

Optional command challenges for teams who have escaped. Crack any of them and enter the answer on the escape screen. No calculators needed.

1 Solvent Showdown

The same three dyes were run in three solvents. These are their R_f values.

No.	Solvent	Dye X	Dye Y	Dye Z
1	Water	0.40	0.40	0.75
2	Ethanol	0.00	0.35	0.60
3	Propanone	0.20	0.50	0.80

Best solvent for separating all three ☐

Solvent where one dye did not move ☐

Solvent where two dyes would look like one spot ☐

3 Purity Check

pure = 1 · impure = 2. Impure samples melt **lower** and over a **range**.

1. Water (pure melts at 0 °C) melts between -4 and -1 °C. ☐

2. Paracetamol (pure melts at 169 °C) melts sharply at 169 °C. ☐

3. Benzoic acid (pure melts at 122 °C) melts between 114 and 119 °C. ☐

4. Sulfur (pure melts at 115 °C) melts sharply at 115 °C. ☐

2 Liquid Air

Air is cooled until it is a liquid, then warmed slowly in a fractionating column. Each gas boils off at its own boiling point.

Label	Gas	Boiling point / °C
8	Oxygen	-183
6	Nitrogen	-196
1	Krypton	-153
3	Argon	-186

In what order do they boil off?

ORDER → → →

4 Route Planner

A flask holds **iron filings, sand, salt and water**. Get **all four back, including the water**.

4 Using a magnet

7 Filtration

2 Simple distillation

3 Fractional distillation

9 Crystallisation

5 Chromatography

Some techniques are decoys. Choose the ones you need, in order.

ORDER → →

Optional command challenges for teams who have escaped. Crack any of them and enter the answer on the escape screen. No calculators needed.

1 Solvent Showdown

The same three dyes were run in three solvents. These are their R_f values.

No.	Solvent	Dye X	Dye Y	Dye Z
1	Propanone	0.10	0.45	0.85
2	Water	0.55	0.55	0.30
3	Ethanol	0.20	0.00	0.70

Best solvent for separating all three ☐

Solvent where one dye did not move ☐

Solvent where two dyes would look like one spot ☐

2 Liquid Air

Air is cooled until it is a liquid, then warmed slowly in a fractionating column. Each gas boils off at its own boiling point.

Label	Gas	Boiling point / °C
7	Argon	−186
9	Krypton	−153
2	Nitrogen	−196
4	Oxygen	−183

In what order do they boil off?

ORDER → → →

3 Purity Check

pure = 1 · impure = 2. Impure samples melt **lower** and over a **range**.

1. Naphthalene (pure melts at 80 °C) melts sharply at 80 °C. ☐

2. Stearic acid (pure melts at 69 °C) melts between 61 and 66 °C. ☐

3. Ice made from sea water (pure ice melts at 0 °C) melts between −3 and −1 °C. ☐

4. Sucrose (pure melts at 186 °C) melts sharply at 186 °C. ☐

4 Route Planner

A flask holds **sand, iron filings, ethanol and water**. Get all four back, separately.

8 Using a magnet

1 Filtration

6 Fractional distillation

3 Simple distillation

5 Crystallisation

9 Chromatography

Some techniques are decoys. Choose the ones you need, in order.

ORDER → →