From detection to estimation

A qualitative test asks whether reducing sugar is detected. A semi-quantitative test estimates its concentration by comparing an unknown with known standards.

TWO WAYS TO COMPARE THE SAME REACTION

A. FIXED-TIME COLOUR

Heat every tube for the same time, then compare the final appearance with standards.

B. TIME TO FIRST CHANGE

Use the same visible endpoint for every tube, then compare how long it takes to reach it.

Both require known concentrations tested under the same conditions as the unknown.

1. USE A RANGE OF STANDARDS

Prepare several known reducing sugar concentrations that span the likely unknown. Include a zero-sugar blank. Test standards and unknown with the same reagent batch and method. For a glucose solution, calibrate with glucose; different reducing sugars need not give identical responses.

2. KEEP THE COMPARISON FAIR

Control the sample volume, Benedict's reagent volume and concentration, water-bath temperature, tube dimensions and mixing. Standardise sample preparation and initial temperature. For the colour method, fix heating time; for the timing method, time to the same defined endpoint.

3. REPORT AN ESTIMATE, NOT FALSE PRECISION

Blue is a negative result under the test conditions. Positive tests may appear green, yellow, orange or brick-red. These colours are not universal concentration labels: compare with standards made in the same experiment. A colour match usually supports an approximate value or interval.

Scope: Cambridge Biology 9700 syllabus, section 2.1, outcome 2, p. 17.

Build a useful comparison scale

Worked preparation example: make 10 cm³ of each standard from a 2.0% (mass/volume) glucose stock. These are concentrations before adding Benedict's reagent.

DILUTION: THE AMOUNT OF GLUCOSE IS CONSERVED

$$C_{stock}V_{stock} = C_{final}V_{final}$$

For 0.5%: V_{stock} = (0.5% × 10 cm³) / 2.0% = 2.5 cm³

Use 2.5 cm³ stock and 7.5 cm³ water; mix thoroughly.

FINAL GLUCOSE / %	STOCK / cm³	WATER / cm³
0.0	0.0	10.0
0.5	2.5	7.5
1.0	5.0	5.0
1.5	7.5	2.5
2.0	10.0	0.0

COMPARE COLOURS AFTER IDENTICAL HEATING

Use equal portions of each standard and the unknown. Add equal volumes of Benedict's solution, mix and heat in the same controlled bath for a fixed time. Compare at the same point after heating, with consistent lighting, background and mixing or settling.

INTERPRET THE MATCH

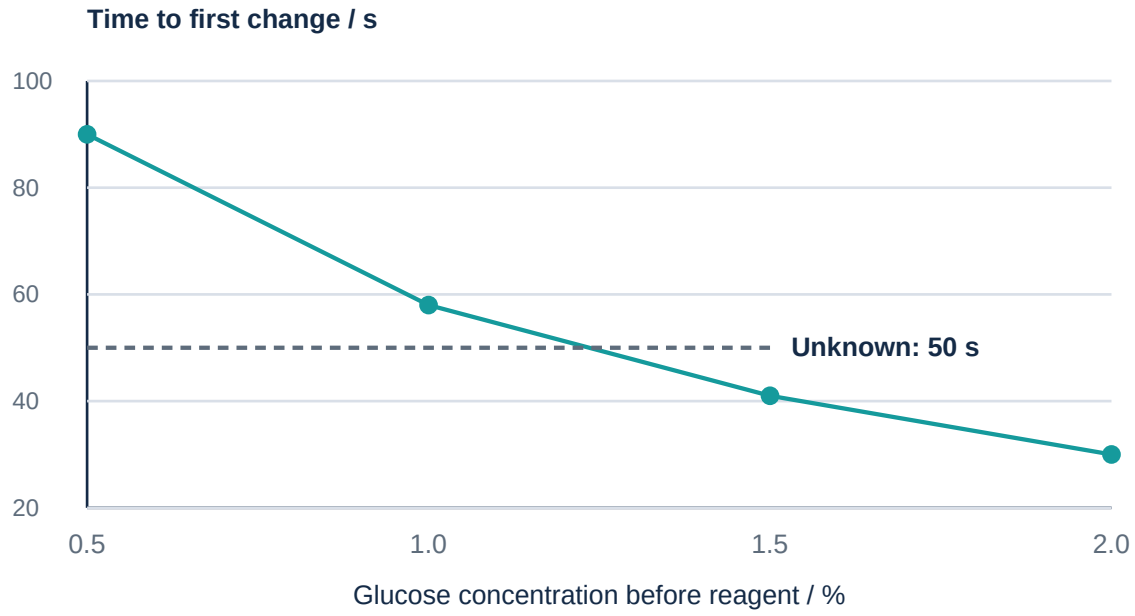
Illustrative result: the unknown lies between the appearances of the 0.5% and 1.0% standards. Report approximately 0.5-1.0%, not automatically 0.75%. Prepare closer standards to narrow the interval. If outside the scale, extend it or dilute and retest.

Scope: Cambridge Biology 9700 syllabus, section 2.1, outcome 2, p. 17.

Use time as the comparison

Within a calibrated range, a higher reducing sugar concentration usually reaches the first visible colour change sooner. Establish the relationship with standards; do not assume an inverse formula.

ILLUSTRATIVE DATA: NOT A UNIVERSAL CALIBRATION



Standards: 0.5% → 90 s; 1.0% → 58 s; 1.5% → 41 s; 2.0% → 30 s.

1. MEASURE A CONSISTENT ENDPOINT

Define the first visible departure from blue before starting. Use the same timing start event, observer and viewing conditions. Repeat each standard and unknown, inspect anomalous readings and use a representative mean time.

2. READ WITHIN THE MEASURED RANGE

Here, 50 s falls between 58 s and 41 s, so the unknown is approximately 1.0-1.5%. A calibration curve can refine an estimate if justified by the data. Do not extrapolate beyond the standards or treat no change as zero seconds.

Dilution correction: if the unknown was diluted fivefold and its diluted value is 0.8%, the original estimate is 0.8% × 5 = 4.0%. Correct for pre-dilution, not reagent addition shared by standards and unknown.

Safety: use eye protection and suitable holders for hot tubes. Follow the approved water-bath procedure and reagent handling instructions.

Scope: Cambridge Biology 9700 syllabus, section 2.1, outcome 2, p. 17.