Serial dilution of a coloured solution

YEAR 10 · LESSON 2 · Pearson Edexcel International GCSE (9–1)

Name _____ Class _____ Date _____

Chemistry (Single Award) / Science (Double Award) · 1.3 (dilution strand); 1.4 (solute, solvent, solution only)
1.5C theory extension: Chemistry only — not Double Award

Opening question
How far can you dilute a coloured solution before its colour is no longer visible, and what does this suggest about the amount of dye in each tube?

A concentrated solution contains a larger amount of dye in each small volume. Make a ten-fold serial dilution, mix each tube, and record colour against a white background. Colour is not a view of individual particles, and this deliberately mixed series is not a demonstration of diffusion or saturation.

Equipment · per group

8 test tubes and rack; 10 cm^3 measuring cylinder; **9 fresh, dry, graduated 1 cm^3 transfer devices** (pipettes with fillers, or syringes); about 80 cm^3 water; teacher-issued water-soluble food dye; white paper/tile; eye protection; coloured pencils; paper towels; labelled waste vessel and sink access.

Safety · before you begin
Wear eye protection. Use a filler with a pipette; never mouth-pipette. Syringes do not need fillers. Never taste or drink laboratory materials. Dye can stain: avoid skin contact, wipe spills and tell your teacher. Keep tubes in the rack. Report broken glass and do not pick up shards. No heating.

Method · measure, swirl, transfer

1. Label eight clean test tubes 1–8 and stand them in a rack. Add **9 cm^3 water** to each tube.

2. With a **fresh, dry, graduated 1 cm^3 device**, add **1 cm^3 issued food dye** to tube 1. Mix thoroughly by **gentle swirling only**, without adding water. Tube 1 now contains 10 cm^3.

3. Using a new fresh, dry, graduated device, transfer exactly **1 cm^3 mixed solution from tube 1 to tube 2**. Gently swirl tube 2 thoroughly. Repeat in order through tube 8, using a fresh, dry device for each different donor. Mix before every transfer.

4. Do not rinse and reuse devices during this series. Keep the series free of extra water or extra draws. Do not return used or leftover liquid to stock or an earlier tube. The first eight devices cover stock → 1 and the seven transfers between tubes.

5. After mixing tube 8, use the **ninth fresh, dry, graduated device** to remove **1 cm^3 to the labelled waste vessel**. All eight tubes finish at a **nominal 9 cm^3**. This final discard is required. With issued dye = 1, ideal relative concentrations run from 10^{-1} (tube 1) to 10^{-8} (tube 8).

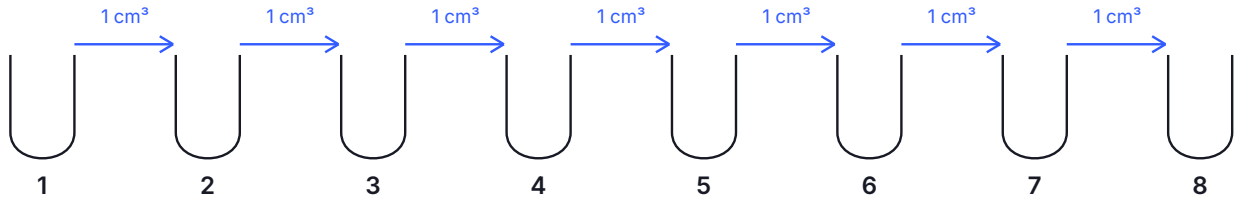
6. View all tubes against the same white background with similar lighting and viewing direction. Record colour and visibility on page 2. Accept an early loss of visible colour; do not expect eight distinct shades.

Record your serial dilution

YEAR 10 · LESSON 2 · Pearson Edexcel International GCSE (9–1)

Record only your own observations. Use “yes”, “faint” or “no” for visible colour; the first tube may already be faint. A visual colour change is not a direct observation of individual particles.

TRANSFER SCHEMATIC — not an observed colour series; not to scale



Start: 9 cm³ water in every tube. Add 1 cm³ issued dye to tube 1. Mix before every transfer. After mixing tube 8, discard 1 cm³ from it to the labelled waste vessel: all tubes finish at 9 cm³.

Tube	Transferred / cm³ (source)	Water added / cm³	Relative concentration[1]	Colour description / pencil sketch	Visible?
1	1, issued dye	9	10^{-1}		
2	1, tube 1	9			
3	1, tube 2	9			
4	1, tube 3	9			
5	1, tube 4	9			
6	1, tube 5	9			
7	1, tube 6	9			
8	1, tube 7	9			

[1] Issued dye = 1. Complete the concentration column using a factor of 1/10 at each step. Volumes are preparation instructions, not measured results. Every tube finishes at a nominal 9 cm³.

A. Show why concentration is multiplied by 1/10 at each transfer. Find tube 3’s concentration relative to the issued dye.

B. First tube with no visible colour (or “none”): _____. First tube difficult to distinguish from water: _____. Note any uncertainty.

Cleanup

Only if your teacher permits, rinse dilute food-dye waste down the sink with plenty of water. Rinse/return equipment, wipe benches and wash hands. Report broken glass; use the glass bin.

Explain and evaluate

YEAR 10 · LESSON 2 · Pearson Edexcel International GCSE (9–1)

1. Use your results to compare dye concentration in a later tube with tube 1. If the colour disappeared earlier than expected, report it honestly. Does no visible colour establish that no dye remains?

2. Has dilution destroyed dye particles? Explain fading using particle ideas, while distinguishing your observations from your explanation.

3. Why use the same white background and viewing conditions? Why must every tube be mixed before sampling?

4. Why use fresh, dry devices and gentle swirling without adding water? Why discard 1 cm^3 from mixed tube 8 to waste?

5. Identify the solute, solvent and solution in this food-dye practical. Use the terms correctly in one sentence.

6. Why is this mixed series not a demonstration of diffusion? In words only, explain how gas particles could spread a smell through a room. No gas-diffusion experiment was performed here.

7. THEORY EXTENSION · CHEMISTRY ONLY · 1.5C · not Double Award. Define solubility in g per 100 g of solvent at a stated temperature. No solubility measurement was made in this practical.