Pearson Edexcel · International GCSE · Biology

Practical Skills ·

There is no practical exam: Papers 1 and 2 ask you to plan investigations, process results and evaluate methods for the practicals named in the specification. Living material varies, so the marks go to fair tests, replicates, controls and careful measurement.

Planning a fair test

State the independent variable with its values (at least five), the dependent variable with how it is measured and its unit, and the variables you control, each with HOW it is kept the same.

Biological variables to control: the source, age, size or mass of the organisms or tissue; temperature (a thermostatically controlled water bath); pH (a buffer solution); light (a lamp at a fixed distance).

Control experiment – a set-up identical except that the factor being tested is missing – boiled enzyme, boiled seeds, no plant. It shows the result is caused by that factor

Replicate: carry out each condition three or more times and calculate the mean, so one unusual organism does not decide the result. Leave anomalous results out of the mean.

Name a risk and its precaution for THIS practical: ethanol is flammable, so heat it in a water bath, never over a flame; a scalpel cuts away from the fingers on a tile; wash hands after handling soil or microorganisms.

Results, graphs and rates

Table: independent variable in the first column, quantity and unit in each heading, raw results then the mean, all to the same number of decimal places.

Draw a line graph when both variables are continuous (temperature against rate) and a bar chart when the independent variable is in categories (type of food, species).

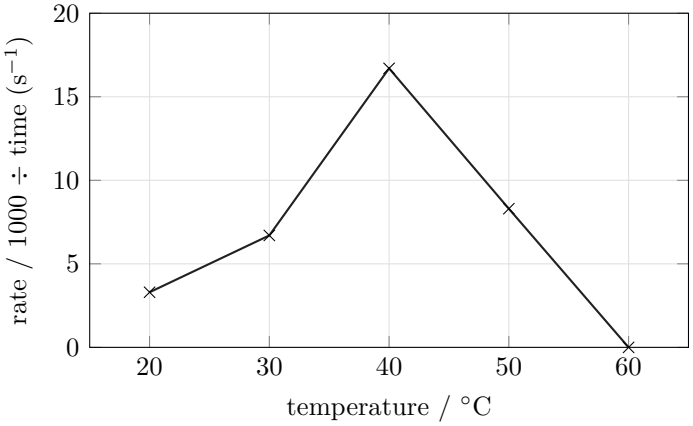
Rate = amount changed ÷ time, with a unit (cm^3/min, mm/h). When the measurement is the TIME for something to happen, rate = 1 ÷ time: the shorter the time, the faster the rate.

Describe a trend, then quote data: ‘the rate increased from 3.3 at 20 °C to a maximum of 16.7 at 40 °C, then fell to 0 at 60 °C’.

Worked analysis: temperature and amylase activity

Starch solution and amylase were each warmed to the same temperature in a water bath, then mixed. Every 10 s a drop was added to iodine solution on a spotting tile; the time was recorded when the iodine stayed orange-brown (no starch left). Three repeats at each temperature.

temperature / °C	**20**	**30**	**40**	**50**	**60**
mean time / s	300	150	60	120	no change in 600 s
rate / 1000 ÷ time (s^{-1})	3.3	6.7	16.7	8.3	0



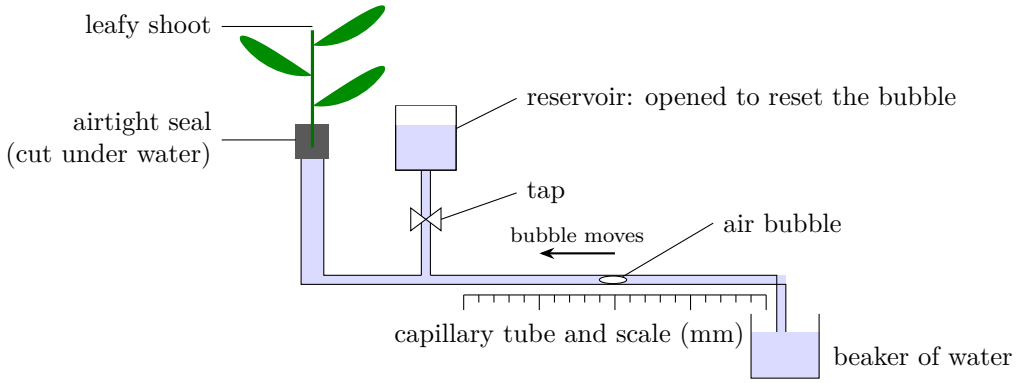
Points joined with straight lines: with readings only every 10 °C, the true optimum could lie anywhere between 30 °C and 50 °C.

Explain: from 20 °C to 40 °C the molecules gain kinetic energy, so there are more frequent successful collisions between enzyme and substrate. Above the optimum the active site changes shape (the enzyme is denatured), so starch no longer fits and the rate falls.

Improve: test at 2 °C or 5 °C intervals between 30 °C and 50 °C to find the optimum more precisely; sample more often than every 10 s; keep the pH constant with a buffer.

Worked calculation: transpiration with a potometer

A leafy shoot was cut under water (so no air enters the xylem) and fitted to a potometer. The air bubble in the capillary tube, of radius 0.50 mm, moved 30 mm in 5.0 minutes.



As the leaves lose water, water is drawn into the shoot and the bubble moves towards it along the scale.

1. Volume of water taken up = πr^2 × distance = 3.14 × (0.50 mm)^2 × 30 mm = 23.6 mm^3.

2. Rate of water uptake = 23.6 mm^3 ÷ 5.0 min = 4.7 mm^3/min.

A potometer measures water UPTAKE; nearly all of it is lost by transpiration, but a little is used in photosynthesis. Let the shoot settle for a few minutes in each new condition before timing, and reset the bubble with the reservoir between readings.

Investigating environmental factors: a fan at different distances (wind), a lamp at different distances (light), a clear plastic bag over the shoot (humidity), all with the room temperature recorded.

Worked calculation: energy in food :

A 0.50 g piece of dried bread was set alight and held under a boiling tube containing 20 cm^3 of water until it stopped burning. The water's temperature rose from 21 °C to 36 °C.

1. Energy transferred = mass of water × 4.2 J/g °C × temperature rise = 20 g × 4.2 × 15 °C = 1260 J.

2. Energy per gram = 1260 J ÷ 0.50 g = 2520 J/g, about 2.5 kJ/g.

The true value for bread is roughly 10 kJ/g. Much of the energy heats the air and the tube, and the food may not burn completely, so the result is far too low. Improve: a calorimeter that surrounds the flame, a draught shield, relighting the food until it will not burn.

The specification's practicals – what each one needs

Food tests – glucose: Benedict's, heat in a water bath, blue → green, yellow or brick-red; starch: iodine, orange-brown → blue-black; protein: biuret, blue → purple; fat: shake with ethanol, then pour into water – a cloudy white emulsion

Diffusion and osmosis – non-living: Visking tubing, or agar cubes of different sizes in acid or dye; living: potato cylinders blotted dry and weighed before and after 30 minutes in sucrose solutions. Use percentage change in mass, because the starting masses differ

Photosynthesis – count the bubbles of oxygen from pondweed (or collect them) with the lamp at different distances, with a heat shield or water bath so temperature stays constant. Starch test on a leaf: boil in water, then in ethanol (in a water bath) to remove chlorophyll, then iodine. Variegated or covered leaves show chlorophyll and light are needed

Gas exchange in leaves – hydrogencarbonate indicator: yellow with more CO_2, orange-red at normal air levels, purple with less. Leaves in the dark turn it yellow (respiration only); in bright light purple (photosynthesis faster than respiration)

Respiration in seeds – germinating seeds in a vacuum flask with a thermometer, beside a flask of boiled seeds as the control; rinse both in disinfectant so microorganisms on dead seeds do not respire. Limewater or hydrogencarbonate indicator shows the CO_2

Anaerobic respiration in yeast – yeast in boiled, cooled glucose solution under a layer of oil (no oxygen); count the bubbles of CO_2 or measure the gas at different temperatures or sugars

Exercise and breathing – breaths per minute at rest, straight after exercise, and every minute until back to the resting rate; the same person and the same exercise for each run

Seed germination – seeds on damp cotton wool, with one factor missing in each tube: no water (dry), no oxygen (boiled water under oil, or a sealed tube with an oxygen absorber), cold (a refrigerator). Count how many germinate

Quadrats – population size in two areas: random coordinates from a random number table, at least ten quadrats, count the organisms, mean per quadrat × area ÷ quadrat area. Distribution: quadrats at intervals along a transect, recording a factor such as light at each

What examiners keep reporting

A control variable named without its method: ‘temperature’ gains nothing; ‘kept at 30 °C in a water bath’ does.

Confusing the control experiment with a controlled variable. Boiled seeds are a control; the mass of seeds is a controlled variable.

‘Enzymes are killed by heat.’ Enzymes are proteins, not living things: they are denatured – the active site changes shape.

Using the change in mass, not the percentage change, when the starting masses differ.