

Exercise walk-through

Partition coefficients ■ 25.2

eXercise

You must be able to

- state what a partition coefficient is
- calculate and use a partition coefficient
- explain how solute and solvent polarity affect its value

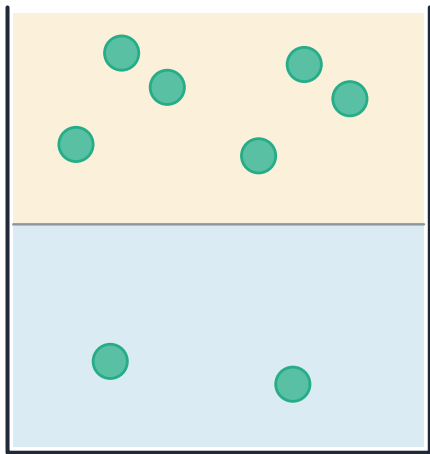
Method — Partition coefficient

The **partition coefficient** K_{pc} is the ratio of the concentrations of a solute in two immiscible solvents at equilibrium (the solute in the same physical state in both):

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

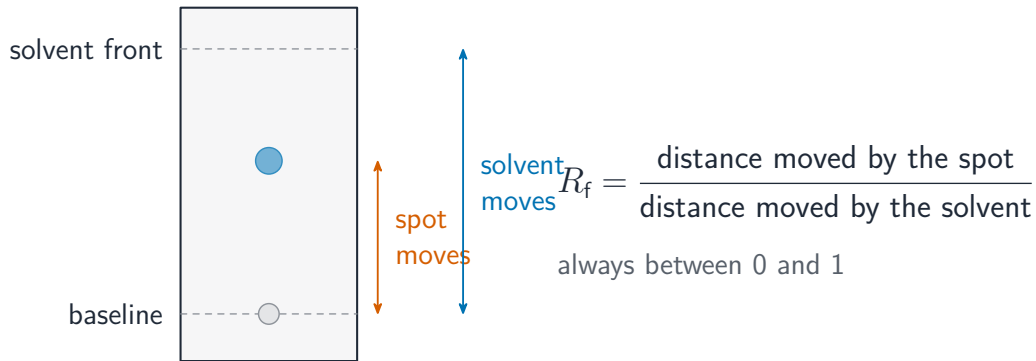
A solute dissolves better in the solvent of **similar polarity** (“like dissolves like”), so the value depends on the polarities of the solute and the two solvents.

Method — Partition coefficient



$$K_{pc} = \frac{\text{solvent 1 (non-polar)} \quad [\text{solute in 1}]}{\text{solvent 2 (water)} \quad [\text{solute in 2}]}$$

Method — Partition coefficient



Chromatography separates by partition

Practice 2.1 ■ 1 mark

State what a partition coefficient measures.

Solution 2.1

Method: Partition coefficient

Worked steps

the ratio of the concentrations of a solute distributed between two immiscible solvents at equilibrium **B1**.

Practice 2.2 ■ 1 mark

State the rule that decides which solvent a solute prefers.

Solution 2.2

Method: Partition coefficient

Worked steps

“like dissolves like” — a solute prefers the solvent of similar polarity **B1**.

Exam-style 3.1 ■ 1 mark

A non-polar solute is shaken with water and hexane (a non-polar solvent). It will mostly be found in:

- A** the water
- B** the hexane
- C** equally in both
- D** neither

Solution 3.1

Method: Partition coefficient

- A the water
- B the hexane
- C equally in both
- D neither



Worked steps

B. A non-polar solute dissolves better in the non-polar hexane.

Exam-style 3.2 ■ 1 mark

The partition coefficient depends on:

- A** the temperature only
- B** the polarities of the solute and the two solvents
- C** the volume of the container
- D** the colour of the solute

Solution 3.2

Method: Partition coefficient

- A the temperature only
- B the polarities of the solute and the two solvents** 
- C the volume of the container
- D the colour of the solute

Worked steps

- B.** It depends on the polarities of the solute and the solvents.

Exam-style 3.3 ■ 1 mark

A solute is shaken with equal volumes of two immiscible solvents. At equilibrium its concentration is 0.80 mol dm^{-3} in solvent A and 0.20 mol dm^{-3} in solvent B.

- (a) Calculate the partition coefficient $K_{\text{pc}} = \frac{[\text{A}]}{[\text{B}]}$.
- (b) State, with a reason, which solvent the solute dissolves in better.

Solution 3.3

Method: Partition coefficient

Worked steps

(a) $K_{pc} = 0.80/0.20 = 4.0$ **B1**.

(b) solvent A **M1**; the higher concentration shows the solute is more soluble in A (it is of more similar polarity) **A1**.

Exam-style 3.4 ■ 2 marks

Explain why a polar solute has a higher concentration in water than in hexane.

Solution 3.4

Worked steps

a polar solute and water can form strong interactions (e.g. hydrogen bonds / dipole-dipole) **M1**; hexane is non-polar and cannot, so the solute prefers the water **A1**.