Paper chromatography of coloured mixtures

YEAR 10 · LESSON 7 · Pearson Edexcel International GCSE (9–1)

Name _____ Class _____ Date _____

Chemistry (Single Award) / Science (Double Award) · 1.10 (paper chromatography only; partial coverage), 1.11, 1.12 and 1.13

Opening question
Which reference dyes could be present in a mixture, based on spot colour and Rf on the same chromatogram? What would this evidence not prove?

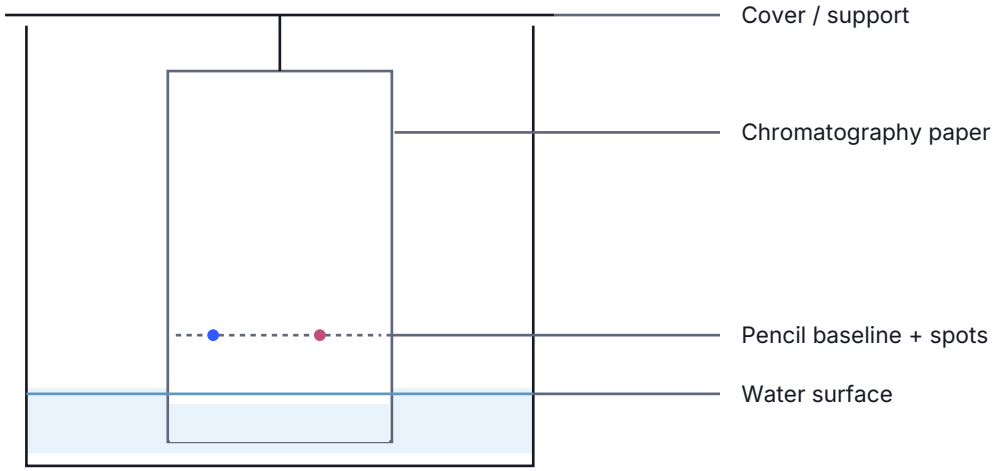
Many inks and food colourings contain several dyes. Separate water-soluble samples side by side on chromatography paper using water, then mark the solvent front immediately and calculate Rf values for clear spots. Compare results cautiously: a colour/Rf match supports a possible identity, not proof.

Equipment · per group

Chromatography paper cut to fit; 100 cm³ or 250 cm³ beaker; watch glass or Petri-dish lid; splint/rod and paper clips or equivalent support; HB pencil; millimetre ruler; separate clean capillary or spotter per sample; distilled/deionised water; teacher-issued water-soluble inks and/or food colourings, including at least one mixture, plus suitable reference dyes for the same-paper run; drying tray/paper towel; eye protection; access to a glass/sharps bin.

Safety · before you begin
Wear eye protection. Use **water only** with the issued water-soluble samples. Do not taste inks, dyes or sweets. Dyes stain: wipe spills and wash hands. Handle capillaries carefully; tell your teacher about broken glass and never pick it up with your fingers. No unshielded UV viewing. Follow your teacher's instructions.

Check the setup before starting



Setup schematic (not to scale). The lower edge dips into water; the pencil baseline and all starting spots stay above the water. Paper hangs clear of the beaker walls.

One careful class run is the default. Repeat only if needed or if your teacher directs you. Read the full method on page 2 before you begin.

Method · one water-run chromatogram

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1. Handle the chromatography paper by its edges. Check that it fits inside the empty beaker, hanging vertically near the bottom without touching the walls.

2. Use **pencil** to rule a baseline about **2 cm** above the lower edge. Mark evenly spaced crosses on it, well away from the paper edges. Label each sample in pencil **beside** its cross, not underneath the spots.

3. Spot actual water-soluble inks and/or food colourings, including a suitable mixture, plus known suitable references on the same paper. Use a separate clean spotter per sample; make each spot a few millimetres across. Let it dry. Re-apply once or twice if needed, keeping it small. Do not let spots merge.

4. Add **water only** to the beaker, to about **1 cm depth**. Check that the solvent surface will be below the baseline and all starting spots. Cover the beaker.

5. Hang the paper with its lower edge in the water, baseline and spots **above the water**, and paper clear of the walls. Replace the cover. Keep the beaker still.

6. When the solvent front approaches the top but is still below the paper edge, remove the paper. **Immediately mark the solvent front in pencil across the paper.**

7. Let the paper dry on the tray. Lightly outline suitable clear spots and mark their centres. Keep the dried chromatogram as your primary record.

8. For each clear, resolved spot, measure from the baseline to its centre and from the baseline to the corresponding solvent front, in millimetres. Use the same measurement direction. If a spot is streaked or unresolved, record that rather than inventing a centre.

9. Calculate Rf = distance to spot centre ÷ distance to solvent front. It has no unit. For a suitable run, values lie from 0 to 1; clear migrated spot centres below the front give $0 < Rf < 1$.

10. Compare spot colour and Rf with references on the **same paper**. A match supports a possible identity; it does not prove it. If no suitable references are available, describe the separation without claiming an identity.

Teacher demonstration · watch and record

Observe the pre-run circular chromatogram. What separated? If multiple rings are visible, what does that support? Why would a single ring not prove purity? Use two key words: chromatogram, dissolve, soluble, solvent, mixture.

Cleanup

Keep your dried chromatogram as instructed. Follow local disposal rules: water with traces of food dye may normally go to the sink with running water if permitted; ask your teacher about ink waste. Broken capillaries go in the glass/sharps bin, not general waste. Rinse beakers, wipe the bench and wash hands.

Results · keep the actual chromatogram

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Solvent: water. Date/time: _____ Paper type: _____
Record one row per clear spot. For streaks or unresolved spots, write “not reliably measurable”. Do not invent distances, centres, identities or extra spots.

Sample / lane	Spot colour	Baseline → centre / mm	Baseline → front / mm	Rf (2 d.p.)	Possible reference match

Sketch your actual chromatogram. Label baseline, sample lanes, spots/centres and solvent front; or attach the dried paper without covering the table.

Calculate from suitable clear spot centres

Rf = distance from baseline to spot centre ÷ distance from baseline to solvent front
Both distances use the same unit; Rf has no unit. Use the solvent-front position in the same lane/direction. A spot at the baseline has Rf = 0; a clear spot centre below the front has 0 < Rf < 1. Do not force a result into range: check the measurements or repeat if the run is unsuitable.

My calculation for one spot: Rf = _____ mm ÷ _____ mm = _____

Run the actual water-soluble samples, including a mixture. Any separate labelled comparison-data exercise is supplementary only and must state matching paper, solvent and other conditions; do not present it as your measured results.

Analysis · composition and identification

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1. Which samples produced more than one resolved spot? Which showed only one? Use evidence, and explain why one visible spot does not prove a pure substance.

2. Which reference dyes could match spots in the mixture, using both colour and Rf on the same paper? If none match, say so. Discuss how measurement uncertainty affects your judgement; do not assume a universal matching tolerance.

3. Show a calculation using your own suitable measurements. Why does Rf have no unit? Why should a clear spot centre below the solvent front give Rf less than 1?

4. Why must the baseline and sample labels be drawn in pencil, not ink? Why put labels beside the starting spots?

Analysis · method and evaluation

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5. Why must the starting spots stay above the water? Why mark the solvent front immediately after removing the paper?

6. Explain why different dyes travel different distances, using solubility in the water and attraction to the paper. Avoid saying a dye “likes” a phase.

7. Why compare Rf only with the same solvent, paper and other relevant conditions? Why is a reference lane on the same paper helpful?

8. Why do matching colour and Rf in one solvent support only a possible identity? What further evidence could test the suggestion?

9. Predict the effects of (a) starting spots that are too large, (b) paper touching the beaker wall and (c) an ink that is not water-soluble. Which faults would justify repeating the run?

Evidence check: a single visible spot may conceal co-migrating components or components that are not detected. Keep claims proportionate to what your run actually shows.