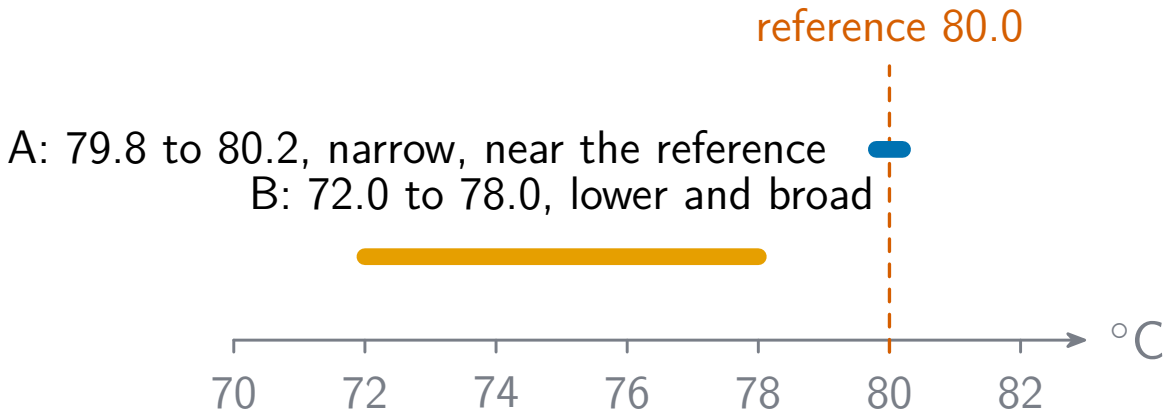
Exercise walk-through

8.1

Purity, formulations and chromatography (4.8.1.1–4.8.1.3)

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Figure: Purity and formulations



- A **pure substance** melts at one fixed temperature.
- Impurities lower and broaden the range.

Chromatography

- **Chromatography** separates the substances in a **mixture**.
- In paper **chromatography**, the paper is the **stationary phase**, which does not move, and the **solvent** is the **mobile phase**, which moves up through the paper.
- Each substance is shared between the two phases in a different way.
- A substance that is more attracted to the **solvent** moves further up the paper.

$$R_f = \frac{\text{distance from baseline to centre of spot}}{\text{distance from baseline to solvent front}}$$

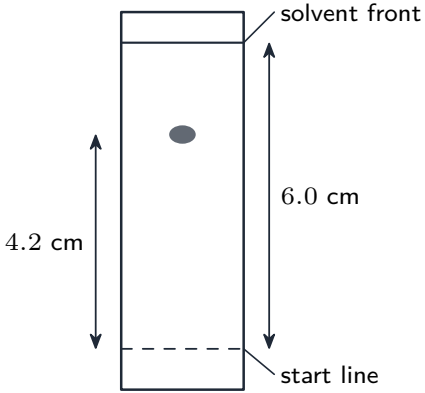
Identifying metal ions (chemistry only)

- **Flame tests.** For a **flame test** , dip a clean wire loop in the solid, hold it in a hot Bunsen flame, and observe the colour.
- Clean the loop between tests to avoid **contamination** .
- In a **mixture**, one colour can hide another: the strong yellow of sodium can mask the others.
- **Sodium hydroxide test.** Add a few drops of sodium hydroxide solution to a solution of the compound.

$$\mathrm{CuCl_2(aq) + 2NaOH(aq) \rightarrow Cu(OH)_2(s) + 2NaCl(aq)}$$

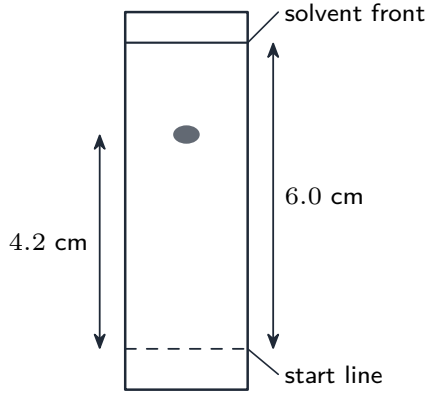
Exercise 2.1

2.1 Use the chromatogram to calculate the R_f value of the spot. [2]



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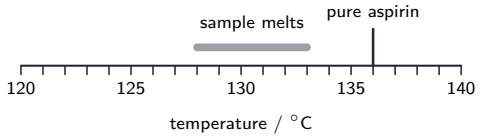


2.1

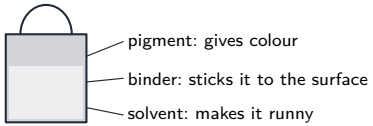
- $4.2 \div 6.0 = \mathbf{0.70}$

Exercises 2.2·2.3

2.2 Pure aspirin melts at 136 °C. The line shows the melting range of a student's sample. Is the sample pure? Explain your answer. [2]

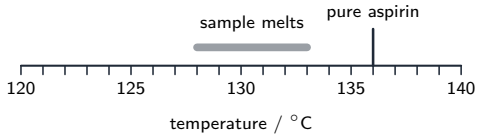


2.3 Explain why a paint is a formulation. [2]



Exercises 2.2·2.3

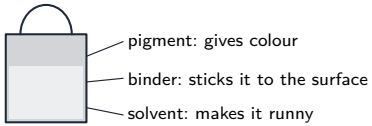
2.2 Pure aspirin melts at 136 °C. The line shows the melting range of a student's sample. Is the sample pure? Explain your answer. [2]



2.2

- no, it is impure; it melts over a range, below 136 °C

2.3 Explain why a paint is a formulation. [2]



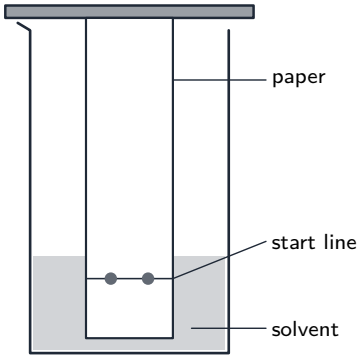
2.3

- it is a mixture made to a recipe for a use; each part is in a measured amount and has a job, e.g. pigment for colour

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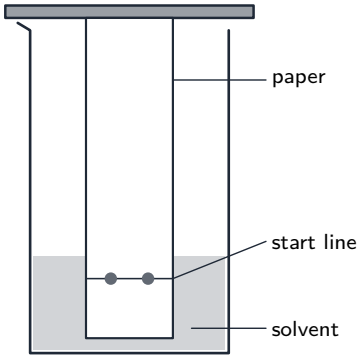
Exercise 3.1

3.1 The diagram shows how a student sets up paper chromatography. Explain why the start line is drawn in pencil, and why the solvent is below the start line. [3]



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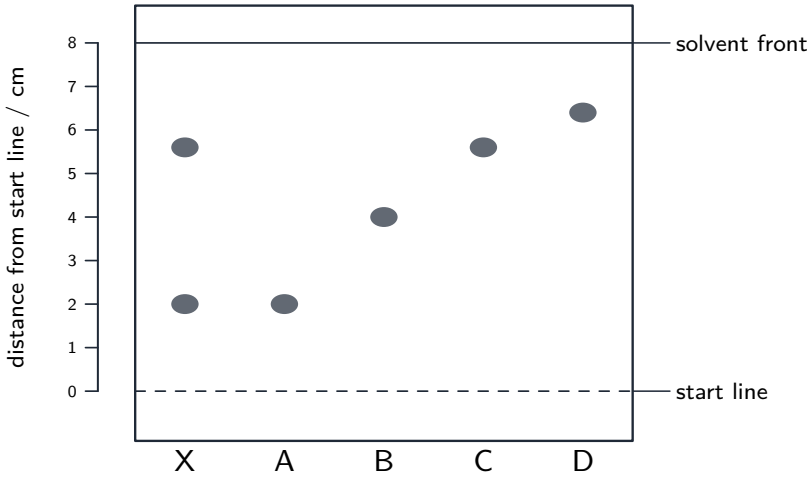
3.1

- pencil does not dissolve, so it does not move up the paper
- if the solvent were above the line, the spots would dissolve into the solvent in the beaker
- with the solvent below, it rises up the paper and carries the spots, so they separate

Exercise 3.2 (a)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

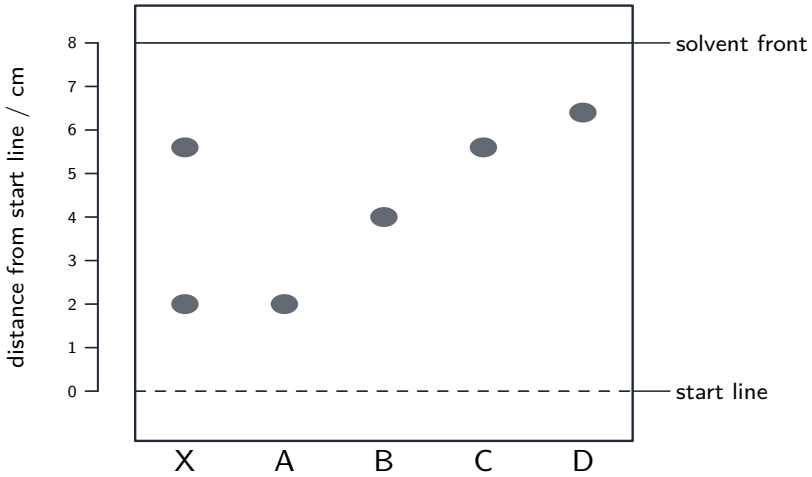
(a) Which dyes are in X? Explain your answer. [2]



Exercise 3.2 (a)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(a) Which dyes are in X? Explain your answer. [2]



(a) **A and C**; the spots of X are at the same heights as A and C

Exercise 3.2 (b)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(b) Use the scale to calculate the R_f value of dye B. [3]

Exercise 3.2 (b)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(b) Use the scale to calculate the R_f value of dye B. [3]

(b) B moved 4.0 cm; $4.0 \div 8.0 = \mathbf{0.50}$

Exercise 3.2 (c)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(c) Dye D has the largest R_f value. Explain why it moved furthest. [2]

Exercise 3.2 (c)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(c) Dye D has the largest R_f value. Explain why it moved furthest. [2]

(c) D is more soluble in the solvent; so it spends more time in the mobile phase and less time held by the paper

Exercise 3.2 (d)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(d) Describe how the student could carry out this experiment. [6]

Exercise 3.2 (d)

3.2 A food colouring X is compared with four known dyes A, B, C and D. The solvent front is 8.0 cm above the start line.

(d) Describe how the student could carry out this experiment. [6]

(d) points to include:

- draw a start line in pencil about 1 cm from the bottom of the paper
- put small spots of X and of A, B, C and D on the line, spaced apart
- stand the paper in a beaker with solvent below the start line, and cover it
- leave until the solvent has moved most of the way up
- take out the paper, mark the solvent front in pencil and let it dry
- compare the heights of the spots, or measure them and calculate R_f values

Levels: **5–6** a full, logical answer with correct chemistry and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.