IGCSE BIOLOGY 0610 · ATP SHORTCUTS · ~11 MIN READ

Biology ATP Shortcuts (Paper 6)

The practical skills sheet: biological drawings, magnification, variables, tables and graphs, the classic practicals and how to plan and evaluate. Written for the practical and alternative-to-practical papers.

Drawing | Magnification | Variables | Graphs | Practicals | Planning | Evaluating

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No tag = **Core** (everyone) EXTENDED Extended only highlight = comes up again and again

HANDY worth memorising Test yourself at the end

IN 30 SECONDS

- **Drawings, calculations and graphs** are the easiest marks in the practical paper. Follow the rules every time: large, pencil, clear lines, labels ruled and touching.
- **Magnification = image size ÷ actual size.** Convert to the same unit first: 1 mm = 1000 µm.
- **Planning and evaluating** use the independent, dependent and control variables with numbers, repeats and a way to reach a conclusion.

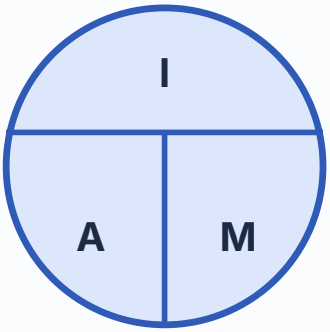
1 Drawing and magnification

Biological drawings

- **Use a sharp pencil** and draw large, using more than half the space available. Do not shade or colour.
- **Draw clear, continuous lines.** Draw only what you can see, in the correct proportions, not what you expect to see.
- **Label lines are ruled,** do not cross each other, and touch the part. Do not use arrows. Write labels in pencil, horizontally, beside the drawing.
- **Give the drawing a title** and say whether it is a plan (outlines of tissues only, no cells) or a detailed drawing of cells.
- **Take your measurement** from the drawing with a ruler, in millimetres. Measure the same line on the specimen.

Magnification

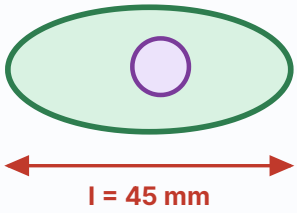
cover the one you want



I = size of the image (the drawing)
A = actual size of the specimen
M = magnification

M = I ÷ A **I = A × M** **A = I ÷ M**

Use the same units for I and A: 1 mm = 1000 µm



A = 0.15 mm
M = 45 ÷ 0.15
= ×300
(no units)

Cover the quantity you want to find. If I is the drawing and A is the real specimen, then M tells you how many times bigger the drawing is.

- **Convert to the same units first.** 1 mm = 1000 µm, so 0.15 mm = 150 µm.
- **Magnification has no units.** Write it as ×300, not 300 mm.

WORKED EXAMPLE

A drawing of a cell is 54 mm long. The actual cell is 0.06 mm long. Find the magnification.

1. M = I ÷ A = 54 ÷ 0.06
2. **= ×900**

WORKED EXAMPLE

A cell is drawn 72 mm long at a magnification of ×600. Find the actual length in µm.

1. A = I ÷ M = 72 ÷ 600 = 0.12 mm
2. **0.12 mm × 1000 = 120 µm**

WORKED EXAMPLE

A scale bar 20 mm long on a drawing represents 50 µm. Find the magnification.

1. 50 µm = 0.05 mm
2. **M = 20 ÷ 0.05 = ×400**

COMMON MISTAKE

Dividing a size in **mm** by a size in **µm** without converting. The units must match.

2 Variables, tables and graphs

Variables in common experiments

Investigation	Independent variable	Dependent variable	Control variables
Enzyme and temperature	temperature	time for the starch to disappear	pH, volumes, enzyme and starch concentrations
Photosynthesis in pondweed	distance of the lamp	bubbles per minute	temperature, same plant, carbon dioxide
Osmosis in potato	sucrose concentration	percentage change in mass	size of the cylinders, time, temperature
Transpiration with a potometer	light, wind or temperature	distance the bubble moves	same shoot, same time
Respiration of seeds	temperature	time for the indicator to change colour	mass of seeds, volume of indicator

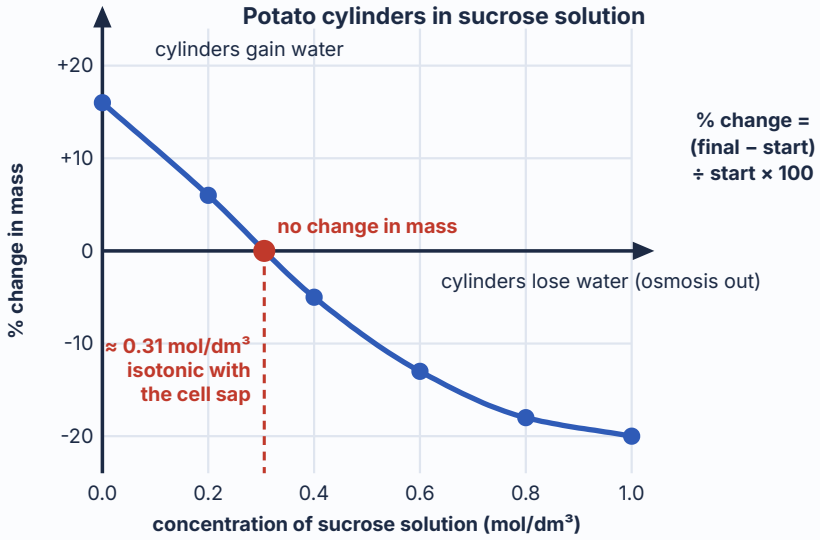
- **Independent:** the one you change, over at least 5 values. **Dependent:** the one you measure. **Control:** kept the same, and you must say how.
- **Typical controls:** temperature (use a water bath), volume and concentration of solutions, mass or size of samples, time, and the same apparatus.

Tables

- **Put the independent variable in the first column.** Write units in the column heading, such as time / s, and not in the cells.
- **Record readings to the same number of decimal places** in each column. Include a column for the mean of repeats.
- **Anomalous results:** circle them, do not include them in the mean, and suggest a reason.

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Graphs and calculations



Plot the independent variable on the x-axis. The point where the line crosses zero shows no net movement of water.

$$\text{percentage change} = \frac{\text{final} - \text{start}}{\text{start}} \times 100$$

a negative answer means a loss of mass

- **Axes:** label both with units, use a scale that fills more than half of the grid, and plot points as small crosses or dots.
- **Join the points** with a ruled straight line between points, or a smooth curve if the pattern is clearly curved, as the question asks. Do not extend the line beyond the data.
- **Rate** = amount ÷ time. The rate of a reaction is the gradient of the graph.

WORKED EXAMPLE

A potato cylinder has a mass of 3.20 g at the start and 2.88 g after 30 minutes in sucrose solution. Find the percentage change in mass.

1. change = 2.88 − 3.20 = −0.32 g
2. **percentage change = −0.32 ÷ 3.20 × 100 = −10.0%**

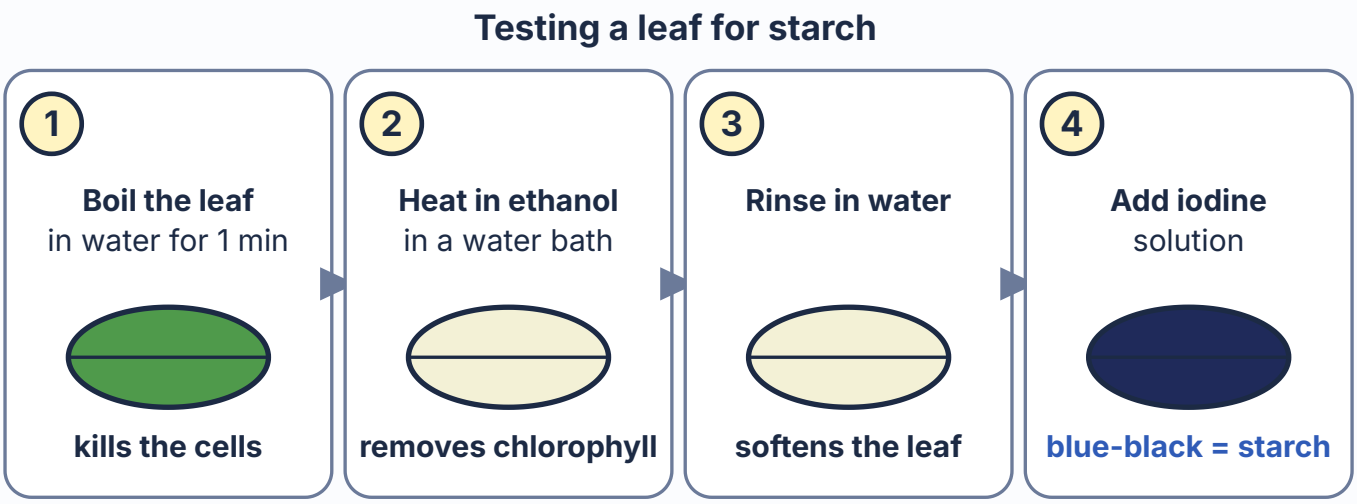
WORKED EXAMPLE

A student counts 24 bubbles from pondweed in 2 minutes. Find the rate of photosynthesis in bubbles per minute.

1. **rate = 24 ÷ 2 = 12 bubbles per minute**

3 The classic practicals

Testing a leaf for starch

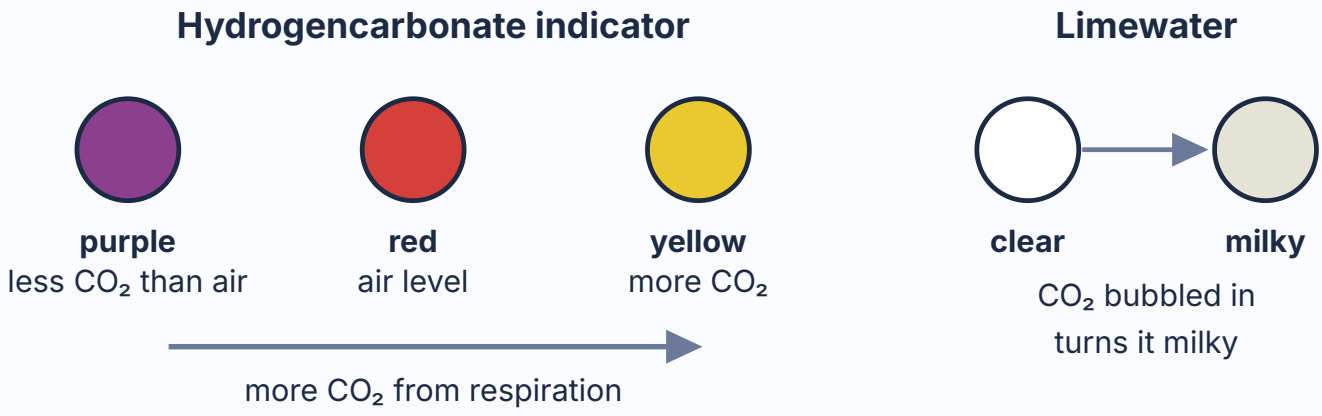


Safety: ethanol is flammable. Heat it in a water bath, with no naked flame.

Boiling in ethanol removes the green colour so that the blue-black iodine colour can be seen.

- **Destarch the plant first** by leaving it in the dark for 24 to 48 hours. Then leave it in light before the test.
- **Controls:** a leaf kept covered with foil or in the dark (no light), or a variegated leaf where only the green parts make starch.
- **Safety:** ethanol is flammable. Turn off the Bunsen burner and heat the ethanol in a water bath that has just been boiled.

Respiration and carbon dioxide



Hydrogencarbonate indicator is red in air, yellow when there is more carbon dioxide and purple when there is less.

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- **Respiration of seeds or small animals:** place them above the indicator in a closed tube. The indicator turns yellow as carbon dioxide is released.
- **Control:** an identical tube with glass beads or boiled seeds, so you know the colour change is caused by living respiration.
- **Heat from respiration:** germinating seeds in a vacuum flask with a thermometer. The temperature rises. Boiled seeds are the control.

The microscope

- **Start on low power,** focus with the coarse focus and then the fine focus. Then move to a higher power and use only the fine focus.
- **Lower the coverslip at an angle** to avoid air bubbles. Use a stain such as iodine for plant cells, and methylene blue for animal cells.
- **Cut a thin section** so that light can pass through it. Thick specimens look dark and unclear.

Enzymes, osmosis and transport

- **Amylase and starch:** mix at a set temperature, take samples every 30 seconds and add them to iodine on a spotting tile. The time when the iodine stays orange-brown is when the starch has gone.
- **Catalase and hydrogen peroxide:** measure the volume of oxygen collected, or the height of the foam, in a set time.
- **Equilibrate:** put the enzyme and substrate in separate tubes in the water bath for 5 minutes before you mix them.
- **Potato osmosis:** cut cylinders with a cork borer to the same size, blot dry before weighing, and leave them in each solution for the same time.
- **Potometer:** cut the shoot under water, seal all joints with petroleum jelly and measure how far the bubble moves in a set time.
- **Plants and dye:** a stem in coloured water shows the xylem as a stained line, and a cross-section shows where the water goes.

4 Planning and evaluating

The 6-mark plan

- **1. Independent variable and range:** at least 5 values, such as temperatures of 10, 20, 30, 40 and 50 °C.
- **2. How you change it:** for example with a water bath and a thermometer, or by diluting solutions.
- **3. Dependent variable and how you measure it:** for example "time taken for the starch to disappear".
- **4. Two control variables and how you keep them constant,** with values.
- **5. Repeat** at least 3 times and calculate a mean.
- **6. Safety and conclusion:** a sensible safety precaution, and how you will use the results to reach a conclusion (plot a graph, find the optimum).

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Evaluating the method

Problem	Improvement
judging the colour change by eye	use a colour chart or a colorimeter
cylinders of different size or surface area	cut with a cork borer to the same length
water not at a constant temperature	use a thermostatically controlled water bath
bubbles are hard to count	count for longer, or collect the gas in a syringe
only one result for each value	repeat and calculate a mean
an anomalous result	repeat that experiment and ignore the anomaly

- **Accurate** means close to the true value. **Reliable** means repeating gives similar results.
- **Conclusion:** state the pattern in the results using numbers from your table or graph, then explain it with the biology.

EXAM TIP

Enzyme plans: bring the enzyme and substrate to the test temperature for 5 minutes **before** mixing them. This is a very common mark.

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5 Test yourself

Test yourself — cover the answers first

QUICK CHECK

1. What is the formula for magnification?
2. Convert 0.25 mm into µm.
3. Should a biological drawing be shaded?
4. Why must label lines be ruled and touch the part?
5. Name the three types of variable.
6. What colour does iodine turn in the presence of starch?
7. Why is the leaf boiled in ethanol?
8. What colour is hydrogencarbonate indicator in air?
9. Why is the potato blotted dry before weighing?
10. How many values of the independent variable should a plan use?

EXAM-STYLE

11. Describe how you would find the concentration of sucrose solution that has the same water potential as potato cells. [5]
12. A student measures the length of a cell as 45 mm on a drawing. The magnification is ×300. Calculate the actual length in mm. [2]
13. Suggest why the same method gave different bubble counts for two students. [2]

Show answers

1. image size ÷ actual size
2. 250 µm
3. no, use clear continuous lines only
4. so there is no doubt which part is labelled
5. independent, dependent and control
6. blue-black
7. to remove chlorophyll so the iodine colour can be seen
8. red
9. to remove the surface water so that only the potato mass is measured
10. at least 5
11. cut potato cylinders of the same size with a cork borer and measure each mass
    place one in each of at least 5 sucrose concentrations for the same time
    blot dry and reweigh
    calculate the percentage change in mass for each
    plot a graph and find where the line crosses zero change
12. A = I ÷ M
    45 ÷ 300 = 0.15 mm
13. the lamp may have been at different distances or the temperature was not controlled
    the bubbles were counted by eye so it is hard to be consistent

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