A-LEVEL CHEMISTRY • EXERCISE SHEET

# 37.2 Gas/liquid chromatography

Name: ____________ Class: ________ Date: __________ **Total: 21 marks**

**KEY WORDS** retention time 保留时间 • mobile phase 流动相 • stationary phase 固定相 • gas/liquid chromatography 气液色谱 • chromatography 色谱

## Objective

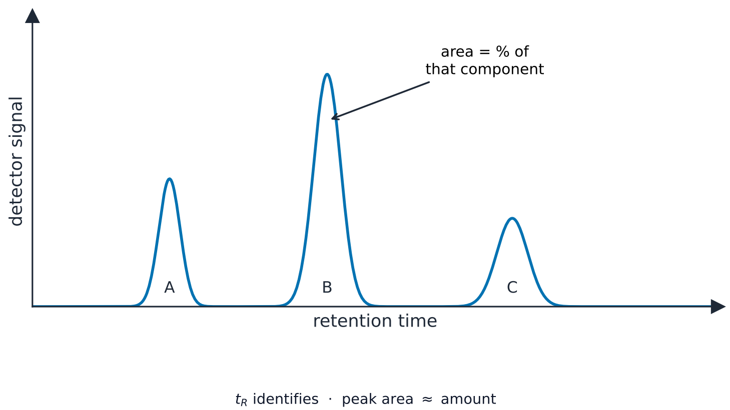
Build the skills to answer exam questions on **gas/liquid chromatography** 气液色谱 (GLC) — the phases, **retention time** 保留时间, and reading peak areas.

**You must be able to:**

- identify the stationary and mobile phases in GLC
- explain what retention time depends on
- use peak areas to find the composition of a mixture

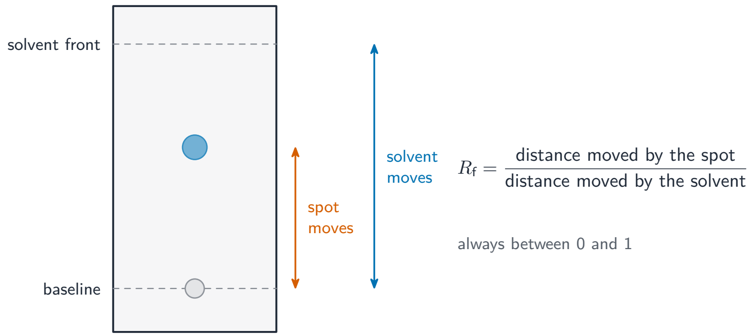
## 1 Worked examples

### Reading a chromatogram




*Each component gives a peak at its own retention time; the peak area is its percentage in the mixture*






*GLC alongside TLC as a chromatographic method*

- **stationary phase:** a high-boiling non-polar liquid on a solid support; **mobile phase:** an unreactive carrier gas.
- **retention time** = how long a component takes to pass through; more interaction with the stationary phase → **longer** retention time.
- **peak area** = the proportion (percentage) of that component.

## 2 Practice

**2.1** Name the mobile phase in GLC. [1]

**2.2** State what the **area** of a GLC peak tells you. [1]

## 3 Exam-style questions

**3.1** In GLC, a component that interacts **more** with the stationary phase has a: [1]

- **A** shorter retention time
- **B** longer retention time
- **C** larger $R_f$
- **D** smaller peak area

**3.2** The **percentage** of each component in a mixture is found from the: [1]

- **A** retention time
- **B** number of peaks
- **C** area under each peak
- **D** height of the baseline

**3.3** A GLC trace of a three-component mixture has peak areas 5, 3 and 2 units.

(a) Calculate the percentage of the first component. [2]

(b) State which component left the column **last**, given it interacted most with the stationary phase. [1]

**3.4** Explain why different components of a mixture have different retention times. [2]



**3.5** A mixture of three alcohols is analysed by gas/liquid chromatography. The chromatogram shows three peaks.

| **Peak** | **Retention time / min** | **Peak area / arbitrary units** |
|---|---|---|
| 1 | 1.8 | 132 |
| 2 | 3.4 | 396 |
| 3 | 5.9 | 132 |

(a) Name the mobile phase and the stationary phase in GLC, and state what each does. [3]

(b) Calculate the percentage composition of the mixture, stating the assumption you are making. [3]

(c) Explain why the component of peak 3 has the longest retention time. [3]

(d) The three peaks alone cannot identify the alcohols. Explain why, and name one technique that can be coupled to GLC to solve this. [3]

## Solutions

**2.1** an unreactive carrier gas.

**2.2** the percentage (proportion) of that component in the mixture.

**3.1 B**. More interaction with the stationary phase → longer retention time.

**3.2 C**. The area under each peak gives the percentage.

**3.3** (a) total area $= 5 + 3 + 2 = 10$; first component $= \frac{5}{10} \times 100 = 50\%$.
(b) the component with the **longest** retention time / smallest $R_f$-type behaviour — the one that interacts most strongly.

**3.4** each component interacts to a different extent with the stationary phase; the more it interacts, the more it is held back, so it takes longer to pass through.

**3.5** (a) The mobile phase is an **inert carrier gas** such as nitrogen or helium, which sweeps the vaporised sample through the column; the stationary phase is a high-boiling **liquid** coated on an inert solid support; components separate because each spends a different fraction of its time dissolved in the liquid rather than moving with the gas.
(b) Total area $= 132+396+132 = 660$; peak 1 $= \frac{132}{660} = 20\%$, peak 2 $= \frac{396}{660} = 60\%$, peak 3 $= 20\%$. The assumption is that the **detector responds equally** to each component, so peak area is proportional to the amount present.
(c) That component is the most soluble in the liquid stationary phase, or has the strongest intermolecular attraction to it; it therefore spends the greatest fraction of its time dissolved and the least moving with the carrier gas; so it takes longest to reach the detector.
(d) A retention time is only characteristic **under identical conditions** — column, temperature and flow rate — and two different compounds can share one, so a peak alone names nothing. Coupling the column to a **mass spectrometer** (GC–MS) gives each peak a fragmentation pattern that identifies it.