GCSE
CHEMISTRY
8462/2H

Paper 2 Higher Tier

Mark scheme

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Version: 1.0 Final

2 4 6 G 8 4 6 2 / 2 H / M S

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 Examiner.

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

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 their 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 (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

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**.
Alternative words in the mark scheme are shown by a solidus 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 errors / 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** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, 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. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

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

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **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 <u>not</u> 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.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

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, if necessary, 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. With practice and familiarity, you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

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.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(test) flame test (result) yellow (flame) **OR** (test) flame emission spectroscopy (1) (result) lines match sodium spectrum (1)	 allow FES	1 1	AO1 4.8.3.1 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(test) (add acidified) silver nitrate (solution) (result) white precipitate	 MP2 is dependent upon the award of MP1	1 1	AO1 4.8.3.4 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	to ensure that all the water has evaporated		1	AO3 4.10.1.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	mass of evaporating dish and dry contents − mass of empty evaporating dish		1	AO1 4.10.1.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	(mean concentration of NaCl =) $\frac{35.2 + 34.6 + 36.4 + 33.8}{4}$		1	AO2 4.10.1.2 RPA8
	or $\frac{140}{4}$	allow **1** mark for $\frac{35.2 + 34.6 + 33.8}{3} = 34.5$		
	$= 35.0$ (g/dm^3)		1	
	(mean concentration of Na^+ =) $35.0 \times \frac{39.3}{100}$	allow correct use of an incorrectly determined mean concentration of sodium chloride	1	
	$= 13.8$ (g/dm^3)	allow 13.755 correctly rounded to at least 3 significant figures	1	
	alternative approach 1:			
	(total concentration of NaCl = 35.2 + 34.6 + 36.4 + 33.8 = 140 total concentration of Na+ =) $140 \times \frac{39.3}{100}$ (1)	allow **1** mark for (35.2 + 34.6 + 33.8 = 103.6) $103.6 \times \frac{39.3}{100} = 40.71$		
	$= 55.02$ (g/dm^3) (1)			
	(mean concentration of Na^+ =) $\frac{55.02}{4}$ (1)	allow correct use of an incorrectly determined total concentration of Na^+		
	$=13.8$ (g/dm^3) (1)	allow 13.755 correctly rounded to at least 3 significant figures		

	alternative approach 2: (concentrations of Na^+ =) $35.2 \times \frac{39.3}{100}$ $34.6 \times \frac{39.3}{100}$ $36.4 \times \frac{39.3}{100}$ $33.8 \times \frac{39.3}{100}$ (1) = 13.83 13.60 14.31 13.28 (1) (mean concentration of Na^+ =) $\frac{13.83 + 13.60 + 14.31 + 13.28}{4}$ (1) =13.8 (g/dm^3) (1)	allow **1** mark if a concentration of 36.4 is treated as an anomaly and not used allow correct use of incorrectly determined concentration(s) of Na^+ allow 13.755 correctly rounded to at least 3 significant figures		

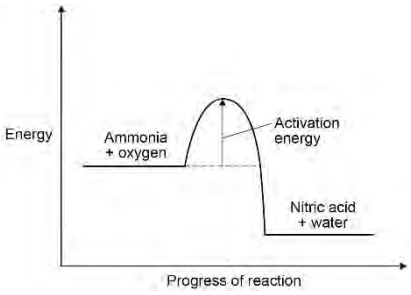
Total Question 1	**10**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	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.
02.2	iron	allow Fe	1	AO1 4.6.1.4 4.10.4.1

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	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.
02.5	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.
02.6	fertilisers	allow explosives allow sports injury packs	1	AO3 4.10.4.1 4.10.4.2

Total Question 2	**8**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	combustion reversible		1 1	AO2 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	water molecules break down and reform at the same rate		1	AO2 4.6.2.3

Question	Answers	Mark	AO / Spec. Ref.
03.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.10.1.2 4.10.1.3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content **Potable water production** • pass water through filter beds • to remove solids • use chlorine / ozone / UV light • to sterilise water • to destroy microbes **Waste water treatment** • screening • using a metal grid • to remove solids • to remove grit • sedimentation • to produce sewage sludge and effluent • anaerobic digestion of sewage sludge • aerobic biological treatment of effluent access to **Level 3** requires reference to **both** potable water production **and** waste water treatment.		

Total Question 3	**9**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1		allow converse argument allow stationary phase for paper		AO1 4.8.1.3 RPA6
	the yellow dye travels further		1	
	(because the yellow) dye has a weaker attraction to the (chromatography) paper		1	
		if no other mark awarded allow for **1** mark the weaker the attraction to the (chromatography) paper the greater the distance travelled (by the dye)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(in Experiment **2**) the yellow dye travels further	allow mobile phase for solvent	1	AO3 4.8.1.3 RPA6
	(because) the solvents are different		1	
	(and) the yellow dye is more soluble in ethanol (than water) **or** (and) the yellow dye is more attracted to ethanol (than water)	allow the yellow dye is less soluble in water (than ethanol) allow the yellow dye is less attracted to water (than ethanol)	1	
	OR (in Experiment **1**) the yellow dye does not travel as far (1) (because) the solvents are different (1)			
	(and) the yellow dye is less soluble in water (than ethanol) **or** (and) the yellow dye is less attracted to water (than ethanol) (1)	allow (and) the yellow dye is more soluble in ethanol (than water) allow (and) the yellow dye is more attracted to ethanol (than water)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	**A** is an impure (substance) **and** **B** is a pure (substance)	allow **A** is a mixture **and** **B** is a pure (substance)	1	AO3 4.8.1.1 4.8.1.3 RPA6
	(because) **A** contains two dyes **and** **B** contains one dye	allow (because) **A** produces two spots **and** **B** produces one spot if no other mark awarded allow **1** mark for **A** contains two dyes (so) is impure (substance) **or** **A** contains two dyes (so) is a mixture **or** **B** contains one dye (so) is pure (substance)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	$0.48 = \frac{5.4}{\text{distance moved by solvent}}$		1	AO2 4.8.1.3 RPA6
	(distance moved by solvent =) $\frac{5.4}{0.48}$		1	
	=11.25 (cm)	allow 11.25 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the ratio / proportion of spot distance (moved) to solvent distance (moved) is fixed / constant	allow the distance travelled by the spot relative to the distance travelled by the solvent is constant allow the distance travelled by the spot is (directly) proportional to the distance travelled by the solvent	1	AO1 4.8.1.3 RPA6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	any **two** from: • (more) sensitive • (more) accurate • fast(er)	allow small(er) sample allow greater resolution	2	AO1 4.8.3.6

Total Question 4	**13**

Question 5

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

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

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

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

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

Total Question 5	**12**

Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.10.2.1 4.10.3.2
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • bamboo is renewable • aluminium is a finite resource • growing bamboo uses up agricultural land • mining aluminium ore is a polluting activity • cost of aluminium alloy is lower • (so) can be replaced more frequently • aluminium alloy is stronger • (so) can withstand larger forces • aluminium alloy has lower mass • (so) bicycle is faster • (so) is easier to carry / transport • the aluminium alloy frame lasts less long • (so) bicycle must be replaced more frequently • aluminium alloy is recyclable (so) aluminium ores are conserved • bamboo can provide renewable heat energy • (so) less overall contribution to global warming • (and) is carbon neutral • neither material may reach landfill • both materials have a sustainable disposal method **Reasoned judgment**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	aluminium (alloy) has an oxide coating		1	AO1 4.10.3.1
	(so) contact between aluminium (alloy) and water / air / oxygen is prevented	do **not** accept sacrificial protection	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(coating with) grease	allow (coating with) oil allow galvanise allow use stainless steel as the alloy	1	AO2 4.10.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(carbon fibre) reinforcement	allow reinforces the polymer / resin ignore (carbon) fibres	1	AO2 4.10.3.3
	(polymer resin) matrix / binder	allow binds the fibres / fragments ignore (polymer) resin	1	

Total Question 6	**11**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1		ignore (hydrochloric / nitric / sulfuric) acid		AO1 4.8.3.5
	(test) add barium chloride (solution)	allow add barium nitrate (solution)	1	
	(result) white precipitate		1	
		MP2 is dependent upon MP1 being awarded		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	the yield is smaller at higher temperatures because the reaction is exothermic		1	AO2 4.6.2.6

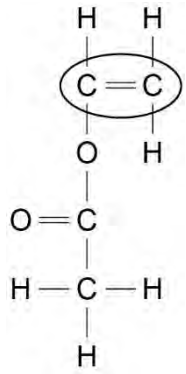
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3		allow converse		AO2 4.6.2.7
	there are more moles / molecules (of gas) on the left	ignore particles	1	
	(so the position of) equilibrium shifts to the right		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	any **two** from: • the yield is already high • more energy required • risk of explosion is increased • higher income from increased yield is outweighed by the extra expenditure • increased cost of safety precautions	allow requires stronger vessels allow requires thicker walls	2	AO3 4.6.2.7

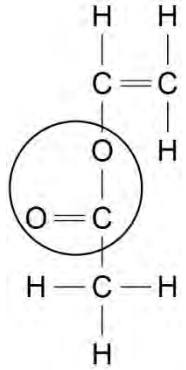
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	vanadium (V)		1	AO3 4.1.3.2

Total Question 7	**8**

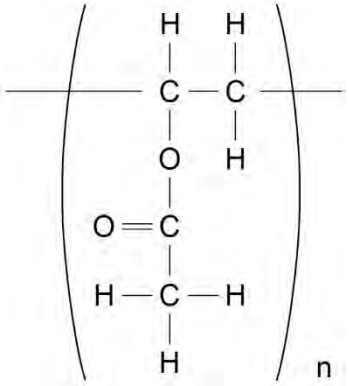
Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1			1	AO2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	orange (bromine water) turns colourless	allow yellow / brown allow is decolourised ignore clear	1 1	AO2 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3			1	AO3 4.7.2.4 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	$2\ C_4H_6O_2 + 9\ O_2 \rightarrow 8\ CO_2 + 6\ H_2O$	allow multiples allow **1** mark for $C_4H_6O_2 + O_2 \rightarrow$ with incorrect / no multipliers allow **1** mark for $\rightarrow CO_2 + H_2O$ with incorrect / no multipliers ignore state symbols	3	AO2 4.7.2.1 4.1.1.1 4.3.1.1 4.7.2.1 4.7.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	single C-C bond in polymer repeating unit n after polymer repeating unit	do **not** accept extra atoms added to trailing bonds an answer of  scores **2** marks	1 1	AO2 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	addition polymer		1	AO2 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	thermosoftening	allow thermoplastic	1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	cross-links between (polymer) chains (so) too much energy needed to overcome the cross-links	allow covalent bonds between (polymer) chains allow (so) too much energy needed to overcome the covalent bonds between (polymer) chains	1 1	AO1 4.2.2.5 4.10.3.3

Total Question 8	**13**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(some) hydrogen / gas escapes (from the flask)		1	AO3 4.6.1.2 RPA5
	(because the reaction starts) before the stopper is put in	allow (because) stopper cannot be inserted instantly	1	
		allow for **1** mark some air (from the conical flask) is collected **or** allow some hydrogen remains in the conical flask **or** allow some hydrogen remains in the delivery tube		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	(volume = 39 − 25 =) 14 (cm^3)		1	AO2 4.3.5
	(14 cm^3 =) 0.014 (dm^3)	allow correct use of an incorrectly determined volume	1	4.6.1.1 RPA5
	(moles of hydrogen =) $\frac{0.014}{24}$	allow correct use of an incorrectly determined volume allow correct use of an incorrect / no conversion of volume	1	
	= 5.8 x 10^{-4} (mol)	allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol)	1	
	alternative approach 1:			
	(24 dm^3 =) 24 000 (cm^3) (1)			
	(volume = 39 − 25 =) 14 (cm^3) (1)			
	(moles of hydrogen =) $\frac{14}{24000}$ (1)	allow correct use of an incorrectly determined volume allow correct use of an incorrect / no conversion of volume		
	= 5.8 x 10^{-4} (mol) (1)	allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol)		

	alternative approach 2: (24 dm^3 =) 24 000 (cm^3) (1) (moles of hydrogen at 100 s = $\frac{39}{24000}$ =) 0.001625 **and** (moles of hydrogen at 40 s = $\frac{25}{24000}$ =) 0.00104 (1) (moles 100 s – moles 40 s =) 0.001625 – 0.00104 (1) = 5.8 x 10^{-4} (mol) (1) **alternative approach 3:** (39 cm^3 =) 0.039 (dm^3) **and** (25 cm^3 =) 0.025 (dm^3) (1) (moles of hydrogen at 100 s = $\frac{0.039}{24}$ =) 0.001625 **and** (moles of hydrogen at 40 s = $\frac{0.025}{24}$ =) 0.00104 (1) (moles 100 s – moles 40 s =) 0.001625 – 0.00104 (1) = 5.8 x 10^{-4} (mol) (1)	allow correct use of an incorrect / no conversion of volume allow correct use of an incorrectly determined number of moles allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol) allow correct use of an incorrect / no conversion of volume allow correct use of an incorrectly determined number of moles allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	tangent drawn at 45 s		1	AO2 4.6.1.1 RPA5
	correct values for *y* step **and** *x* step from tangent	allow correct use of an incorrectly drawn tangent allow a tolerance of ± ½ a small square for each coordinate	1	
	(rate =) $\frac{\text{value for } y \text{ step}}{\text{value for } x \text{ step}}$	allow correct use of incorrectly determined value(s) from the tangent for *y* step and/or *x* step	1	
	correct calculation of rate (mol/s)		1	
	rate given in standard form (mol/s)	allow a correctly calculated answer in standard form from an incorrect attempt at rate determination	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	line starting at 0,0.000 and less steep than existing line		1	AO2 4.3.2.4 4.3.4 4.6.1.1 RPA5
	becomes level at 0.0084 mol	allow a tolerance of ± ½ a small square	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	(increasing the temperature) increases the rate of reaction		1	AO1 4.6.1.2 4.6.1.3
	(because) particles have more energy	allow (because) particles move faster	1	
	(so) the frequency of collisions increases	allow (so) a greater proportion of collisions have enough energy to react ignore successful	1	

Total Question 9	**16**