction / 'count bubbles' / measure volume of gas
- change concentration / 'volume' of acid

Control Variables:

- amount / mass / length / same 'size' of magnesium
- volume / amount of acid

Total			8

4.6.1.2 Factors which affect the rates of chemical reactions

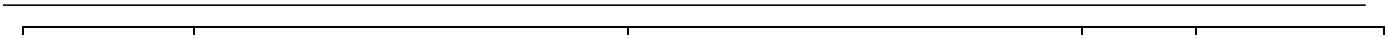
Answer 07 · Mark scheme June 2015 | CH2FP | Original Q5 | Legacy

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**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 07 · Mark scheme

June 2015 | CH2FP | Original Q5 | Legacy



4.6.1.2 Factors which affect the rates of chemical reactions

Answer 08 · Mark scheme June 2015 | CH2FP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	any **one** from: • solution becomes colourless or colour fades • zinc becomes bronze / copper coloured • zinc gets smaller • bubbles or fizzing	 allow copper (forms) or a solid (forms) allow zinc dissolves ignore precipitate	1	**AO2** 2.5.1
6(b)	improvement: use a plastic / polystyrene cup or add a lid reason - must be linked reduce / stop heat loss **OR** improvement: use a digital thermometer reason - must be linked more accurate or easy to read or stores data	 accept use lagging/insulation allow use a data logger allow more precise or more sensitive ignore more reliable ignore improvements to method, eg take more readings	1 1	**AO3** 2.5.1a,b

Question 6 continues on the next page

Question 6 continued

6(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. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.	**AO2/AO3** 2.5.1a,b

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	There is a statement about the results.	There are statements about the results. These statements may be linked or may include data.	There are statements about the results with at least one link and an attempt at an explanation.

Examples of chemistry points made in the response:

Description:

Statements
Concentration of copper sulfate increases
Temperature change increases
There is an anomalous result
The temperature change levels off
Reaction is exothermic

Linked Statements
Temperature change increases as concentration of copper sulfate increases
The temperature change increases, and then remains constant
After experiment 7 the temperature change remains constant

Statements including data
The trend changes at experiment 7
Experiment 3 is anomalous

Attempted Explanation:
Temperature change increases because rate increases
Temperature change levels off because the reaction is complete

Explanation:
As more copper sulfate reacts, more heat energy is given off
Once copper sulfate is in excess, no further heat energy produced

Total			**9**

4.6.1.2 Factors which affect the rates of chemical reactions

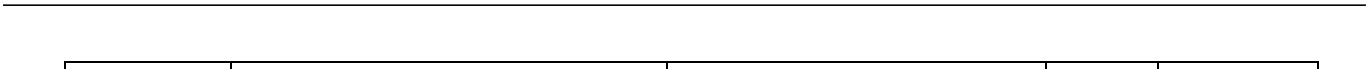
Answer 09 · Mark scheme June 2016 | CH2FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
4(a)	sulfur dioxide	accept SO_2	1	AO2 2.6.1a
4(b)(i)	curved line of best fit between the 4 non-anomalous points		1	AO2 2.4.1a
4(b)(ii)	temperature was lower (than 40 °C)	accept student missed the moment when the cross disappeared accept smaller volume of acid or acid more dilute	1	AO3 2.4.1c
4(b)(iii)	0.005 **or** 1/200	correct answer with or without working gains **2** marks if answer incorrect, allow **1** mark for 0.32 / 64	2	AO2 2.4.1a
4(b)(iv)	The particles move faster. The particles collide with more energy.		1 1	AO1 2.4.1c
4(b)(v)	activation		1	AO1 2.4.1.b
Total			**8**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 09 · Mark scheme

June 2016 | CH2FP | Original Q4 | Legacy



4.6.1.2 Factors which affect the rates of chemical reactions

Answer 10 · Mark scheme June 2017 | CH2FP | Original Q5 | Legacy

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

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 10 · Mark scheme

June 2017 | CH2FP | Original Q5 | Legacy

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**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 10 · 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

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 10 · Mark scheme

June 2017 | CH2FP | Original Q5 | Legacy

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**

4.6.1.2 Factors which affect the rates of chemical reactions

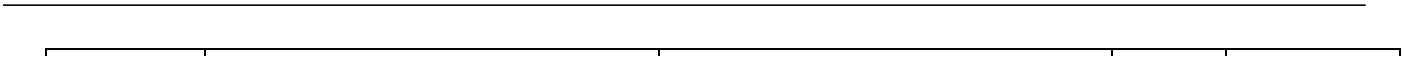
Answer 11 · Mark scheme June 2017 | CH3FP | Original Q3 | Legacy

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**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 11 · Mark scheme

June 2017 | CH3FP | Original Q3 | Legacy



Answer 12 · Mark scheme

June 2018 | 8462/1F | Original Q6

The full source mark scheme begins on page 43. Follow original question 6 in that document.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 13 · Mark scheme June 2018 | 8462/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	83 (cm^3)	allow 83.0 / 83.00	1	AO2 4.6.1.2
07.2	mass of magnesium powder temperature of hydrochloric acid		1 1	AO1 4.6.1.2
07.3	$\frac{(46 + 47 + 49)}{3}$ = 47 (cm^3) (2 sf)	an answer of 47 (cm^3) scores **2** marks allow 47.3(333) (cm^3) for **1** mark an answer of 43 (cm^3) scores **1** mark	 1 1	AO2 4.6.1.1 4.6.1.2
07.4	all points plotted correctly (inc 0,0)	allow a tolerance of ± ½ a square allow ecf from question **07.3** ignore line allow **1** mark for four points plotted correctly	2	AO2 4.6.1.1 4.6.1.2
07.5	$\frac{80}{50}$ = 1.6 (cm^3/s)	an answer of 1.6 (cm^3/s) scores **2** marks allow 80 ± 2 allow 1.60 ± 0.04	 1 1	AO2 4.6.1.1
07.6	rate is greatest at start (then) rate decreases reaction stops	allow rate is faster at start allow (then) rate slows down	1 1 1	AO2 4.6.1.1 4.6.1.2

4.6.1.2 Factors which affect the rates of chemical reactions

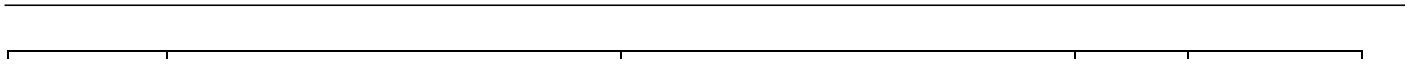
Answer 13 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	there are more particle collisions each second there are more particles in the same volume		1 1	AO1 4.6.1.3
07.8	(gas is) not carbon dioxide	ignore does not react with limewater	1	AO3 4.8.2.3
07.9	hydrogen pop sound	allow H_2	1 1	AO1 4.8.2.1
Total			**17**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 13 · Mark scheme

June 2018 | 8462/2F | Original Q7



4.6.1.2 Factors which affect the rates of chemical reactions

Answer 14 · 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**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 15 · Mark scheme

June 2019 | 8462/2F | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(aq)	allow aqueous / aq	1	AO1 4.2.2.1 4.2.2.2
10.2	(gas) syringe stopclock / stopwatch	allow measuring cylinder (and water trough) allow balance allow timer / clock / watch	1 1	AO1 4.6.1.1
10.3	all points plotted correctly line of best fit	allow a tolerance of ± ½ a small square allow at least 3 points plotted correctly for **1** mark. allow correctly drawn line of best fit for incorrectly plotted points	2 1	AO2 4.6.1.1
10.4	(rate) decreases (rate decreases) more slowly as time increases (rate) becomes zero at 60 s	allow slows down allow (rate decreases) at a non-linear rate allow the reaction stops at 60 s allow ecf from question **10.3**	1 1 1	AO3 4.6.1.1
10.5	more bubbles were produced in the first 10 seconds the magnesium was used up more quickly		1 1	AO2 4.6.1.2
Total			**11**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 16 · Mark scheme

November 2020 | 8462/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	measuring cylinder	allow pipette / burette	1	AO3 4.6.1.1
03.2	limewater turns milky		1	AO1 4.8.2.3
03.3	all six points plotted correctly line of best fit	allow a tolerance of ± ½ a small square allow **1** mark for four or five points plotted correctly	2 1	AO2 4.6.1.1
03.4	(volume =) 48 (cm^3) (rate=) $\frac{48}{60}$ = 0.8 (cm^3/s)	 allow correct use of an incorrectly determined value for volume	1 1 1	AO2 4.6.1.1
03.5	(between 0 and 20 seconds) (volume of gas) increases (between 80 and 100 seconds) no change (in volume of gas)	 allow reaction stops	1 1	AO2 4.6.1.1

Question 3 (continued)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	systematic error		1	AO3 4.6.1.1
03.7	(area of one face = 2 x 2 =) 4 (mm^2) (total surface area =) 4 x 6 = 24 (mm^2)	 allow correct use of an incorrectly calculated area of one face 	1 1 1	AO2 4.6.1.2
03.8	faster		1	AO1 4.6.1.3
Total			**15**	

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 17 · Mark scheme

November 2021 | 8462/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(equation contains the symbol) ⇌	allow description of arrow / symbol	1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the mass of each substance does not change the rates of the forward reaction and reverse reaction are equal		1 1	AO3 AO1 4.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	the mixture will have become a paler purple		1	AO3 4.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	increases decreases increases	must be in this order	1 1 1	AO1 4.6.1.2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	change the temperature **or** add a catalyst	ignore references to pressure	1	AO1 4.6.1.2 4.6.1.3

Total			8

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 18 · Mark scheme

November 2021 | 8462/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(diagram) gas syringe **or** inverted measuring cylinder over water		1	AO3 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(error) (delivery) tube is in (sulfuric) acid (problem) (sulfuric) acid will travel up tube **or** no hydrogen / gas will be collected		1 1	AO3 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	line of best fit	must include 0, 0	1	AO2 4.6.1.1 4.6.1.2 RPA5

Question 5 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(volume of gas =) 45 (cm^3)	allow a tolerance of ± ½ a small square allow volume from drawn curve	1	AO2 4.6.1.1 4.6.1.2 RPA5
	(rate =) $\frac{45}{60}$	allow correct use of incorrectly determined volume at 60 seconds	1	
	= 0.75		1	
	cm^3/s		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	the line of best fit for higher concentration would have a steeper slope		1	AO1 4.6.1.1 4.6.1.2 RPA5

Total			**9**

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 19 · Mark scheme

November 2021 | 8462/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	fuel		1	AO1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	propene		1	AO2 4.7.2.1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(percentage yield =) $\frac{380}{400} \times 100$ = 95 (%)		1 1	AO2 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	some ethanol changes back into ethene and steam some ethanol escapes from the apparatus		1 1	AO2 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	C_2H_5OH + **3** O_2 → 3 H_2O + 2 CO_2	allow multiples	1	AO2 4.1.1.1 4.3.1.1 4.7.2.3

4.6.1.2 Factors which affect the rates of chemical reactions

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(advantages) (fermentation) low energy usage (fermentation) uses renewable raw materials (disadvantages) (fermentation) produces impure ethanol (fermentation) slow rate of reaction		 1 1 1 1	AO3 4.7.2.2 4.7.2.3 4.10.1.1

Total			**11**

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 20 · Mark scheme

June 2022 | 8462/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$Na_2S_2O_3$ + 2 HCl → **2** NaCl + H_2O + SO_2 + S	allow multiples	1	AO2 4.1.1.1 4.3.1.1 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(s)		1	AO1 4.2.2.2 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	a cross on a piece of paper		1	AO1 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	the rate of reaction decreased		1	AO3 4.6.1.1 4.6.1.2 RPA5

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 20 · Mark scheme

June 2022 | 8462/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	one of the reactants was used up		1	AO3 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	initially the line of best fit would be steeper		1	AO2 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	fewer reactant particles have the activation energy the reactant particles move more slowly		1 1	AO2 4.6.1.2 4.6.1.3

Total Question 6		8

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 21 · Mark scheme

June 2023 | 8462/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	to reduce the escape of gas		1	AO3 4.6.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	(mean rate =) $\frac{0.78 + 0.81 + 0.81}{3}$	allow $\frac{0.78 + 0.81 + 0.68 + 0.81}{4}$	1	AO3
	0.80 (cm^3/s)	= 0.77 (cm^3/ s) for **1** mark	1	AO2
	$0.80 = \frac{20}{\text{mean time taken}}$	allow correct use of incorrectly determined mean rate	1	AO2
	(mean time taken =) $\frac{20}{0.80}$		1	AO2
	= 25 (s)		1	AO2 4.6.1.1 RPA5
	alternative approach: $0.78 = \frac{20}{\text{time}}$ **or** $0.81 = \frac{20}{\text{time}}$ (1)			
	(trial 1 time = $\frac{20}{0.78}$ =) 25.6 (1)			
	(trial 2 and 4 time = $\frac{20}{0.81}$ =) 24.7 (1)			

	(mean time =) $\frac{25.6 + (2 \times 24.7)}{3}$ (1) = 25 (s) (1)	allow correct use of incorrectly determined value(s) for time allow $\frac{25.6 + 29.4 + (2 \times 24.7)}{4}$ = 26.1 (s) for **1** mark		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	use a lower temperature use sulfuric acid of a lower concentration		1 1	AO1 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	(test) burning / lit splint (result) burns with a (squeaky) pop sound	MP2 is dependent upon MP1 being awarded allow flame do **not** accept glowing splint allow pops	 1 1	AO1 4.8.2.1

Total Question 8	10

4.6.1.2 Factors which affect the rates of chemical reactions

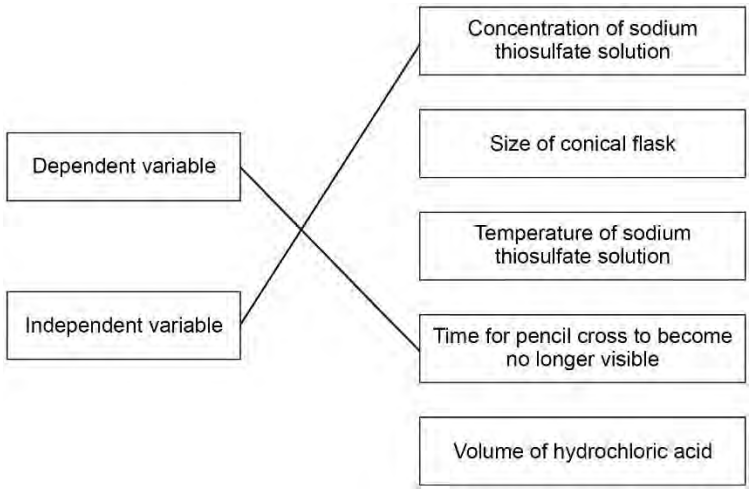
Answer 22 · Mark scheme

June 2024 | 8462/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	volume (of reactants) is 90 cm^3	allow volume (of reactants) is greater than 50 cm^3	1	AO3 4.6.1.2 RPA5
	(so conical) flask will overflow	allow (so) solutions will not fit (in conical flask)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	measuring cylinder	allow (volumetric / graduated) pipette allow burette	1	AO1 4.6.1.2 RPA5

Question	Answers	Mark	AO / Spec. Ref.
05.3	 allow **1** mark if dependent variable and independent variable are identified the wrong way round do **not** accept more than **one** line drawn from a box on the left	1 1	AO1 4.6.1.2 RPA5

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 22 · Mark scheme

June 2024 | 8462/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the time taken will increase		1	AO3 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	32 g/dm^3		1	AO3 4.6.1.1 4.6.1.2 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	the particles are closer together the particles collide more frequently		1 1	AO1 4.6.1.3 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	decreases increases		1 1	AO2 4.6.1.2 4.6.1.3 RPA5

Total Question 5	**11**

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 23 · Mark scheme

June 2025 | 8462/2F | Original Q2

Question 2

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	9		1	AO2 4.1.1.1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	making a polymer		1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(*y*-axis 0, 20), 40, 60, 80, (100)	ignore intermediate values	1	AO2 4.7.2.1
	carbon bar drawn to 86%	allow a tolerance of ± ½ a small square	1	
	carbon bar labelled		1	

Answer 23 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(test) add bromine (water) (result) (bromine water) turns (from orange to) colourless	 allow (bromine water) decolorises ignore clear MP2 is dependent upon MP1 being awarded	1 1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	$C_{10}H_{22} \longrightarrow C_3H_6 + C_7H_{16}$		1	AO2 4.1.1.1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	fuels		1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	the molecules collide more frequently at 750 °C		1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	(at 750 °C the rate of reaction is) higher	allow (at 450 °C the rate of reaction is) lower	1	AO2 4.6.1.2

Total Question 2	12

4.6.1.2 Factors which affect the rates of chemical reactions

AQA

GCSE
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8462/1F - PAPER 1 FOUNDATION TIER

Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

4.6.1.2 Factors which affect the rates of chemical reactions

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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 from aqa.org.uk

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MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

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
- the Assessment Objectives and specification content that each question is intended to cover.

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 and underlining

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 bullet points 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.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students 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.

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

[1 mark]

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

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student 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

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

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 is 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 ecf 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 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do not accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

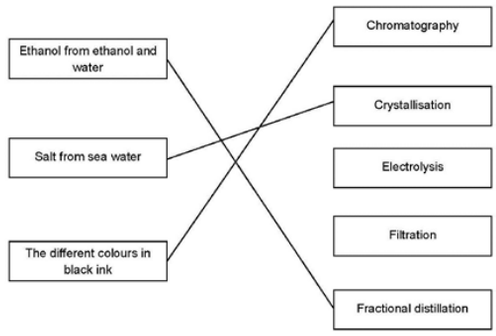
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1			1 1 1	AO1 4.1.1.2
01.2	include a (filter) funnel	allow funnel drawn on the diagram ignore clamp stand	1	AO3 4.1.1.2
01.3	evaporate condense	must be this order	1 1	AO1 4.1.1.2
01.4	$\frac{2}{20} \times 100$ = 10 (%)	an answer of 10 (%) scores **2** marks an answer of 11.1(%) **or** 90 (%) scores **1** mark	1 1	AO2 4.2.2.7
01.5	an alloy		1	AO1 4.2.2.7
01.6	the layers in the mixture are distorted		1	AO1 4.2.2.7

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	8000 nm^3		1	AO2 4.2.4.1
Total			**11**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7		1	AO1 4.1.2.6
02.2	small molecule		1	AO2 4.1.2.6 4.2.2.4
02.3	F_2		1	AO1 4.1.1.1 4.1.2.6
02.4	the reactivity decreases (going down Group 7)	allow the reactivity decreases from chlorine to iodine	1	AO1 4.1.2.6
	(because) chlorine displaces bromine and iodine	allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine	1	AO3 4.1.2.6
	(and) bromine displaces iodine **or** iodine does not react	allow (and) bromine has one reaction **or** iodine has no reactions allow (and) iodine cannot displace bromine	1	AO3 4.1.2.6
02.5	80		1	AO2 4.3.1.2

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(1.2 kg =) 1200 (g) **or** (900 g =) 0.9 (kg)	an answer of 75 (%) scores **2** marks	1	AO2 4.3.3.1
	$(\frac{900}{1200} \times 100) = 75(\%)$ **or** $(\frac{0.9}{1.2} \times 100) = 75(\%)$	allow an answer correctly calculated from: $(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100)$ **or** $(\frac{\text{incorrect attempt at conversion of 900}}{1.2} \times 100)$	1	
Total			**9**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nucleus neutron neutron electron proton	must be in this order	1 1 1 1 1	AO1 4.1.1.3 4.1.1.4 4.1.1.5
03.2	$(A_r)\ \frac{(63 \times 70) + (65 \times 30)}{100}$ = 63.6	an answer of 63.6 scores **2** marks	1 1	AO2 4.1.1.6
03.3	copper / Cu	allow ecf from answer to question **03.2**	1	AO2 4.1.1.1
03.4	$\frac{1.2 \times 10^{-10}}{10\,000}$ **or** $1.2 \times 10^{-10} \times 1 \times 10^{-4}$ $= 1.2 \times 10^{-14}$ (m)	an answer of 1.2×10^{-14} (m) scores **2** marks a correct answer not in standard form scores **1** mark	1 1	AO2 4.1.1.5
Total			**10**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	3.6 (cm^3)		1	AO2 4.4.3.4
04.2	hydrogen line only		1	AO3 4.4.3.4
04.3	both lines		1	AO3 4.4.3.4
04.4	graphite has delocalised electrons		1	AO1 4.2.3.2
04.5	**cathode** zinc (1) **anode** chlorine (1) hydrogen (1) bromine (1)	do **not** accept chloride allow **1** mark if chlorine and zinc the wrong way around do **not** accept bromide allow **1** mark if bromine and hydrogen the wrong way around	1+1 1+1	AO2 4.4.3.2 4.4.3.4
Total			**8**	

4.6.1.2 Factors which affect the rates of chemical reactions

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	gas		1	AO1 4.2.2.2
05.2	the gas escapes	allow carbon dioxide escapes do **not** accept references to evaporation	1	AO1 4.3.1.3
05.3	5.12 (g)		1	AO2 4.3.1.3
05.4	4.00 (g) trial 1	allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number	1	AO3 4.3.1.3
05.5	reheat (and reweigh) until constant mass	 an answer of heat to constant mass scores **2** marks if no other mark scored allow for **1** mark heat for longer **or** (heat at a) higher temperature **alternative approach**: (1) continue heating and pass gas through limewater (1) until the (lime)water stops bubbling **or** until the limewater no longer turns cloudy	1 1	AO3 4.3.1.3

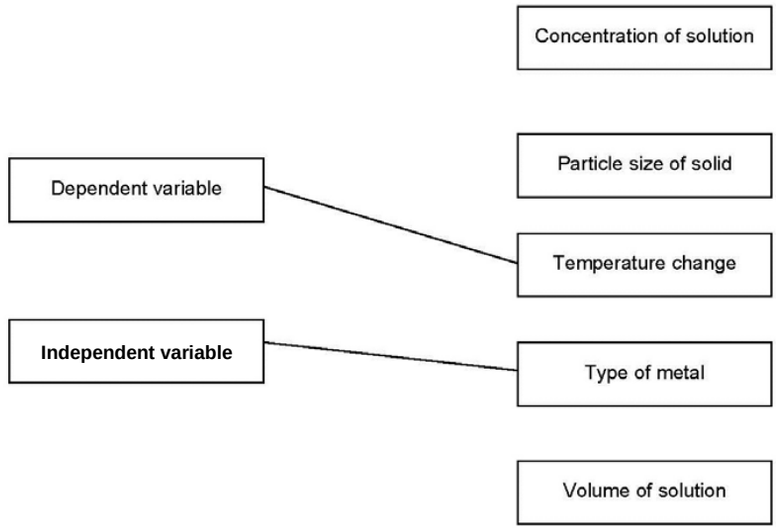
4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	straight line of best fit	must touch at least 5 of the 6 plots	1	AO2 4.3.1.3
05.7	correct value read from line of best fit in Figure 8	allow tolerance of ± ½ small square	1	AO2 4.3.1.3
05.8		a correctly calculated value from their answer to question **05.7** scores **2** marks		AO2 4.3.1.3
	(mass =) $168 \times \frac{\text{answer from question } \mathbf{05.7}}{8.4}$	allow (mass =) answer from question **05.7** × 20	1	
	correctly calculated value (g)		1	
Total			**10**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	 allow **one** mark if answers are reversed		1 1	AO1 4.5.1.1
06.2	polystyrene is a better insulator		1	AO3 4.5.1.1
06.3	both bars labelled both bars correctly plotted	 allow tolerance of ± ½ small square ignore width and spacing of bars if no other mark scored, allow **1** mark for any one bar correctly plotted and labelled	1 1	AO2 4.5.1.1

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	temperature increases **or** temperature does not decrease	ignore because it is exothermic allow (because) energy / 'heat' is transferred to the surroundings energy / 'heat' is not taken in from the surroundings allow the energy of the products is less than the energy of the reactants	1	AO3 4.5.1.1
06.5	(most reactive) magnesium (zinc) nickel	this order only	1	AO3 4.5.1.1 4.4.1.2
06.6	suitable method described the observations / measurements required to place in order an indication of how results would be used to place the unknown metal in the reactivity series **approaches that could be used:** **approach 1:** add the unknown metal to copper sulfate solution (1) measure temperature change (1) place the metals in order of temperature change (1)		1 1 1	AO3 4.4.1.2 4.5.1.1

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6 cont.	**approach 2:** add the metal to salt solutions of the other metals **or** heat the metal with oxides of the other metals (1) measure temperature change (only if salt solutions used) **or** observe whether a chemical change occurs (1) compare temperature change or whether there is a reaction to place in correct order (1) **approach 3:** add all of the metals to an acid (1) measure temperature change or means of comparing rate of reaction (1) place the metals in order of temperature change or rate of reaction (1) **approach 4:** set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1) measure the voltage of the cell (1) place the metals in order of voltage (1)			
06.7	D		1	AO1 4.5.1.2
06.8	C		1	AO1 4.5.1.2
Total			**12**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	sodium oxide	allow Na_2O	1	AO2 4.1.1.1 4.1.2.5 4.4.1.1
07.2	oxidation		1	AO1 4.4.1.1
07.3	13		1	AO1 4.4.2.4
07.4	sodium hydroxide		1	AO2 4.1.1.1
07.5	OH^-		1	AO1 4.4.2.4
07.6	(volume =) $\frac{250}{1000}$ or ¼ or 0.25 (dm^3) **or** (mass per cm^3 =) $\frac{40}{1000}$ (g) or 0.04 (g) ($\frac{250}{1000}$ × 40 =) 10 (g)	an answer of 10 (g) scores **2** marks	1 1	AO2 4.3.2.5

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	all points correct	allow a tolerance of ± ½ a small square allow **1** mark for 3 points correct ignore any attempt at a line of best fit	2	AO2 4.1.2.5
07.8	39 (°C)	allow any value from 34 to 46 (°C)	1	AO2 4.1.2.5
Total			**10**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	any **one** from: • metal • (metal) hydroxide • (metal) carbonate • alkali	allow named example allow correct formula ignore base allow ammonium hydroxide allow ammonium carbonate allow soluble base allow ammonia	1	AO1 4.4.2.1 4.4.2.2 4.4.2.3
08.2	$Ca(NO_3)_2$	allow $Ca^{2+}(NO_3^-)_2$	1	AO2 4.4.2.2

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.4.2.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use magnesium oxide and sulfuric acid • add sulfuric acid to a beaker • warm sulfuric acid • add magnesium oxide • stir • continue adding until magnesium oxide is in excess • filter • using a filter paper and funnel • to remove excess magnesium oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		
Total			**8**

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
09.2	26 30 26	must be this order	1 1 1	AO2 4.1.1.4 4.1.1.5
09.3	any **two** from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	carbon is more reactive (than nickel)	allow converse	1	AO1 4.4.1.2 4.4.1.3
	(so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1	
09.5		an answer of 67.8 (%) scores **3** marks an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.3.2
	(total M_r of reactants =) 87		1	
	(percentage atom economy) $= \frac{59}{87} \times 100$	allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$	1	
	= 67.8 (%)	allow an answer from an incorrect calculation to 3 sig figs	1	
Total			**11**	

4.6.1.2 Factors which affect the rates of chemical reactions

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	copper, zinc, sodium chloride solution		1	AO2 4.5.2.1
10.2	a reactant is used up	allow the reaction stops allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant	1	AO1 4.5.2.1
10.3	the reaction is not reversible		1	AO1 4.5.2.1
10.4	$2H_2 + O_2 \rightarrow 2H_2O$	allow fractions / multiples allow **1** mark for O_2	2	AO1 AO2 4.1.1.1 4.5.2.2

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="5">10.5</td><td>Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.</td><td>5–6</td><td>AO3</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td><td>AO3</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td><td>AO2</td></tr>
<tr><td>No relevant content</td><td>0</td><td></td></tr>
<tr><td>Indicative content

reasons why fuel cells could be judged as better
<table>
<tr><th>from the table</th><th>from other knowledge</th></tr>
<tr><td>• time for refuelling a fuel cell is faster than recharging
or
a fuel cell does not need to be recharged
• a fuel cell has a greater range</td><td>• hydrogen can be renewable if made by electrolysis using renewable energy
• lithium-ion batteries can catch fire
• produces only water
or
no pollutants produced
• lithium-ion batteries may release toxic chemicals on disposal
• lithium-ion batteries (eventually cannot be recharged so) have a finite life</td></tr>
</table>
reasons why the lithium-ion battery could be judged as better
<table>
<tr><th>from the table</th><th>from other knowledge</th></tr>
<tr><td>• lithium-ion uses energy more efficiently
• cost of lithium-ion car much less
• cost of recharging much less than refuelling with hydrogen</td><td>• hydrogen is often made from fossil fuels so is not renewable
• charging points are more widely available than hydrogen filling stations
• hydrogen takes up a lot of space
or
is difficult to store
• hydrogen can be highly flammable / explosive
• no emissions produced
• (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life</td></tr>
</table></td><td></td><td>4.4.3.4
4.5.2.1
4.5.2.2</td></tr>
<tr><td>Total</td><td></td><td></td><td>11</td></tr>
</table>

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 12 · Examiner comments

June 2018 | 8462/1F | Original Q6

Question 6 (low and standard demand)

06.1 25% of students could identify both variables, with 41% identifying one. This was usually the independent variable.

Many thought that the concentration of the solution was the dependent variable. A compensatory mark was awarded to those who identified the two correct variables but had them the wrong way round.

06.2 86% of students understood the reason for using a polystyrene cup in this required practical activity.

06.3 This question was very well done, with 83% of students able to draw a bar chart correctly. Of those who achieved a single mark, forgetting to label the bars was more common than mis-use of the scale.

06.4 50% of students answered correctly. Of the unsuccessful attempts, many failed to express their ideas coherently. Some confused endothermic with exothermic, eg saying the temperature decreased, ignoring the evidence in front of them.

There was confusion between heat and temperature: heat is not increasing, and temperature is not given out. Some students thought ‘taking in heat’ means the temperature would rise. This shows a common misunderstanding of endothermic reactions: students think that heat energy is moving, rather than being converted from heat energy to chemical energy.

06.5 81% of students were able to give the correct order of reactivity.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 12 · Examiner comments

June 2018 | 8462/1F | Original Q6

06.6 Students found this question difficult to answer. 19% of students achieved all three marks, although47% achieved at least one mark. 14% of students did not attempt the question.

Students answer in terms of repeating the experiment using the unknown metal, and reorder the four elements according to the temperature change. However, many decided to use a different method, with varying degrees of success.

Alternative approaches that were accepted were:

- reacting all four metals with an acid and assessing the rate of reaction or temperature change
- carrying out a series of displacement reactions, either by adding the unknown metal to salt solutions of the other three metals, or by heating the unknown metal with oxides of the others
- using the unknown as the test electrode in a series of electrochemical cells and measuring the voltage.

Approaches that were not accepted included:

- trying to react the metal with the other metals
- measuring melting or boiling point
- looking at the periodic table.

06.7 53% of students could identify line D as the correct answer. A decent number of students confused products with reactants.

06.8 This was well done, with 75% of students able to identify the activation energy on the reaction profile.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 13 · Examiner comments

June 2018 | 8462/2F | Original Q7

Question 7 (low demand)

07.1 88% of students read the volume correctly. As for incorrect readings, '80.3 (cm^3)' was the most common.

07.2 This question was found to be fairly difficult, with 31% of students correctly identifying both of the control variables.

07.3 This calculation challenged many students as they often ignored the instruction to not include the anomalous result (30) or included the time (40). Many did not give their answers to two significant figures. 41% of students achieved full marks.

07.4 Generally the graph points were accurately plotted although the final point was occasionally mistakenly taken as 110 (rather than 100). More commonly the origin was omitted. A few students also misread the question and either plotted all the data points rather than just the mean and / or drew a line of best fit.

07.5 The calculation was completed correctly by students who read the volume at 50 seconds, but many chose a different time to that in the question. A significant minority inverted the expression, 50 ÷ 80 rather than 80 ÷ 50.

07.6 Generally, students showed a notable lack of understanding in this question. The graph was volume against time, but the question asked how the rate changed with time. Most responses were either wholly or partially about volume rather than rate. 10% of students achieved full marks, while 14% achieved two.

07.7 Again, this was challenging, with 38% of students correctly identifying both of the reasons for the faster rate of reaction.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 13 · Examiner comments June 2018 | 8462/2F | Original Q7

07.8 Most appeared to know that limewater was used to test for carbon dioxide, although many answers did not appear to realise that it was necessary to name the gas that was being tested for.

07.9 The burning splint test was commonly identified correctly as the test for hydrogen and incorrectly for oxygen, carbon dioxide and a whole range of other substances, many of which are not gases.

Answer 20 · Examiner comments June 2022 | 8462/2F | Original Q6

Question 6 (Low and standard demand)

06.1 The equation was correctly balanced by about three-quarters of the students.

06.2 Over 80% of the students knew that (s) represents a solid reactant.

06.3 The use of a cross on paper to monitor the turbidity of the sulfur produced was known by over 70% of the students, although use of a gas syringe was a common incorrect response.

06.4 Over 80% of the students gained the mark, by associating a drop in gradient on the graph with a fall in the rate of reaction.

06.5 Many deduced that one of the reactants was used up, with over 60% of the students gaining a mark. A sizeable number asserted that no light was reaching the sensor, even though the graph did not reach $y = 0$.

06.6 Over 60% of the students gained a mark, but most of the remainder thought that the line would be less steep at the start.

06.7 Over 50% of the students gained two marks. However, there was a wide range of incorrect response combinations, the most common of which used the two responses which were linked to a higher temperature rather than a lower one.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 21 · Examiner comments

June 2023 | 8462/2F | Original Q8

Question 8 (Standard demand)

08.1 Around 10% of students gained this mark by recognising that adding the stopper would reduce the loss of gas. Weaker responses tended to be absolutes including stating that no gas would escape.

08.2 The calculation discriminated well. Approximately 30% of students successfully completed the calculation, usually showing full details of their working. Most students gained the first 2 marking points by discarding the anomalous result and calculating the mean. The alternative approach detailed in the mark scheme was seldom seen.

08.3 25% of students gained both marks and more than 45% gained 1 mark. The most frequently seen incorrect responses were those that identified factors that would increase rather than decrease the rate of reaction.

Answer 21 · Examiner comments

June 2023 | 8462/2F | Original Q8

08.4 Only 25% of students were able to give the correct test and result for hydrogen gas. Weaker responses failed to include the test and only described the result usually as a squeaky pop and gained no marks. Incorrect tests were less commonly seen but the most frequent incorrect test used was a glowing splint.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 22 · Examiner comments June 2024 | 8462/2F | Original Q5

Question 5 (low and standard demand)

05.1 One in two students were able to correctly explain why a 50 cm^3 flask is unsuitable for use in the method provided and obtain both marks. A further one in four achieved one mark for recognising that the flask was too small but did not provide a reason as to why this would be a problem.

05.2 More than 65% of students were able to correctly name a suitable piece of apparatus for measuring volume. The vast majority of students answered measuring cylinder with burette being a popular second choice. Care should be taken over the spelling of burette to avoid the incorrect response biuret.

05.3 Just over one third of students achieved both marks in this question and a further third achieved one mark. Students appeared to struggle to recognise and correctly identify both the independent and dependent variables. A sizeable number of students identified the independent and dependent variables the wrong way around achieving the compensation mark. It is important that students read the question carefully as there was a significant number of students who drew multiple lines from each box.

05.4 Over 4 in 5 students correctly identified that the time taken for the cross to disappear would increase.

05.5 Over 75% of students correctly identified the concentration of sodium thiosulfate that had the highest rate of reaction.

05.6 This question was well answered with over 90% of students being able to identify at least one correct statement to explain the effect of increasing the concentration. Almost 50% of students correctly identified both statements.

05.7 Just over 60% of students correctly identified what would happen to the time taken for the cross to disappear for both of the changes made to the investigation with a further 10% of students correctly identifying the effect of just one change. The most common incorrect response was to reverse the order.

4.6.1.2 Factors which affect the rates of chemical reactions

Answer 23 · Examiner comments June 2025 | 8462/2F | Original Q2

Question 2

02.1 Half of the students correctly identified the alkene as propene. Both butene and ethene were commonly seen.

02.2 Over 80% of students were able to give the number of atoms in the molecule as 9.

02.3 Over two thirds of students correctly identified the use of alkenes.

02.4 Nearly 80% of students scored all three marks for plotting the bar chart. Of the remaining students, most scored two marks, the most common error was to plot the bar at 92, rather than 86.

02.5 The test for alkenes is not well known. Slightly more than 1 in 10 students scored either mark on this question. A full range of tests was seen, with nearly 30% of students did not attempt this item.

Answer 23 · Examiner comments June 2025 | 8462/2F | Original Q2

02.6 Nearly two thirds of students correctly completed the formula in the equation. Many students recognised that the number should be 7, but did not follow the conventions of writing formulas, so did not gain the mark because the 7 was too large. When writing formulas, it is expected that the tops of numbers are discernibly below the tops of upper-case letters.

02.7 Over half of students correctly identified the use of alkanes as fuels. Both distractors were frequently seen.

02.8 Nearly 90 % of students correctly answered this item.

02.9 Three quarters of students correctly compared the rates, with many explaining why the rate changes using the ideas from the previous item.