AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.8.1.3

Chromatography

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**18**
Available paper years	**2007–2024**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.8.1.3 Chromatography

Answer 01 · Mark scheme

March 2007 | CHY1B | Original Q3 | Legacy

Three	**A**	ethanol	**2**
	B	ethene	**4**
	C	helium	**1**
	D	poly(propene)	**3**

Answer 02 · Mark scheme

January 2008 | CHY1H | Original Q3 | Legacy

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

Answer 03 · Mark scheme

June 2008 | CHY1BP | Original Q8 | Legacy

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

4.8.1.3 Chromatography

Answer 04 · Mark scheme

June 2008 | CHY1H | Original Q3 | Legacy

question	answers	extra information	mark
3(a)	check if safe to eat / healthy **or** permitted	accept references to allergies / medical problems	1
3(b)	any **three** from: • made up of two colours / dots • contains an unknown colour / dot • contains a harmful colour • contains E104 / quinoline yellow **or** does not contain E133 / brilliant blue • further analysis needed	accept dye for colour	3
3(c)	there could be other additives (in the sweets) could still contain / use / add natural colours	ignore No or Yes but No must be implied accept any other type of additives but **not** colourings accept non-artificial for natural **or** named natural colours	1 1
Total			**6**

4.8.1.3 Chromatography

Answer 04 · Mark scheme June 2008 | CHY1H | Original Q3 | Legacy

COMPONENT NUMBER: CHY1H

COMPONENT NAME: Science B / Chemistry

STATUS: Final

DATE: June 2008

Answer 05 · Mark scheme June 2009 | CHY1BP | Original Q9 | Legacy

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

* This question has been removed

Answer 06 · Mark scheme November 2010 | CHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	chromatography	**1**
	B	combustion	**4**
	C	hydrogenation	**3**
	D	unsaturation	**2**

4.8.1.3 Chromatography

Answer 07 · Mark scheme

June 2011 | CHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	any **two** from: • improve the colour / appearance • additives are permitted / not banned / listed on the label • link between additives and hyperactivity not proved • maintain the low cost of the drink **or** natural colours would make the drink cost more	ignore reference to taste / shelf-life / sales etc allow cheaper if qualified	2
4(b)	have a control group / placebo **or** test children before any drink given give a drink to at least 3 groups **or** give a drink at least 3 times give each additive to different group / children / at different times observe / monitor / compare behaviour of group / children		1 1 1 1
4(c)(i)	so that there would be trust / respect / no bias		1
4(c)(ii)	compare the colours / spots from the orange drink with those of the (three) additives there should be no matching colours / spots	accept diagram of chromatogram(s) with spots for E102, 104, 110 and sample	1 1
Total			9

4.8.1.3 Chromatography

Answer 07 · Mark scheme June 2011 | CHY1H | Original Q4 | Legacy

CHY1H

Answer 08 · Mark scheme November 2011 | CHY1BP | Original Q9 | Legacy

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

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

4.8.1.3 Chromatography

Answer 09 · Mark scheme

June 2012 | CH2HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	prevent evaporation of solvent	allow prevent loss of solvent allow to support the (chromatography) paper	1
1(a)(ii)	ink dissolves in the solvent **or** carbon / graphite does not dissolve in the solvent	allow ink 'runs' / spreads **or** pencil does not 'run' / spread allow ink would affect the result / mixes with colours accept pencil for carbon / graphite	1
1(b)(i)	4		1
1(b)(ii)	any **one** from: • because not all colours match • not all colours are safe • some colours could be unsafe • some colours travelled higher (than safe colours)	no mark for 'no / don't know' ignore numbers	1
1(c)(i)	any **two** from: • rapid / quick • accurate • sensitive **or** detects very small quantities	ignore reliable / precise accept small sample	2

Question 1 continues on the next page . . .

4.8.1.3 Chromatography

CH2HP

Question 1 cont'd…..

question	answers	extra information	mark
1(c)(ii)	separates		1
1(c)(iii)	identifies solvents / compounds / substances	accept (relative) molecular mass accept formula mass accept M_r accept relative mass accept molecular ion peak	1
Total			**8**

4.8.1.3 Chromatography

Answer 09 · Mark scheme

June 2012 | CH2HP | Original Q1 | Legacy

CH2HP

4.8.1.3 Chromatography

Answer 10 · Mark scheme

January 2013 | CH2HP | Original Q4 | Legacy

question	answers	extra information	mark
4(a)	it is not used up	accept does not change accept reusable allow does not react	1
4(b)	they would melt **or** they have a low melting point	allow would lose their shape ignore soften	1
	because there are no cross links **or** there are weak intermolecular forces	accept there are weak bonds / forces between (polymer) chains	1
4(c)(i)		ignore reference to mass spectroscopy do **not** accept other incorrect process described	
	substances carried by gas	allow named gas	1
	(through) column / coil / tube **or** (through) solid (material) / powder		1
	at different speeds	accept different retention times	1
4(c)(ii)	(relative) molecular mass / M_r	allow (relative) formula mass **or** relative mass ignore relative atomic mass ignore identity of substance / molecule	1
Total			**7**

4.8.1.3 Chromatography

Answer 10 · Mark scheme

January 2013

CH2HP

4.8.1.3 Chromatography

Answer 11 · Mark scheme

Question 6

question	Answers	extra information	Mark
6(a)	has simple / small molecules	accept molecular covalent	1
	the intermolecular forces / intermolecular bonds (are weak)	do **not** accept weak covalent bonds **or** reference to incorrect bonding	1
	only need a small amount of energy to be overcome	accept only need a small amount of energy to separate the molecules if no other mark awarded, allow it has a low boiling point for **1** mark	1
6(b)(i)	to separate		1
6(b)(ii)	(relative) molecular mass	allow M_r / (R)MM / relative mass / mass of molecule / (R)FM	1
6(c)(i)	any pH value from 0 to 6.9		1
6(c)(ii)	hydrogen	allow H^+ ignore H / H_2 / H^-	1
6(d)	any **three** from:		3
	• same number of protons	accept same atomic number numbers if given must be correct	
	• ^2H has one neutron • ^1H has no neutrons	accept different mass number **or** different number of neutrons for **1** mark ignore relative atomic mass	
	• same number of electrons	numbers if given must be correct	
Total			10

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

4.8.1.3 Chromatography

Answer 12 · Mark scheme June 2014 | CH2HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(a)(i)	(phosphoric) acid	*allow phosphoric*	1	2 / 2.6.2d	G
1(a)(ii)	H^+ / hydrogen (ion)	*if ion symbol given, charge must be correct*	1	2 / 2.6.2d	E
1(b)(i)	pencil so it will not run / smudge / *dissolve* **or** because ink would run / smudge / *dissolve*	 *ignore pencil will not interfere with / affect the results* *ignore ink will interfere with / affect the results*	1 1	2 / 2.3.2b	E
1(b)(ii)	any **three** from: • *3* colours in Cola • *2* colours in Fruit drink • one of the colours is the same • two of the colours in Cola are different • one of the colours in Fruit drink is different • *one of the colours in Cola is the most soluble*	*reference to spots / dots = max **2*** *allow colouring for colour* *allow more colours in cola **or** fewer colours in fruit drink* *allow some of the colours in the drinks are different* *accept one of the colours in Cola has the highest R_f value*	3	3 / 2.3.2b	E
1(c)	different substances travel at different speeds **or** have different retention times	*accept different attraction to solid* *ignore properties of compounds*	1	1 / 2.3.2c	E

4.8.1.3 Chromatography

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
1(d)(i)	Is there caffeine in a certain brand of drink?		1	3 / 2.3.2	A
1(d)(ii)	any **two** from: • cannot be done by experiment • based on opinion / *lifestyle choice* • ethical, *social* or economic issue	*accept caffeine has different effects on different people*	2	3 / 2.3.2	E
Total			**11**		

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID

2 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.

AO / Spec. Ref.: 1 + 2 / 2.1.1f/g 2.2.1a 2.2.2a

ID: E

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 bonding and/or structure **or** melting / boiling point of chlorine **or** sodium chloride.*	*There are statements about the bonding and/or structure of chlorine **or** sodium chloride.*	*There are statements about the bonding and/or structure of chlorine **and** sodium chloride.* *There is an explanation of why chlorine is a gas **or** sodium chloride is a solid.*

Examples of chemistry points made in response:

Chlorine:

covalent bonds between atoms

forming simple molecules

no / weak attraction / bonds between molecules

low boiling point

Sodium chloride:

*ionic bonds **or** electrostatic attraction*

strong bonds

in all directions

between oppositely charged ions

forming giant lattice

large amounts of energy needed to break bonds

high melting point

Total			6

4.8.1.3 Chromatography

Answer 12 · Mark scheme

June 2014 | CH2HP | Original Q1 | Legacy



Answer 13 · Mark scheme

June 2017 | CH2HP | Original Q5 | Legacy

The full source mark scheme begins on page 28. Follow original question 5 in that document.

4.8.1.3 Chromatography

Answer 14 · Mark scheme

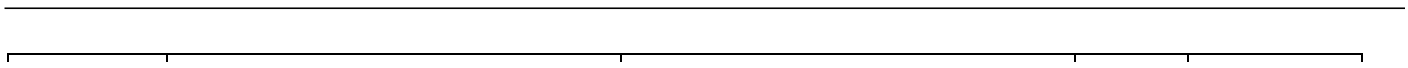
June 2018 | 8462/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	start line drawn in ink	allow start line should have been drawn in pencil	1	AO3 4.8.1.3
	(so) ink dissolves **or** ink runs in solvent / water	(as) pencil does not dissolve **or** pencil does not run in solvent / water	1	
	water used (as solvent) **or** water in beaker	allow ethanol not used	1	
	(so) colours will not dissolve / move		1	
04.2	any **two** from: • the flowers have no colours in common • A / B contain one colour • C contains two colours • (the colour in) B is most soluble	allow the flowers are not the same colour allow C is a mixture of colours allow (the colour in) B has the highest R_f value allow one of the colours in C is the least soluble	2	AO3 4.8.1.3
04.3	(distance moved =) $\frac{3.2}{0.65}$	an answer of 4.9 (cm) scores **2** marks	1	AO2 4.8.1.3
	(distance moved) = 4.9 (cm)	allow 4.923076923 (cm) correctly rounded	1	
Total			**8**	

4.8.1.3 Chromatography

Answer 14 · Mark scheme

June 2018 | 8462/2H | Original Q4



4.8.1.3 Chromatography

Answer 15 · Mark scheme

November 2020 | 8462/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$0.60 = \frac{5.7}{\text{distance moved by solvent}}$ (distance moved by solvent =) $\frac{5.7}{0.60}$ = 9.5 (cm)		1 1 1	AO2 4.8.1.3 RPA6
04.2	some of the compounds are colourless (in solution) **or** dyes / compounds have the same R_f values	allow there are only two compounds that are coloured (in solution)	1	AO3 4.8.1.3 RPA6
04.3	allow the solvent front to travel further use a different solvent		1 1	AO3 4.8.1.3 RPA6
04.4	so that the (shade of) green is the same	allow because the green ink is a formulation	1	AO3 4.8.1.2
04.5	the dye is less soluble in the new solvent and more attracted to the new paper		1	AO3 4.8.1.3
Total			**8**	

4.8.1.3 Chromatography

Answer 16 · Mark scheme

November 2021 | 8462/2H | Original Q3

Question 3

Question	Answers	Mark	AO/ Spec. Ref
03.1	**Level 3**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.8.1.3 RPA6
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The design/plan 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 **Method** • draw (pencil) start line on (chromatography) paper • place spot of food colouring on start line • use of suitable solvent • place solvent in beaker / container • place (chromatography) paper in beaker / container • so (chromatography) paper is in solvent • but solvent is below start line • use a lid • wait for solvent to travel up the (chromatography) paper (until near top) • mark solvent front • dry the (chromatography) paper **Measurements** • measure distance between start line and centre of spot • measure distance between start line and solvent front • use of measurements to determine R_f value		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	different solvent used		1	AO3 4.8.1.3 RPA6

4.8.1.3 Chromatography

Question 3 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	paper		1	AO1 4.8.1.3 RPA6

Total			**8**

4.8.1.3 Chromatography

Answer 17 · Mark scheme

June 2023 | 8462/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the start line is drawn in ink	allow the start line should be drawn in pencil	1	AO3 4.8.1.3 RPA6
	the start line is below the water level	allow the start line should be above the water level	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$0.60 = \frac{\text{distance moved by dye}}{12.0}$		1	AO2 4.8.1.3 RPA6
	(distance moved by dye =) 0.60×12.0		1	
	= 7.2 (cm)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		allow converse		
	the R_f value is smaller for Paper **A**		1	AO2
	(because the red dye) is more attracted to Paper **A** (than to Paper **B**)		1	AO3
	(so the red dye) spends a greater (proportion of the) time distributed in Paper **A** (than in Paper **B**)		1	AO3
				4.8.1.3 RPA6
		if no other mark awarded allow **1** mark for the dye has a different attraction to each paper		

4.8.1.3 Chromatography

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	use a different solvent	allow use ethanol (as the solvent)	1	AO1 4.8.1.3 RPA6

Total Question 6	9

4.8.1.3 Chromatography

Answer 18 · Mark scheme

June 2024 | 8462/2H | Original Q4

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)		

4.8.1.3 Chromatography

Answer 18 · Mark scheme

June 2024 | 8462/2H | Original Q4

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)		

4.8.1.3 Chromatography

Answer 18 · Mark scheme

June 2024 | 8462/2H | Original Q4

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	

4.8.1.3 Chromatography

Answer 18 · Mark scheme

June 2024 | 8462/2H | Original Q4

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**

4.8.1.3 Chromatography

GCSE

Additional Science / Chemistry

CH2HP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

4.8.1.3 Chromatography

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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4.8.1.3 Chromatography

Information to Examiners

1. General

The mark scheme for each question shows:

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

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Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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

Full marks can be given for a correct numerical answer, without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only. Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation '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 Accept/allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore/Insufficient/Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4 Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information.
- Simple understanding.
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail.
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information.
- Clear understanding.
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given.
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised.
- Detailed understanding, supported by relevant evidence and examples.
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.8.1.3 Chromatography

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	a smooth curve through or close to all points except (30,12)		1	AO2 2.4
1(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
1(a)(iii)	45-50 (seconds)		1	AO3 2.4
1(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
1(a)(v)	0.6 (cm^3 per second)	allow 0.55 to 0.65	1	AO2 2.4
1(b)(i)	 temperature volume (of hydrogen peroxide)	concentration of hydrogen peroxide = max **1** ignore amount (of hydrogen peroxide)	 1 1	AO3 2.4
1(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

4.8.1.3 Chromatography

1(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**	

4.8.1.3 Chromatography

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>2</td><td></td><td></td><td>6</td><td rowspan="6">AO1
2.1.1h
2.2.4b,c
2.2.5a,b</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td colspan="4"><table>
<tr><th>0 marks</th><th>Level 1
(1–2 marks)</th><th>Level 2
(3–4 marks)</th><th>Level 3
(5–6 marks)</th></tr>
<tr><td>no relevant information given</td><td>a statement about the structure or a property of a metal
or
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer</td><td>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</td></tr>
</table></td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="4">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</td></tr>
</table>

4.8.1.3 Chromatography

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**

4.8.1.3 Chromatography

Question	Answers	Extra Information	Mark	AO / Spec. Ref
3(a)(i)	2 bonding pairs 4 unbonded electrons on each atom	accept dots, crosses, e, - or any combination ignore any electrons on any inner shells if no other mark awarded allow **1** mark for 1 bonding pair and 6 unbonded electrons on each atom	1 1	**AO2** 2.1.1g
3(a)(ii)	covalent	allow convalent and covelant ignore single or double ignore shared, shared bond or sharing	1	**AO1** 2.1.1g
3(a)(iii)	weak intermolecular forces require little energy to overcome	reference to weak covalent or weak ionic bonds = **0** accept weak intermolecular bonds MP2 dependent on MP1 if no other mark awarded allow 1 mark for simple/small molecules	1 1	**AO1** **AO2** 2.2.1a,b

4.8.1.3 Chromatography

3(b)(i)	**2** Mg + O_2 → **2** MgO	accept multiples	1	**AO2** 2.2.2
3(b)(ii)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2**		**AO1** **AO2** 2.1.1a,b,c,f
	magnesium loses (electrons) **and** oxygen gains (electrons)		1	
	two (electrons transferred)		1	
	noble gas structure **or** 8 electrons in outer shells **or** (electrostatic) attraction between ions **or** forms ionic bonds	accept full outer shell (of electrons)	1	
3(b)(iii)	particles 1-100 nm in size	accept contain a few hundred atoms/ions accept have a high surface area to volume ratio ignore reference to (very) small particles do **not** accept smaller than an atom/ion	1	**AO1** 2.2.6a

4.8.1.3 Chromatography

3(c)	has a high melting point	allow will not melt allow a lot of energy needed to melt ignore boiling point reference to incorrect particles or incorrect bonding or incorrect structure = max **1** from MP2 and MP3	1	**AO1** **AO2** 2.2.3a
	because all atoms linked to other atoms	allow giant structure/lattice ignore many bonds	1	
	by covalent bonds	allow strong bonds allow a lot of energy needed to break bonds accept giant covalent structure for MP2 and MP3	1	
Total			**13**	

4.8.1.3 Chromatography

Question	Answers	Extra Information	Mark	AO / Spec. Ref
4(a)	add copper oxide and (sulfuric) acid		1	**AO1** **AO2** 2.6.1b,c
	excess (copper oxide)		1	
	filter (to remove excess)	ignore impurities	1	
	heat /boil / evaporate / leave (to crystallise)	do **not** accept to dryness	1	
4(b)	(M_r CuO =) 79.5		1	**AO2** 2.3.3c
	24.95/249.5 **or** 0.1 **OR** 79.5/249.5 **or** 0.3186…	allow ecf for M_r CuO from step 1 allow correct rounding to min 2SF	1	
	(24.95/249.5 x 79.5=) 7.95	allow ecf for M_r CuO from step 1 allow ecf from step 2 of incorrect calculation/ rounding of correct ratio allow correct rounding to min 2SF correct answer with or without working gains 3 marks	1	
4(c)(i)	as wealth decreases, ethene production decreases (with the exception of country C or D)	accept converse	1	**AO2** **AO3** 2.6
	sulfuric acid production is not linked to wealth		1	

4.8.1.3 Chromatography

4(c)(ii)	use of products of ethene has increased	allow use of polymers / plastics / ethanol / poly(ethene) has increased ignore use of ethene as a (bio)fuel ignore cost	1	**AO3** 2.2.5
Total			**10**	

4.8.1.3 Chromatography

Question	Answers	Extra Information	Mark	AO / Spec. Ref
5(a)(i)	draw line on paper put (dots of) inks on line place (bottom of) paper in solvent / water any **one** from: line drawn in pencil allow dots of ink to dry line above solvent lid		1 1 1 1	**AO1** 2.3.2b
5(a)(ii)	any **two** from: • A has 3 colours **and** B has 4 colours • 2 colours are the same • **A** has 1 colour not in **B and B** has 2 colours not in **A**	accept 3 colours are different if no other mark awarded allow **one** more colour in ink **B** than in ink **A** (or converse)	2	**AO3** 2.3.2b
5(b)(i)	substances carried by gas through column / tube / coil (packed with solid) (different substances move through the column) at different speeds	 accept (different) substances come out at different times or have different retention times	1 1 1	**AO1** 2.3.2c
5(b)(ii)	(relative) molecular mass	allow (relative) formula mass allow RFM, RMM, M_r	1	**AO1** 2.3.2c
Total			**10**	

4.8.1.3 Chromatography

Question	Answers	Extra Information	Mark	AO / Spec. Ref
6(a)(i)	tick (✓) by: the initial temperature reading was too low		1	**AO3** 2.5
6(a)(ii)	the reaction is exothermic	allow energy is given out	1	**AO3** 2.5.1b
6(b)(i)	(positive/hydrogen) ions gain electrons hydrogen is below sodium in the reactivity series so hydrogen / H_2 is produced	accept (positive/hydrogen) ions are reduced accept reference to high reactivity of sodium If no other mark awarded allow hydrogen (and sodium) ions **or** positive ions are attracted to negative electrode for **1** mark	1 1 1	**AO1** **AO2** 2.7.1c,f,i
6(b)(ii)	**2** (Cl^-) → **Cl_2 + 2e^-**	must be completely correct allow multiples	1	**AO1** 2.7.1g
6(b)(iii)	solution is alkaline because sodium hydroxide / NaOH is produced **or** sodium hydroxide / NaOH is left over	accept hydroxide (ions) / OH^- is produced **or** hydroxide (ions) / OH^- is left over	1 1	**AO1** **AO2** 2.7.1i; 2.6.2d
Total			**8**	

4.8.1.3 Chromatography

Answer 14 · Examiner comments June 2018 | 8462/2H | Original Q4

Question 4 (standard & standard / high demand)

04.1 The lid confused many students and they came up with many creative ways to describe how this would lead to a problem. Another common misconception was that the water level was too low and therefore would affect the R_f value calculated, or that it wouldn't move up the paper. Some students wrote a poorly expressed and confused account of the relationship of the mobile and stationary phases. Nevertheless, 39% of students achieved all four marks.

04.2 Many students described substances, inks and compounds rather than colours. Weaker responses merely described the pattern of the dots rather than the deductions that could be drawn from these patterns. Some students answered in terms of purity. 49% of students achieved both marks.

04.3 65% of students calculated the answer correctly. There was lots of incorrect rounding here. 2.08 was a common wrong answer (from 3.2×0.65).

Answer 15 · Examiner comments November 2020 | 8462/2H | Original Q4

Question 4 (standard / high and high demand)

04.1 Well answered. Some students left contradictory working in place (e.g. 5.7 / 0.60 = 9.5 left alongside 5.7 x 0.60 = 3.42) which compromises their ability to score marks. Once students have decided which answer is correct, they should cross the other out.

04.2 Very few students scored this mark. Some didn't appear to have read the first sentence and just stated that there are two spots because there are two dyes. Many thought that the other compounds were insoluble; very few suggested that compounds could be colourless.

04.3 A majority of students gained one mark here, with many going on to score both.

04.4 Quite well answered by many students. Most referred to consistency of the green colour, with some referring to the ink being a formulation so having to have the same proportions. A few students tried to refer back to the experiment – 'to make it a fair test' or 'to produce the same R_f value'.

04.5 A minority of students selected the correct response.

4.8.1.3 Chromatography

Answer 16 · Examiner comments — November 2021 | 8462/2H | Original Q3

Question 3 (standard demand)

03.1 Nearly two-fifths achieved a Level 3 response and well over four-fifths gained at least a Level 2 mark here. The main barriers to accessing Level 3 were an assertion that the solvent level should start at or above start-line level, or a failure to identify if or how measurements should be made. Level 1 responses usually had several keys steps missing.

03.2 Most students answered this question correctly.

03.3 Most students answered this question correctly.

Answer 17 · Examiner comments — June 2023 | 8462/2H | Original Q6

Question 6 (standard, standard / high and high demand)

Answer 17 · Examiner comments — June 2023 | 8462/2H | Original Q6

06.1 Students had a very good knowledge of chromatography and around 75% of students scored two marks for this question. Incorrect responses included references to a lack of a lid and talking about the chromatography paper in general being in the water and not the starting line specifically.

06.2 This was answered extremely well by most and nearly 90% of students scored full marks. Some students used a correct ratio method to arrive at the correct answer. Only a few scripts had no working and the correct answer but there were a number of other incorrect methods used to arrive at the correct answer which therefore scored no marks.

06.3 Students found this question difficult. Many just quoted information from the table, mostly comparing the different distances moved by the dyes on the different chromatography papers. Only a small percentage of students' answers were comparative and they often did not refer to type A and B chromatography paper. Few noted the difference in R_f values between the 2 papers. The compensatory mark was therefore often the only one accessed by students. Many answers were confused involving contradictory ideas. Differences in attraction to the paper was better understood and answered rather than time spent distributed on different papers. So therefore, on the whole, MP2 was accessed more often than MP3. Around 40% of the students gained 1 mark, with higher marks being rare.

06.4 About 50% of students scored 1 mark. Most just referred to using a different solvent, with a few naming ethanol.

4.8.1.3 Chromatography

Answer 18 · Examiner comments June 2024 | 8462/2H | Original Q4

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

04.1 Those students who gained marks, mostly did so by stating that the yellow dye travelled further up the page. Fewer students were able to explain that this was due to a weaker attraction between the dye and the chromatography paper. These students did not act on the instruction given in the question to refer to the force of attraction between the dyes and the chromatography paper, instead referring to the relative solubilities of the dyes, or their attraction to the solvent. Around 30% gained both marks.

04.2 Most students gained credit for recognising that the yellow dye travels further in experiment **2**. Those that went on to link this to the relative solubility of the dye in ethanol gained credit for marking point 3. Fewer students explicitly stated that the difference in the distance travelled was

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Answer 18 · Examiner comments June 2024 | 8462/2H | Original Q4

due to different solvents being used in each experiment. About a quarter of students scored all three marks.

04.3 Most students considered both dyes in their answers. Students who gained credit usually did so by identifying that dye **A** contained two dyes and dye **B** contained one. However, students often did not gain the first mark as they did not state that dye **A** was impure and dye **B** was pure; instead, they described the dyes in degrees of purity (eg less pure, purer), which was insufficient. Roughly a quarter of students scored both marks.

04.4 This question was well answered and about three-quarters of students were able to gain full marks. Those that didn't gain full marks, commonly didn't gain any credit as they had incorrectly substituted the data given into the equation to calculate the R_f value.

04.5 Only around 10% of students were able to explain the mathematical relationship between the R_f value and the distances travelled by the spot and solvent. Many merely stated that both the spot and solvent travelled further.

04.6 A number of students were able to gain some credit for their answer, with nearly half gaining both marks. Some students incorrectly stated that increased precision was an advantage. Other answers referring to instrumental methods as being more exact, reliable, repeatable, reproducible, efficient or reducing human error were considered too vague.