AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.6.1.3

Collision theory and activation energy

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**21**
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.

4.6.1.3 Collision theory and activation energy

Answer 01 · Mark scheme

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

4.6.1.3 Collision theory and activation energy

Answer 02 · Mark scheme

January 2008 | CHY3F | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
(a)	either: calculations: all correct (ethanol = 6, methanol = 3, peanut oil = 10, vegetable oil = 15) **or** implication of correct calculation (vegetable oil) gives largest temperature / heat increase per gram (owtte)	ignore repetition of data from table unqualified allow 'produced most heat in proportion to the fuel used' owtte for **1** mark	2
(b)	any **one** from: • smoke • soot • carbon • carbon monoxide • carbon dioxide • global warming / climate change / greenhouse gases • (air) pollution • harmful/poisonous	owtte ignore references to crops/food	1
	scrub / wash the gases owtte	filter / remove (gases / fumes / appropriate named substance) owtte (add extra oxygen) can burn more efficiently owtte use a cleaner fuel owtte plant more trees or similar linked to CO_2 any sensible answer 'don't burn so much fuel' insufficient alone ignore extractor fans / air conditioning	1

continued…

4.6.1.3 Collision theory and activation energy

CHY3F

Question 5 continued…

question	answers	extra information	mark
(c)(i)	A		1
(c)(ii)	B		1
total			6

4.6.1.3 Collision theory and activation energy

Answer 02 · Mark scheme

January 2008 | CHY3F | Original Q5 | Legacy

CHY3F

4.6.1.3 Collision theory and activation energy

Answer 03 · Mark scheme

January 2010 | CHY3F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	electricity / (high) temperatures	allow lightning / heat ignore energy	1
3(b)	nitrogen + oxygen → nitrogen oxide / monoxide	allow any oxide of nitrogen	1
3(c)	more than		1
3(d)(i)	A		1
3(d)(ii)	C		1
Total			**5**

4.6.1.3 Collision theory and activation energy

Answer 03 · Mark scheme

January 2010 | CHY3F | Original Q3 | Legacy

CHY3F

4.6.1.3 Collision theory and activation energy

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**

4.6.1.3 Collision theory and activation energy

Answer 04 · Mark scheme

June 2010 | CHY2F | Original Q3 | Legacy

CHY2F

4.6.1.3 Collision theory and activation energy

Answer 05 · Mark scheme

June 2011 | CHY3F | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	goes up		1
2(b)(i)	B		1
2(b)(ii)	A		1
2(b)(iii)	a catalyst activation energy		1 1
2(c)(i)	eg (ensures) complete reaction **or** even heating	allow spread heat / energy allow mixes properly or mix them together or to get correct temperature ignore dissolves	1
2(c)(ii)	lid (on beaker) **or** insulate (beaker) / use a plastic cup	accept cover beaker	1
Total			**7**

4.6.1.3 Collision theory and activation energy

Answer 05 · Mark scheme

June 2011 | CHY3F | Original Q2 | Legacy

CHY3F

4.6.1.3 Collision theory and activation energy

Answer 06 · Mark scheme

June 2013 | CH3FP | Original Q4 | Legacy

Question 4

question	Answers	extra information	Mark
4(a)(i)	42 000	correct answer gains **2** marks with or without working allow 42 kJ if answer incorrect : correct substitution 500 x 4.2 x 20 gains **1** mark	2
4(a)(ii)	any **two** from: • eye protection • lab coat • heat-proof mat • (heat-proof) gloves • (long) hair tied back • stand up • secure the beaker		2
4(a)(iii)	Stir the water before measuring the temperature. Place a lid on the beaker.		1 1
4(b)	the products → S the activation energy → Q the energy released by the reaction → P		1 1 1
4(c)	carbon dioxide produced (crude oil / propane) non-renewable	it =propane allow converse arguments allow greenhouse gas / global warming / atmospheric pollution allow crude oil running out	1 1
Total			11

4.6.1.3 Collision theory and activation energy

Answer 07 · Mark scheme

June 2014 | CH2FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
3(a)(i)	oxygen, sulfur trioxide	both needed for mark	1	2 / 2.4	E
3(a)(ii)	compound		1	2 / 2.1.1a	A
3(b)	increases	*accept (goes) higher / (goes) up / (is) faster) / (are) more frequent*	1	1 / 2.4.1d	G
3(c)	activation		1	1 / 2.4.1b	G
3(d)	catalyst **or** increase temperature		1	3 / 2.4.1h	E
Total			**5**		

4.6.1.3 Collision theory and activation energy

Answer 07 · Mark scheme

June 2014 | CH2FP | Original Q3 | Legacy



4.6.1.3 Collision theory and activation energy

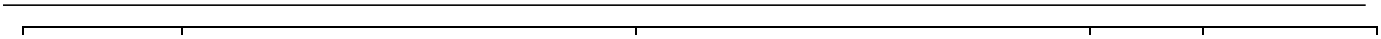
Answer 08 · Mark scheme June 2015 | CH3FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	11		1	**AO2** 3.3.1.c
3(a)(ii)	4620 (J)	correct answer gains **2** marks with or without working allow 4.62kJ for **2** marks if answer is incorrect: 100 x 4.2 x 11 gains 1 mark **or** 100 x 4.2 x (their temp. rise) gains **1** mark **or** 100 x 4.2 x (their temp. rise) correctly calculated gains **2** marks	2	**AO2** 3.3.1.c
3(b)	the temperature increases	allow gets hotter allow heat / energy is given off	1	**AO2** 3.3.1.c
3(c)(i)	(energy of) products lower than (energy of) reactants	allow converse allow arrow C points downwards	1	**AO2** 3.3.1.d
3(c)(ii)	A		1	**AO2** 3.3.1.d
Total			**6**	

4.6.1.3 Collision theory and activation energy

Answer 08 · Mark scheme

June 2015 | CH3FP | Original Q3 | Legacy



4.6.1.3 Collision theory and activation energy

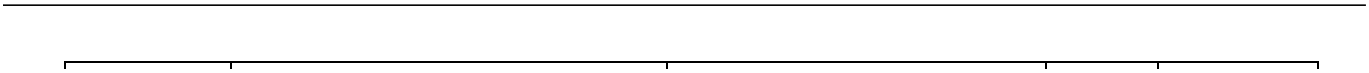
Answer 09 · Mark scheme June 2016 | CH2FP | Original Q4 | Legacy

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**	

4.6.1.3 Collision theory and activation energy

Answer 09 · Mark scheme

June 2016 | CH2FP | Original Q4 | Legacy



4.6.1.3 Collision theory and activation energy

Answer 10 · Mark scheme

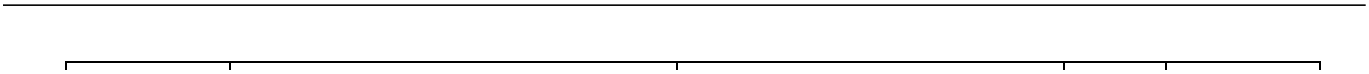
June 2016 | CH3FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
3(a)	water / H_2O	allow steam or hydrogen oxide	1	AO1 3.3.1i
3(b)(i)	A		1	AO2 3.3.1d
3(b)(ii)	exothermic products (energy) lower than reactants (energy)		1 1	AO2/AO3 3.3.1d,e
3(b)(iii)	1860 (kJ)		1	AO2 3.3.1d
3(c)(i)	22.5 38.7 16.2	 allow ecf for correct subtraction	1 1 1	AO2 3.3.1a
3(c)(ii)	50 (g)		1	AO2 3.3.1a
3(c)(iii)	20.1 (kJ)	allow propanol ignore 3	1	AO3 3.3.1a
3(c)(iv)	as the number of carbon atoms (in one molecule of alcohol) increases the heat energy given out increases (when the alcohol is burned)		1	AO3 3.3.1a
3(c)(v)	any **two** from: • no lid • no insulation • no draught shield • incomplete combustion • inaccurate measurement • no repeats (to calculate a mean)	Allow heat / energy loss to surroundings for any one of these marks	2	AO3 3.3.1a
3(c)(vi)	-O-H		1	AO1 3.6.1a
Total			14	

4.6.1.3 Collision theory and activation energy

Answer 10 · Mark scheme

June 2016 | CH3FP | Original Q3 | Legacy



Answer 11 · Mark scheme

June 2018 | 8462/1F | Original Q6

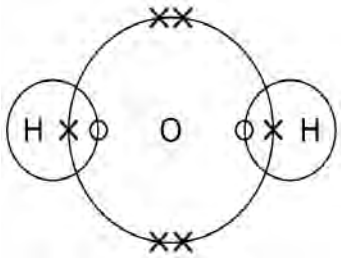
The full source mark scheme begins on page 37. Follow original question 6 in that document.

4.6.1.3 Collision theory and activation energy

Answer 12 · 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**	

4.6.1.3 Collision theory and activation energy

Answer 13 · 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**	

4.6.1.3 Collision theory and activation energy

Answer 14 · Mark scheme

November 2020 | 8462/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	water	allow H_2O do **not** accept energy	1	AO1 4.1.1.1 4.5.2.2
03.2	W = energy X = activation energy Y = overall energy change Z = progress of reaction		1 1 1 1	AO1 4.5.1.2
03.3	to produce a potential difference		1	AO1 4.5.2.2
03.4	magnesium **and** copper (the metals) have the largest difference in reactivity		1 1	AO2 4.4.1.2 4.5.2.1
Total			**8**	

4.6.1.3 Collision theory and activation energy

Answer 15 · 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**	

4.6.1.3 Collision theory and activation energy

Answer 16 · Mark scheme

November 2021 | 8462/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$\frac{54 + 50 + 55}{3}$ = 53 (°C)	if no other mark awarded allow **1** mark for $\frac{54 + 50 + 37 + 55}{4}$ = 49 (°C)	1 1	AO3 AO2 4.4.1.2 4.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(most reactive) magnesium zinc (least reactive) cobalt	allow ecf from question **04.1**	1	AO3 4.4.1.2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(18 ±) 2 (°C)		1	AO2 4.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	control		1	AO1 4.4.1.2 4.5.1.1 RPA4

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	use the same mass of metal / powder		1	AO3 4.4.1.2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(A) progress of reaction (B) activation energy (C) products		1 1 1	AO1 4.5.1.2

Total			**9**

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

Answer 18 · Mark scheme

June 2022 | 8462/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$Na_2S_2O_3 + 2\,HCl \rightarrow$ **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

4.6.1.3 Collision theory and activation energy

Answer 18 · 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

4.6.1.3 Collision theory and activation energy

Answer 19 · 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

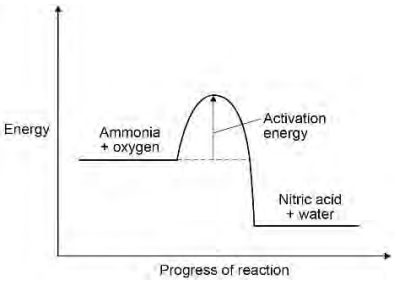
Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	iron	allow Fe	1	AO1 4.6.1.4 4.10.4.1

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

4.6.1.3 Collision theory and activation energy

Answer 19 · 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**

4.6.1.3 Collision theory and activation energy

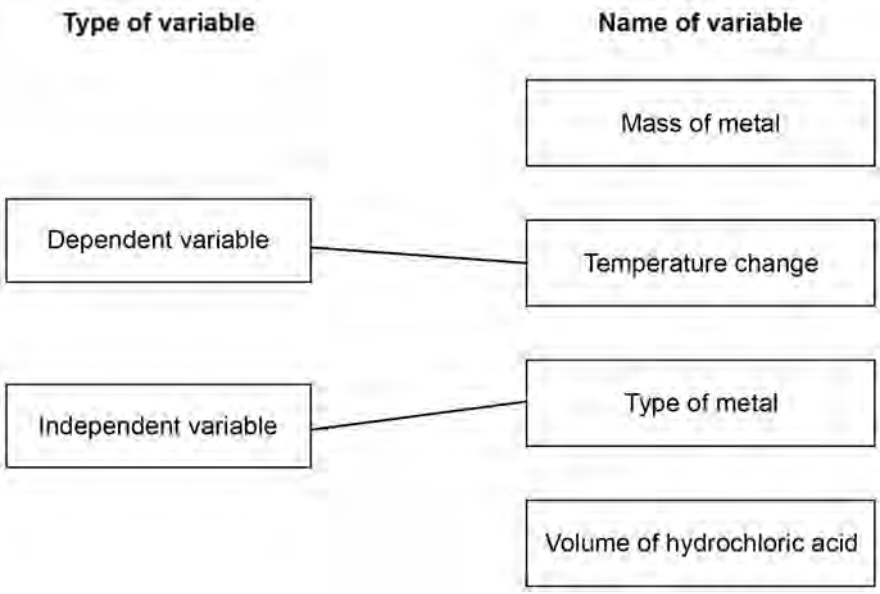
Answer 20 · Mark scheme

June 2025 | 8462/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	magnesium chloride		1	AO2 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	hydrogen		1	AO1 4.4.2.1

Question	Answers	Mark	AO / Spec. Ref.
02.3	 do **not** accept more than one line from a box on the left	1 1	AO1 4.5.1.1 RPA4

Answer 20 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	a polystyrene cup		1	AO3 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	2 °C		1	AO3 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	increases		1	AO1 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	**A**		1	AO1 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	**C**		1	AO1 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	**B**		1	AO1 4.5.1.2

Total Question 2	10

4.6.1.3 Collision theory and activation energy

Answer 21 · 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	

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**

4.6.1.3 Collision theory and activation energy

AQA

GCSE
CHEMISTRY

8462/1F - PAPER 1 FOUNDATION TIER

Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

4.6.1.3 Collision theory and activation energy

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

Copyright © 2018 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

PMT

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.

PMT

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

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.

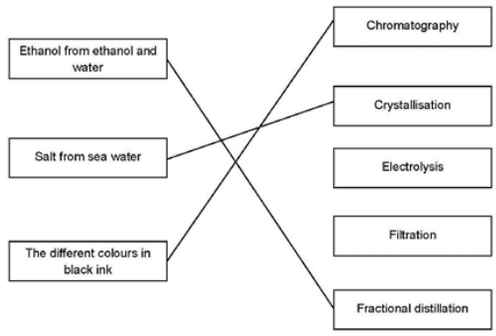
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

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.

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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**	

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) (because) chlorine displaces bromine and iodine (and) bromine displaces iodine **or** iodine does not react	allow the reactivity decreases from chlorine to iodine allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine allow (and) bromine has one reaction **or** iodine has no reactions allow (and) iodine cannot displace bromine	1 1 1	AO1 4.1.2.6 AO3 4.1.2.6 AO3 4.1.2.6
02.5	80		1	AO2 4.3.1.2

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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

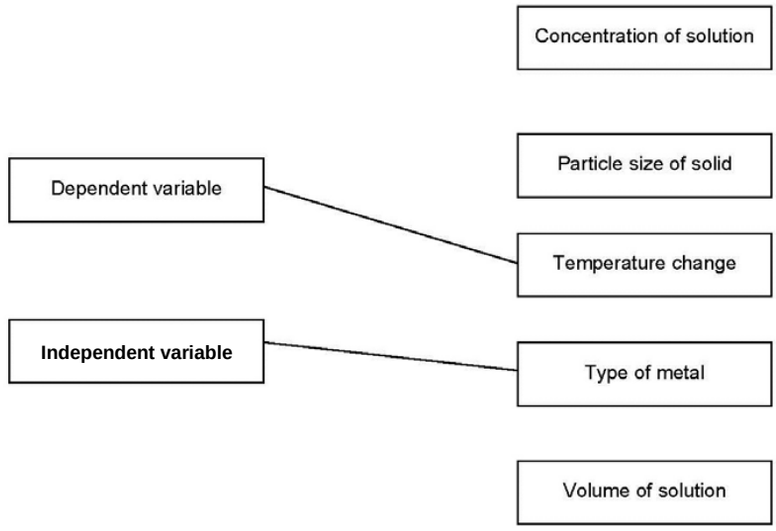
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	gas		1	AO1 4.2.2.2
05.2	the gas escapes	allow carbon dioxide escapes do **not** accept references to evaporation	1	AO1 4.3.1.3
05.3	5.12 (g)		1	AO2 4.3.1.3
05.4	4.00 (g) trial 1	allow 2.89 written in either space, or ringed in the table, unless 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

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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**

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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**	

4.6.1.3 Collision theory and activation energy

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

4.6.1.3 Collision theory and activation energy

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

<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>

Answer 11 · 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.

4.6.1.3 Collision theory and activation energy

Answer 11 · 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.

4.6.1.3 Collision theory and activation energy

Answer 12 · 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 18 · 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.

4.6.1.3 Collision theory and activation energy

Answer 19 · 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.

Answer 19 · Examiner comments

June 2024 | 8462/2F | Original Q9

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.

Answer 20 · Examiner comments

June 2025 | 8462/1F | Original Q2

Question 2 (low and standard demand)

02.1 More than four fifths chose the correct name. Magnesium nitrate was a more popular distractor than magnesium sulfate.

02.2 Fewer than three fifths chose hydrogen as the correct gas. Chlorine was by far the most popular distractor, and oxygen the least.

02.3 Fewer than two fifths of students could identify both variables, but another third could identify one. More students could identify the independent variable correctly than the dependent variable, with the volume of hydrochloric acid being a popular wrong choice for the dependent variable. Some students identified the correct two variables but had them the wrong way round, and a few drew multiple lines from the same box, which automatically negated any marks.

02.4 More than three fifths gave the correct answer, with the two distractors being approximately equal in popularity.

02.5 Just over a third of students gave 2 °C as the resolution of the thermometer, with the majority incorrectly opting for 20 °C. Many appear to think that the resolution of an instrument is the gap between numbered values on the scale rather than the size of the smallest scale division.

02.6 Fewer than half of responses gave the correct answer, with more than half believing that temperature decreases in an exothermic reaction.

02.7 Nearly three quarters of students were able to identify **A** as the reactants. **C** was the most popular distractor, followed by **B** and **D**.

02.8 More than four fifths could identify **C** as the activation energy, with **A** being the most popular distractor.

02.9 Only a quarter of students were able to identify **B** as the overall energy change, with **E** being by far the most popular response.

4.6.1.3 Collision theory and activation energy

Answer 21 · 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 21 · 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.