Exercise walk-through

Thin-layer chromatography ▪ 37.1

eXercise

You must be able to

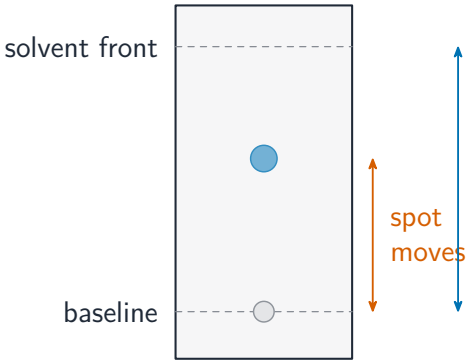
- identify the stationary and mobile phases in TLC
- calculate an R_f value
- explain why one component has a smaller R_f than another

Method — The R_{f} value

$$R_\mathrm{f} = \frac{\text{distance moved by the spot}}{\text{distance moved by the solvent front}}$$

- **stationary phase** stays still (e.g. aluminium oxide on a plate); **mobile phase** is the solvent that moves up.
- R_f is always between 0 and 1.
- a substance that sticks more strongly to the stationary phase (or is less soluble in the mobile phase) moves **less** $\rightarrow$ **smaller** R_f.

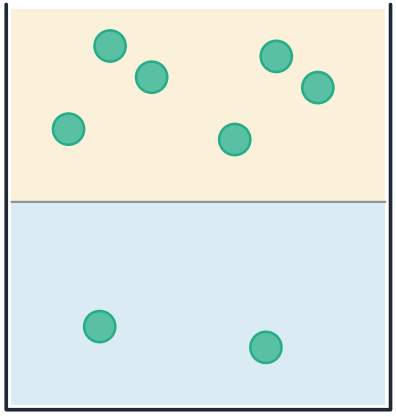
Method — The R_{f} value



$$R_{\text{f}} = \frac{\text{distance moved by the spot}}{\text{distance moved by the solvent}}$$

always between 0 and 1

Method — The R_{f} value



solvent 1 (non-polar)

$$K_{\text{pc}} = \frac{[\text{solute in 1}]}{[\text{solute in 2}]}$$

solvent 2 (water)

TLC separates by partition between phases

Practice 2.1 ▪ 1 mark

Name the stationary phase commonly used in TLC.

Solution 2.1

Method: The R_{f} value

Worked steps

aluminium oxide (alumina) / silica on a plate B1.

Practice 2.2 ▪ 1 mark

A spot moves 3.6 cm; the solvent front moves 4.8 cm. Calculate its R_f.

Solution 2.2

Method: The R_{f} value

Worked steps

$R_{\text{f}} = 3.6/4.8 = 0.75$ **B1**.

Exam-style 3.1 ▪ 1 mark

An R_f value can never be:

A 0.2

B 0.85

C 1.4

D 0.5

Solution 3.1

A 0.2

B 0.85

C 1.4 ✓

D 0.5

Worked steps

C. R_f is always between 0 and 1, so 1.4 is impossible.

Exam-style 3.2 ▪ 1 mark

A component with a **smaller** R_f value:

A is more soluble in the mobile phase

B sticks more strongly to the stationary phase

C moves further up the plate

D has no interaction with the plate

Solution 3.2

Method: The R_{f} value

A is more soluble in the mobile phase

B sticks more strongly to the stationary phase ✓

C moves further up the plate

D has no interaction with the plate

Worked steps

B. A smaller R_f means it sticks more strongly to the stationary phase and moves less.

Exam-style 3.3 ▪ 2 marks

On a TLC plate, a spot travels 2.1 cm while the solvent front travels 6.0 cm.
(a) Calculate the R_f value.
(b) State what a low R_f suggests about how strongly the component binds to the stationary phase.

Solution 3.3

Method: The R_{f} value

Worked steps

(a) $R_{\text{f}} = \dfrac{2.1}{6.0}$ **M1** $= 0.35$ **A1**.

(b) it binds (adsorbs) strongly to the stationary phase **B1**.

Exam-style 3.4 ▪ 2 marks

Explain why two components of a mixture separate on a TLC plate.

Solution 3.4

Worked steps

the components have different affinities for the stationary and mobile phases (M1); so they travel up the plate at different rates and end at different heights, giving different R_f values (A1).