AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.8.1.3

Chromatography

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
Available paper years	**2019–2024**

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 2019 | 8464/C/2H | Original Q3

03.1	a mixture designed as a useful product		1	AO1 5.8.1.2
03.2	dyes distributed differently between the stationary and mobile phase	allow dyes have different solubilities allow dyes have different forces of attraction for stationary phase allow dyes have different forces of attraction for mobile phase allow dyes have different forces of attraction to the paper allow dyes have different forces of attraction to the solvent ignore density	1	AO1 5.8.1.3
	(so dyes) move up the paper at different speeds / rates	allow (so dyes) move different distances up the paper ignore references to time	1	
03.3	(because chromatogram has) different dots / colours		1	AO2 5.8.1.3
	in a (vertical) column	allow above the (original) spot	1	
03.4	run known dyes and food colouring (as a chromatogram)		1	AO2
	compare distances moved **or** compare R_f values		1	AO2
	(so) can identify those that move the same distance as known dyes **or** (so) can identify those that have the same R_f values as known dyes	allow (so) can identify those that move different distances as unknown dyes **or** allow (so) can identify those that have different R_f values as unknown dyes	1	AO2 5.8.1.3
Total			**8**	

5.8.1.3 Chromatography

Answer 01 · Mark scheme

June 2019 | 8464/C/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.8.1.3 Chromatography

Answer 02 · Mark scheme

June 2022 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	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.
01.2	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 02 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$0.24 = \frac{1.8}{\text{distance moved by solvent}}$		1	AO2 5.8.1.3 RPA12
	(distance moved by solvent =) $\frac{1.8}{0.24}$		1	
	= 7.5 (cm)		1	

Total Question 1		10

5.8.1.3 Chromatography

Answer 03 · Mark scheme

June 2023 | 8464/C/2H | Original Q2

Question 2

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	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.
02.3	1		1	AO1 5.8.1.3 RPA12

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

Question	Answers	Mark	AO / Spec. Ref.
02.5	**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 2	**11**

5.8.1.3 Chromatography

Answer 04 · Mark scheme

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	red colour is insoluble (in the solvent) (so) does not move with the solvent		1 1	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$0.87 = \frac{6.4}{\text{distance moved by solvent}}$ (distance moved by solvent =) $\frac{6.4}{0.87}$ = 7.356 = 7.4 (cm)	 allow a correctly calculated answer to 2 significant figures using the values in the question	1 1 1 1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	any **one** from: • (the two dyes) may have the same R_f value (as the blue / yellow colour) • (the two dyes) may have spots in the same place • two of the colours may be insoluble • the other colour may be white	ignore colourless	1	AO3 5.8.1.3 RPA12

5.8.1.3 Chromatography

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	use a different solvent		1	AO3 5.8.1.3 RPA12

Total Question 4	**8**

5.8.1.3 Chromatography

Answer 01 · Examiner comments June 2019 | 8464/C/2H | Original Q3

Question 3 (standard/high demand)

03.1 A minority of students knew the definition of a formulation from the specification or were able to give an equivalent statement. Often students mentioned that it was ‘a mixture’ or ‘chemicals mixed together’ but omitted the idea of ‘to form a useful product’. Some students were able to give examples, but not a definition.

03.2 A large number of students did not explain how chromatography separates the dye. Instead they explained in detail how a chromatography experiment would be undertaken to separate the dyes.

Just over a third of students gained some credit, mostly for the idea that different dyes had different solubilities. A significant number of students incorrectly stated the reason was related to the densities of the dyes. The second marking point was for conveying the idea that the different dyes travel up the chromatography paper at different rates/speeds or distances. However, there were many vague responses referring to different points or places.

Answer 01 · Examiner comments June 2019 | 8464/C/2H | Original Q3

03.3 The majority of students gained at least one mark but only a small minority gained both marks. Responses referred to the food colouring separating into more than one colour/spot/dot on the chromatogram but rarely indicated that these colours/spots would appear vertically above the original dye. Some students described how it was possible to identify the colours separated by ‘matching them against other colours’, which was not asked for in the question.

03.4 Many students failed to gain the first marking point due to not elaborating on ‘do the chromatography experiment’ rather than explain (as requested by the command word) how to conduct the experiment.

Students gained credit for stating that the distances travelled needed to be measured or the R_f values calculated, but then omitted to state how these values could be used to either confirm the identity of the unknown dyes or identify which dyes remained unidentified.

5.8.1.3 Chromatography

Answer 02 · Examiner comments — June 2022 | 8464/C/2H | Original Q1

Question 1

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

01.1 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. Nearly 95% of students gained at least 1 mark, with over 1 in 5 gaining all 4 marks.

Answer 02 · Examiner comments — June 2022 | 8464/C/2H | Original Q1

01.2 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.

01.3 Just over 90% of students were able to identify that the green colour was insoluble in the solvent.

01.4 The calculation of the R_f value relied on the skill that students were able to rearrange the given equation which was successfully achieved by nearly 80% of students. Where an incorrect answer 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 03 · Examiner comments

Question 2

02.1 Nearly nine in ten students knew that the stationary phase was the other phase in chromatography.

02.2 Approximately one in five 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.

02.3 Just under three quarters were able to deduce that there would be one spot. Lots of random numbers were seen for this question, with little pattern.

02.4 Just under three quarters of students were able to correctly calculate the R_f from the values given. There were examples of multiplying the numbers, subtracting them, or dividing them upside down.

02.5 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 R_f values.

To access level 3, which was done by around two in five students, the plan needed to lead to a valid outcome. This required students to identify the key steps in the indicative content. Students were able to explain how to determine the R_f values but few recognised that the values needed to be compared to known R_f values and how this should be done.

To access level 2, which was done by nearly half 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 line needed to be drawn in pencil.

5.8.1.3 Chromatography

Answer 04 · Examiner comments

Question 4 (standard/high demand)

04.1 Although about 40% of students gained 1 or more marks it was rare to see the two marking points together; a tenth of students gained 2 marks. Many students simply repeated the question by stating the red ink did not move: the phrase 'with the solvent' was conspicuous by its absence. Insoluble was the most often seen correct answer. Incorrect explanations included 'too heavy', 'too strong', 'a pure colour', 'unreactive', 'least soluble' and 'not soluble enough'.

04.2 This question was well answered, with just over half of students gaining full marks. The most challenging step was the correct rearrangement of the equation.

04.3 Fewer than 1 in 5 students correctly answered this question. Very few students referred to the colours having the same R_f value. Several students answered in terms of primary colours; or of one of the inks being insoluble, when of course it had to be two of the inks, not just one. Many answers related simply to the diagram rather than showing an understanding of the principles of chromatography.

04.4 Over 80% of students were not able to gain a mark for this question. There was a wide variety of suggestions for changes in the experiment: almost everything in the experiment other than the solvent. Often specificity of language stopped students gaining the mark, as 'stronger solvent' 'weaker solvent', 'more solvent' and 'less solvent' were common, none of which were creditworthy. The ink, the colour of paper, leave for longer and use longer paper were also common incorrect responses.

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