

GCSE Combined Science: Trilogy

Worksheet: Chromatography

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Chromatography

NAME _____

CLASS _____

DATE _____

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A student uses paper chromatography to compare two solvents, water and a mixture of water and ethanol, for separating three food dyes, X, Y and Z.

0 1 . 1

Why should the start line be drawn in pencil and not in ink?

.....

.....

[1 mark]

0 1 . 2

Why must the start line be above the level of the solvent in the beaker?

.....

.....

[1 mark]

0 1 . 3

What is the independent variable in this investigation?

Tick (✓) **one** box.

The distance moved by each dye

☐

The solvent used

☐

The type of paper

☐

The R_f value of each dye

☐

[1 mark]

0 1 . 4

Give **one** variable the student should keep the same.

[1 mark]

0 1 . 5

The water-ethanol mixture is flammable.

Give **one** safety precaution the student should take.

[1 mark]

0 2

A student runs a chromatogram of a black ink and sees it separate into four differently coloured spots.

0 2 . 1

What does this show about the black ink?

Tick (✓) **one** box.

It is a pure substance

It is a mixture of at least four dyes

It is insoluble in the solvent

It has an R_f value of 4

☐
☐
☐
☐

[1 mark]

0 2 . 2

Suggest why the four dyes in the ink separate into four different spots.

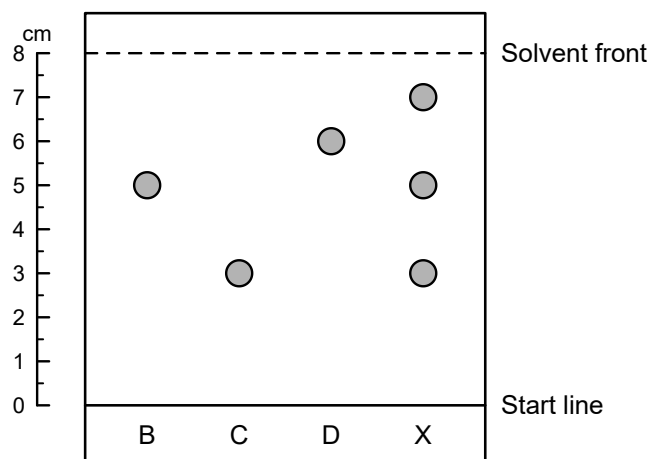
[1 mark]

0 3

A student used paper chromatography to compare an unknown mixture, X, with three reference dyes, B, C and D.

Figure 1 shows the chromatogram, drawn to scale.

Figure 1



0 3 . 1

How many different substances does mixture X contain?

.....

.....

.....

[1 mark]

0 3 . 2

The solvent front moved 8.0 cm from the start line.

Use Figure 1 to calculate the R_f value of dye B.

Use the equation:

$R_f = \text{distance moved by substance} \div \text{distance moved by solvent}$

.....

.....

.....

.....

R_f value =

[2 marks]

0 4

0 4 . 1

Complete the sentences about paper chromatography using words from the list.

insoluble mobile soluble stationary

The paper is the phase.

The solvent is the phase.

A dye that is completely in the solvent will stay on the start line.

.....

.....

.....

.....

.....

.....

[3 marks]

0 4 . 2

A pencil line is used to mark the start line, rather than a pen.

Give the reason why.

.....

.....

[1 mark]

0 5

0 5 . 1

In paper chromatography, what is the mobile phase?

Tick (✓) **one** box.

The paper

☐

The solvent

☐

The start line

☐

The spots of dye

☐

[1 mark]

0 5 . 2

Why is the start line on a chromatogram drawn in pencil and not in ink?

.....

.....

[1 mark]

0 5 . 3

A pure substance is tested using three different solvents.
How many spots would you expect on each chromatogram?

.....

.....

.....

.....
[1 mark]

0 5 . 4

Complete the equation for the R_f value of a substance.
 $R_f = \dots\dots\dots$

.....

.....

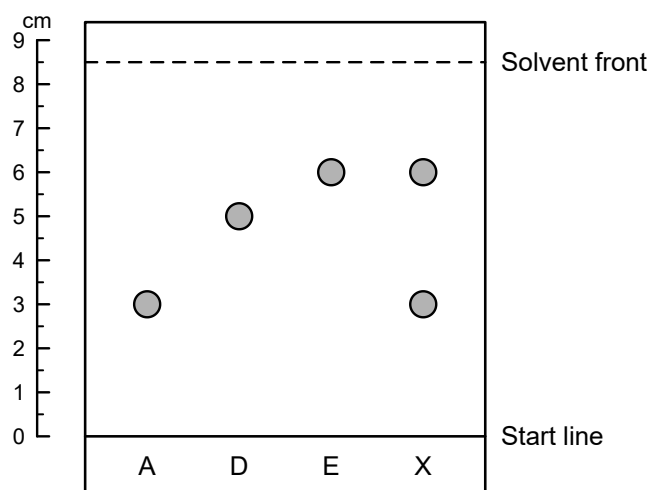
[1 mark]

0 6

A student used paper chromatography to compare an unknown mixture, X, with three reference dyes, A, D and E.

Figure 2 shows the chromatogram, drawn to scale.

Figure 2



0 6 . 1

Use Figure 2 to calculate the R_f value of dye E.

.....

.....

.....

.....

R_f value =

[2 marks]

0 6 . 2

Which of the reference dyes A, D and E are in mixture X?
Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 7

A student used paper chromatography to find out how many dyes are in a food colouring. The student put a spot of the food colouring on a pencil line 2 cm from the bottom of the paper. The student placed the paper in a beaker containing water to a depth of 1 cm and put a lid on the beaker.

0 7 . 1

Give **one** reason why the water must be below the pencil line.

.....

.....

[1 mark]

0 7 . 2

Give **one** reason why the student put a lid on the beaker.

.....

.....

[1 mark]

0 7 . 3

The water moved 7.5 cm from the pencil line. One dye moved 5.4 cm. Calculate the R_f value of this dye. Give your answer to 2 significant figures.

.....

.....

.....

.....

R_f value =

[2 marks]

0 7 . 4

One dye did not move from the pencil line. Suggest why.

.....

.....

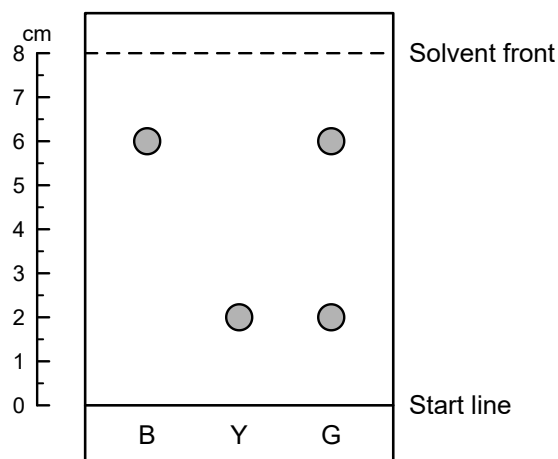
[1 mark]

0 8

A student analysed a green food colouring, G, by paper chromatography alongside a blue dye, B, and a yellow dye, Y.

Figure 3 shows the chromatogram, drawn to scale.

Figure 3



0 8 . 1

Use Figure 3 to calculate the R_f value of dye B.

.....

.....

.....

.....

R_f value =

[2 marks]

0 8 . 2

Use Figure 3 to identify the dyes in the green food colouring G.
Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 8 . 3

Suggest why dyes B and Y moved different distances up the paper.

[1 mark]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Chromatography · 32 marks

Question 1 (5 marks)

01.1 [1 mark]

Answer: Pencil does not dissolve in the solvent, but ink would dissolve and move up the paper.

- pencil (graphite) does not dissolve in the solvent / does not move up the paper, but ink would dissolve and separate (1)
-

01.2 [1 mark]

Answer: So that the dyes do not dissolve into the solvent in the beaker.

- so the dyes do not dissolve / wash into the solvent in the beaker (1)
-

01.3 [1 mark]

Correct: The solvent used

01.4 [1 mark]

Answer: The type of chromatography paper.

- type of paper / size of the dye spots / distance the solvent is allowed to travel / temperature / volume of solvent in the beaker (1)
-

01.5 [1 mark]

Answer: Keep the solvent away from naked flames.

- keep it away from naked flames / make sure no Bunsen burners are lit nearby (1)
-

Question 2 (2 marks)

02.1 [1 mark]

Correct: It is a mixture of at least four dyes

02.2 [1 mark]

- each dye has a different solubility in the solvent and a different attraction to the paper, so each moves a different distance up the paper (1)
-

Question 3 (3 marks)

03.1 [1 mark]

Answer: 3

- 3 / three (1)

03.2 [2 marks]

Answer: 0.63

- distance moved by B = 5.0 cm (1)
- (R_f =) $5.0 \div 8.0 = 0.63$ (1)

Notes: Allow 0.61–0.64.

Question 4 (4 marks)

04.1 [3 marks]

Answer: stationary; mobile; insoluble

- stationary (1)
- mobile (1)
- insoluble (1)

04.2 [1 mark]

- pencil (marks / graphite) does not dissolve in the solvent, so the start line does not move and interfere with the results (1)
-

Question 5 (4 marks)

05.1 [1 mark]

Correct: The solvent

05.2 [1 mark]

- pencil does not dissolve in the solvent / pencil will not move up the paper (1)

Notes: Allow 'ink would dissolve / separate and move up the paper'.

05.3 [1 mark]

Answer: 1

- 1 / one (in each solvent) (1)
-

05.4 [1 mark]

Answer: distance moved by substance ÷ distance moved by solvent

- (R_f =) distance moved by substance ÷ distance moved by solvent (1)
-

Question 6 (4 marks)

06.1 [2 marks]

Answer: 0.71

- distance moved by E = 6.0 cm and distance moved by the solvent = 8.5 cm (1)
- (R_f =) $6.0 \div 8.5 = 0.71$ (1)

Notes: Allow 0.69–0.72.

06.2 [2 marks]

Answer: A and E

- A and E (1)
- the spots in X are at the same heights as (have the same R_f values as) the spots of A and E (1)

Notes: Both letters are needed for the first mark. Max 1 mark if an extra letter is given.

Question 7 (5 marks)

07.1 [1 mark]

- so that the dyes do not dissolve into the water in the beaker (1)

Notes: Allow 'so the spot is not washed off the paper'.

07.2 [1 mark]

- to stop the water / solvent evaporating (1)
-

07.3 [2 marks]

Answer: 0.72

- $5.4 \div 7.5$ (1)
- 0.72 (1)

Notes: An answer of 0.72 scores 2 marks.

07.4 [1 mark]

- the dye is insoluble in water / in the solvent (1)
-

Question 8 (5 marks)

08.1 [2 marks]

Answer: 0.75

- distance moved by B = 6.0 cm and distance moved by the solvent = 8.0 cm (1)
- (R_f =) $6.0 \div 8.0 = 0.75$ (1)

Notes: Allow 0.73–0.77.

08.2 [2 marks]

Answer: B and Y

- B and Y (1)
 - the spots for G are at the same heights (have the same R_f values) as the spots for B and Y (1)
-

08.3 [1 mark]

- they have different solubilities in the solvent / different attractions to the paper, so they are distributed differently between the mobile and stationary phases (1)
-