AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.8.1.3

Chromatography

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**5**
Available paper years	**2018–2024**

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.

5.8.1.3 Chromatography

Answer 01 · Mark scheme

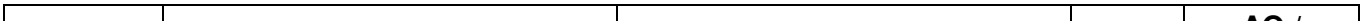
June 2018 | 8464/C/2F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	red **and** blue	both needed for mark	1	AO3 5.8.1.3
	unknown		1	
02.2	red	ignore black	1	AO3 5.8.1.3
	travels least far	dependent on correct colour allow closest to the start line	1	AO2 5.8.1.3
02.3	distance moved by green colour = 12 mm	allow 10 to 14 mm	1	AO2 5.8.1.3
	distance moved by solvent = 36 mm	allow 35 to 36 mm	1	
	$\frac{12}{36}$	allow correct substitution of student's measurements	1	
	R_f value = 0.33	allow correct answer from student's measurements for **2** marks	1	
Total			**8**	

5.8.1.3 Chromatography

Answer 01 · Mark scheme

June 2018 | 8464/C/2F | Original Q2

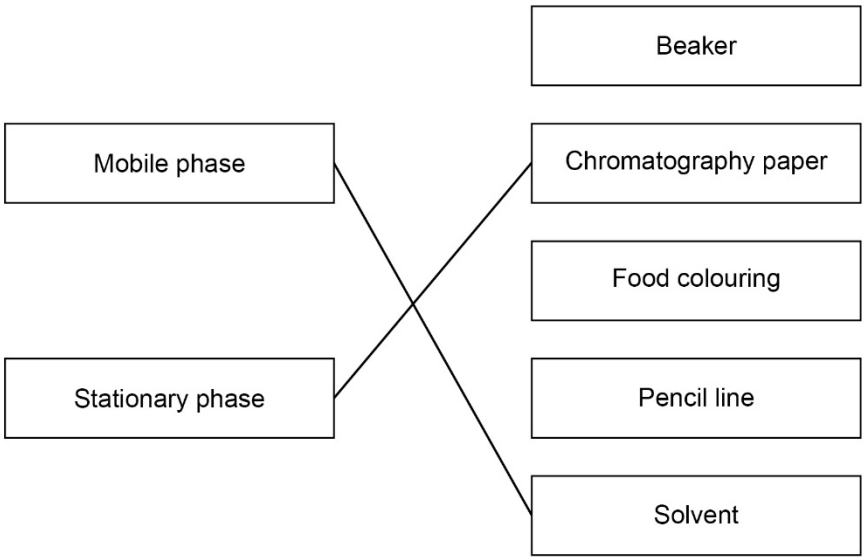


5.8.1.3 Chromatography

Answer 02 · Mark scheme November 2020 | 8464/C/2F | Original Q5

05.1	air		1	AO1 5.8.1.1

05.2	formulation(s)		1	AO1 5.8.1.2

05.3	 additional line from a box on the left negates the mark for that box		1 1	AO2 5.8.1.3

05.4		allow colour for dyes		AO3 5.8.1.3
	Y contains 3 dyes		1	
	Y contains 2 known dyes	allow **Y** contains **A** and **C**	1	
	Y contains an unknown dye	allow **Y** does not contain dye **B**	1	
	alternative approach:			
	Y contains 3 dyes (1)			
	Y contains 1 known dye (1)	allow **Y** contains dye **C**		
	Y contains 2 unknown dyes (1)	allow **Y** does not contain dyes **A** and **B**		

5.8.1.3 Chromatography

Answer 02 · Mark scheme

05.5	$(R_f =) \frac{60}{80}$ = 0.75	 ignore units	1 1	AO2 5.8.1.3

Total			**9**

5.8.1.3 Chromatography

Answer 02 · Mark scheme

November 2020 | 8464/C/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.8.1.3 Chromatography

Answer 03 · Mark scheme

June 2022 | 8464/C/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	any **two** pairs from: (start) line drawn in ink (1) (so ink) will mix with solvent (1) the solvent is above the (start) line (1) (so) colours / ink will dissolve (1) no lid on tank (1) (so) solvent will evaporate (1)	 allow (start) line should be drawn in pencil allow the ink will move up the paper allow the solvent should be below the (start) line	4	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	any **two** from: • (the brown ink) contains the blue, yellow and red (colours) • (the brown ink) contains an unknown colour • (the brown ink) does not contain green ink • blue (colour) is the most soluble **or** red (colour) is the least soluble	 allow blue (colour) has the highest R_f value allow red (colour) has the lowest R_f value ignore green colour is insoluble	2	AO3 5.8.1.3 RPA12

5.8.1.3 Chromatography

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	the green colour was insoluble in the solvent		1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	$0.24 = \frac{1.8}{\text{distance moved by solvent}}$		1	AO2 5.8.1.3 RPA12
	(distance moved by solvent =) $\frac{1.8}{0.24}$		1	
	= 7.5 (cm)		1	

Total Question 6		10

5.8.1.3 Chromatography

Answer 04 · Mark scheme

June 2023 | 8464/C/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	stationary phase		1	AO1 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	any **one** from: (the substances) • move at different speeds • have different solubilities • have different attractions for the (chromatography) paper		1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	1		1	AO1 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(R_f =) $\frac{4.77}{5.30}$ = 0.9		1 1	AO2 5.8.1.3 RPA12

5.8.1.3 Chromatography

Answer 04 · Mark scheme

June 2023 | 8464/C/2F | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.5	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 5.8.1.3
	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 • **draw a pencil line** • near the bottom edge of the (chromatography) paper • **put a small dot of black ink on the pencil line** • put a small volume of water / solvent in a beaker • **place the (chromatography) paper in the solvent** • the dots of ink should be above the level of the water / solvent • support the paper in this position • put a lid on the beaker • **leave to run** • mark position of solvent front • remove from beaker and leave to dry • **determine R_f values** • measure distance of all dots from start line • measure distance of solvent front from start line • calculate R_f values for all dots • compare with known R_f values		

Total Question 6	**11**

5.8.1.3 Chromatography

Answer 05 · Mark scheme

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	formulation		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	pencil (reason) (so) the start line does not dissolve in the solvent		1 1	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(distance moved by red colour) 3.2 (cm) **or** 32 (mm) (distance moved by solvent) 8.0 (cm) **or** 80 (mm) (R_f =) $\frac{3.2}{8.0}$ **or** $\frac{32}{80}$ = 0.4	allow a value in the range 3.1 to 3.3 (cm) allow a value in the range 31 to 33 (mm) allow correct use of incorrectly determined distance(s)	1 1 1 1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	prussian (prussian) has the closest R_f value (to the colour in the printer ink)	allow 0.88	1 1	AO3 5.8.1.3 RPA12

Total Question 3	**9**

5.8.1.3 Chromatography

Answer 03 · Examiner comments — June 2022 | 8464/C/2F | Original Q6

Question 6

This Required Practical Activity is a familiar context on examination papers and most students were able to make some progress.

06.1 Often students gave solutions as opposed to the problems the errors would lead to. The start line being drawn in ink was the most common correct response, however, the problems encountered were often vague such as the experiment would not work. A quarter of students gained at least 1 mark, with a further quarter gaining 2. Far fewer were able to progress much beyond this.

Answer 03 · Examiner comments — June 2022 | 8464/C/2F | Original Q6

06.2 Conclusions were often poorly expressed or incomplete. The conclusion needed to be in terms of what was in brown ink. Common incorrect responses referred to the amount of a colour being linked to where it is found on a chromatogram.

06.3 Just over three quarters of students were able to identify that the green colour was insoluble in the solvent.

06.4 The calculation of the R_f value relied on the skill of rearranging the given equation. Just over 35% of students gained all 3 marks. Where an incorrect response was obtained, no further credit was given when there was no working. Students should be encouraged to show their working in calculations so that appropriate credit can be awarded if a final answer is not given or is incorrect.

5.8.1.3 Chromatography

Answer 04 · Examiner comments

June 2023 | 8464/C/2F | Original Q6

Question 6

06.1 Over half of students knew that the stationary phase was the other phase in chromatography.

06.2 Only approximately one in fifty students knew that separation of inks in chromatography was due to either a difference in solubility or different attractions for the paper. Many students thought that the separation was dependent on melting point, concentration, density, or formula mass.

06.3 Lots of random numbers were seen for this question, but just over a quarter were able to deduce that there would be one spot.

06.4 Just under a quarter of students were able to correctly calculate the Rf from the values given. There were many examples of students multiplying the numbers, subtracting them, or dividing them upside down.

06.5 Students were asked to plan an experiment using paper chromatography to separate the colours in black ink and to subsequently identify the colours from their Rf values.

To access level 3, which was done by fewer than one in ten students, the plan needed to lead to a valid outcome. This required students to identify the key steps in the indicative content. Some students were able to explain how to determine the Rf values but very few recognised that the values needed to be compared to known Rf values and how this should be done.

To access level 2, which was done by nearly one third of students, the method did not necessarily lead to a valid outcome. Common mistakes included the idea that the pencil line should be submerged in the solvent and that the experiment should be left for too long for example, until the ink reached the top of the paper.

Common weaker responses usually gained credit for identifying that the pencil line needed to be drawn in pencil.

It should be noted that just over a quarter of students did not attempt this question at all.

5.8.1.3 Chromatography

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Answer 05 · Examiner comments

Question 3 (low & standard demand)

03.1 Fewer than half of students gained the mark for formulation, formula being the most common distractor chosen.

03.2 About 70% of students gained the first mark for stating that the line should be drawn with a pencil, but the second mark was less often attained due to weak use of language. Instead of stating the pencil would not dissolve, there were many comments about mixing, smudging, moving and running, and other vague explanations that were not acceptable. Some students suggested that the line should be drawn in pencil so it could be rubbed out if necessary.

Some said the line should be drawn in black pen, so it would be clear. Many students had not read the question properly and said the line should be drawn with a ruler, so it would be straight.

03.3 This question was generally well answered, with about two-thirds of students gaining 2 or more marks. Most students were able to correctly measure the distance moved by the red colour; fewer were able to measure the distance moved by the solvent. There was a large variation in the distances given for this value, which suggests students did not know what the solvent front was rather than not having the skills to measure the distance correctly.

Over half of students were then able to correctly substitute their numbers into the R_f expression and attain marking point 3. Some students substituted the numbers into the expression upside down.

About a third of students were correctly able to evaluate the R_f expression and state the correct value for their calculation. The most common reason for not gaining the fourth mark was incorrect rounding.

03.4 Most students correctly identified Prussian in this AO3 question and over half went on to give the correct explanation. Some students incorrectly explained that the answer was Prussian because it had the highest value. Other incorrect answers included Cobalt, because it was the lowest value or Ultramarine because it was the same number but the digits had been written the wrong way round.