IGCSE and O Level Biology tables and graphs

Notes, practice questions and answers for Cambridge IGCSE Biology 0610 and O Level Biology 5090. Free from numrahedu.com, where you can also use the graph plotter, the table fault finder and the chart chooser. Every result in this PDF is made up, for practice.

How to draw a results table

- **Independent variable first.** Put what you changed in the first column, in order from smallest to largest.
- **Quantity and unit in each heading.** Write the quantity, a solidus, then the unit: temperature / °C, time / s.
- **No units in the body.** Write 35, not 35 s. The unit is already in the heading.
- **Same decimal places in a column.** Record every reading as precisely as the instrument shows, and the same way each time: 12.0, 12.5, 13.0, not 12, 12.5, 13.
- **Room for repeats and a mean.** Give each repeat its own column, then a column for the mean.
- **Draw it with a ruler.** Rule a line round every cell, so each reading is easy to find.

Temperature / °C	Time 1 / s	Time 2 / s	Time 3 / s	Mean time / s
10	62	60	64	62
20	44	41	47	44
30	35	33	34	34
40	30	32	34	32

Numrahedu.com: a results table with three repeats and a mean.

Worked examples

Find a mean. A student times the same test three times: 42 s, 45 s and 46 s.
mean = (42 + 45 + 46) ÷ 3
= 133 ÷ 3 = 44.33...
= 44 s, to the same precision as the readings

Mean with an anomaly. The readings are 18, 20 and 34 bubbles in a minute. 34 does not fit the others, so it is anomalous. Leave it out.
mean = (18 + 20) ÷ 2
= 19 bubbles per minute

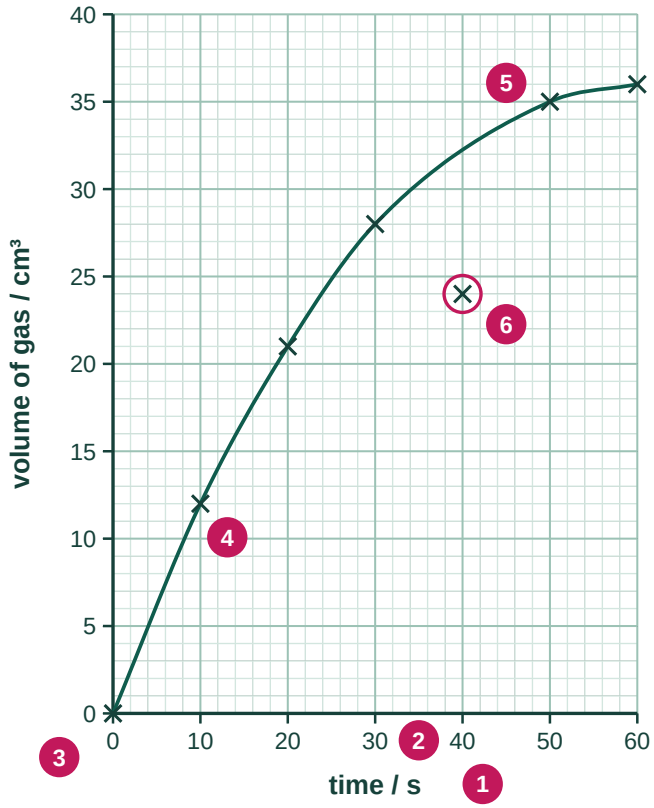
Rate from a graph. A straight line passes through (0 s, 0 cm³) and (40 s, 30 cm³).
rate = change in y ÷ change in x
= (30 - 0) ÷ (40 - 0)
= 0.75 cm³ per s

Find the six faults

A student timed how long an enzyme took to digest some milk at four temperatures. Find six faults in the table. The answers are on the last page.

Time 1 / s	Time 2 / s	Time 3 / s	Mean time	Temperature / °C
62	60	64	62	10
35 s	33	34	34	30
44	40.75	47	44	20
30	32	34	33	40

How to draw a line graph



Numrahedu.com: a line graph drawn well.

What the numbers show

1. The axis label copies the table heading: quantity / unit.
2. The scale goes up in equal steps of 10 for each large square.
3. This axis starts at 0, but it does not have to, as long as the points fill more than half of the grid.
4. Each point is a small, neat cross.
5. One thin, smooth curve of best fit, drawn by eye.
6. This anomalous point is circled and the line ignores it.

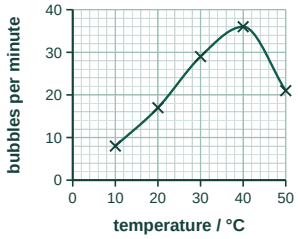
The rules for a line graph

- **Independent variable on the x-axis.** The variable you changed goes across. The one you measured goes up.
- **Label both axes.** Copy the table heading: the quantity, a solidus and the unit, such as temperature / °C.
- **Choose an even scale.** Each large square stands for 1, 2 or 5 units, or 10, 20 or 50. Never 3, 4, 6 or 7, because values between the lines become hard to read.
- **Use more than half the grid.** The points must spread across more than half of the grid, both across and up. An axis does not have to start at zero.
- **Plot points carefully.** Mark each point with a small cross (×) or a dot with a circle round it, placed to within half of a small square.
- **Draw one best-fit line.** A single, thin, smooth straight line or curve, with the points spread evenly on both sides. Ignore any point that is clearly anomalous.
- **Stop at the last point.** Do not extend the line beyond your first and last points unless the question asks you to.

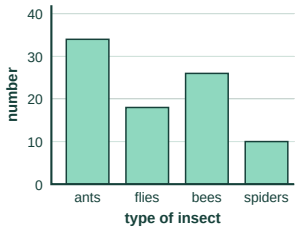
Choosing a scale

Scale	Verdict	Why
1, 2 or 5 per large square	Good	Easy to read: each small square is a simple fraction of the step.
10, 20 or 50 per large square	Good	The same steps, ten times bigger.
3, 4, 6 or 7 per large square	Avoid	Values between the lines become hard to plot and to read.
Points fill less than half the grid	Avoid	Choose a smaller step, or start the axis at a higher number.

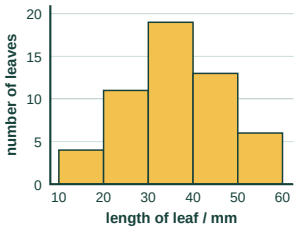
Line graph, bar chart, histogram or pie chart?



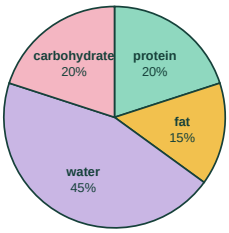
Line graph
Both variables are numbers that can take any value, such as temperature and rate of reaction.
Join the points with a best-fit line.



Bar chart
The data are in categories, or can only be whole numbers, such as types of seed or number of leaves.
Bars of equal width that do not touch.



Histogram
Continuous data sorted into equal groups, such as the lengths of 40 leaves in groups of 10 mm.
Bars that touch, because one group runs straight into the next.



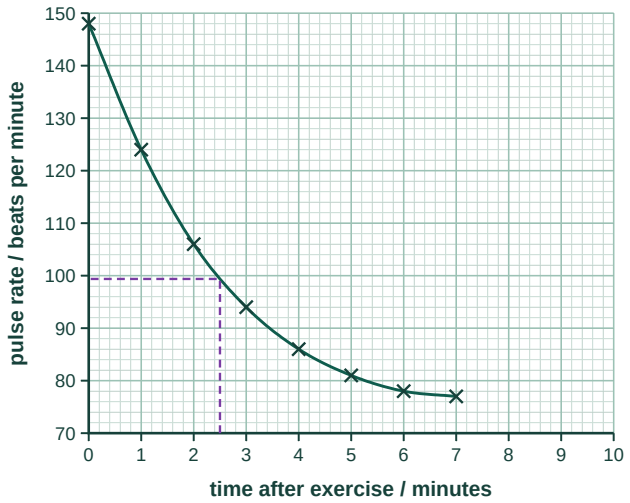
Pie chart
Parts of a whole, usually percentages that add up to 100.
Each 1% is 3.6° of the circle.

Choose the chart

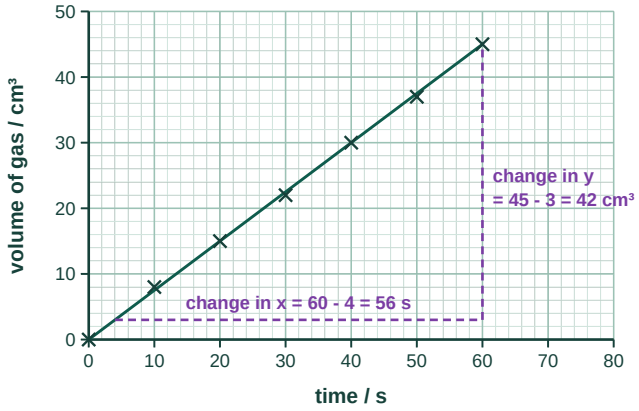
Write the best chart for each set of data. The answers are on the last page.

Data	Best chart
1. The number of bubbles from pondweed at six different lamp distances.	
2. The number of each type of insect caught in a field: beetles, ants, flies and spiders.	
3. The heights of 60 seedlings, sorted into groups: 0 to 9 mm, 10 to 19 mm, 20 to 29 mm, and so on.	
4. The percentage of carbohydrate, fat, protein and water in a food.	
5. The mass of a growing fruit, weighed every day for 10 days.	
6. The mean pulse rate of students in five different sports teams.	
7. The masses of 100 eggs, sorted into groups of 5 g.	
8. The time taken for starch to be digested at pH 2, 4, 6, 8 and 10.	

Reading a graph, and finding a rate



Numrahedu.com: up from 2.5 minutes to the curve, then across: about 99 beats per minute.



Numrahedu.com: a gradient triangle, as large as the line allows.

Reading a value (interpolation)

1. Find the value you are given on its axis.
2. Draw a ruled line straight from it to your best-fit line.
3. Turn and draw a ruled line straight to the other axis.
4. Read the value to within half of a small square, and write it with its unit.
5. Leave the lines on the graph. They show your working.

Extrapolation means extending the line beyond your points to predict a value. Draw the extension as a dashed line, and say that the prediction may not be reliable, because nothing was measured there.

Finding a rate (gradient)

gradient = change in y ÷ change in x

Draw a large triangle under a straight part of the line. Read the changes from the scales, then divide. Here, 42 cm³ ÷ 56 s = 0.75 cm³ per s.

Remember. A rate always has a unit, such as cm³ per s or mm per day.

How to describe a graph in words

Command word	What to write
Describe	Say what the graph shows: the trend, the highest or lowest point, and where it levels off. Quote data, with units, from the graph.
Explain	Give the biological reason for the trend, such as an enzyme being denatured, or light becoming a limiting factor.
Compare	Say how two lines or sets of results are the same and how they differ, with figures for both.

Avoid this, write this

Avoid	Write
It goes up and then down.	As the temperature increases from 10 °C to 40 °C, the number of bubbles increases from 6 to 38 per minute. Above 40 °C it decreases.
The peak is at 40.	The highest rate is 38 bubbles per minute, at 40 °C.
time (in the heading, with no unit)	time / s
35 s, 41 s (units in the body of the table)	35, 41, with s only in the heading
12, 12.5, 13	12.0, 12.5, 13.0, all to the same number of decimal places
Mean of 12, 14 and 40 = 22	40 is anomalous. Leave it out: mean of 12 and 14 = 13.
A line drawn through every point, including an odd one	One smooth best-fit line that ignores the anomalous point.
rate = 0.75	rate = 0.75 cm^3 per s. A rate always has a unit.

Key words

Term	Meaning
Independent variable	The variable you change on purpose, such as temperature. It goes in the first column of a table and on the x-axis of a graph.
Dependent variable	The variable you measure, such as the number of bubbles. It goes in the later columns of a table and on the y-axis.
Control variable	A variable you keep the same, so that only the independent variable can affect the results.
Column heading	The name of the quantity and its unit, separated by a solidus, for example time / s.
Solidus	The slash (/) that separates a quantity from its unit in a table heading or on a graph axis.
Mean	Add up the readings and divide by how many readings there are. Leave out any anomalous result first.
Range	The difference between the highest and the lowest value. For the independent variable, give the lowest and highest values, such as 10 °C to 60 °C.
Anomalous result	A reading that does not fit the pattern of the others. Leave it out of a mean and out of a best-fit line, and repeat it if you can.
Line graph	A graph of two variables that are both measured in numbers, with the points joined by a best-fit line.
Best-fit line	A single, thin, smooth straight line or curve that follows the trend of the points. It does not have to touch every point.
Bar chart	A chart for data in categories, such as types of food. The bars are the same width and do not touch.
Histogram	A chart for continuous data in equal groups, such as heights of 120 to 130 mm. The bars touch.
Pie chart	A circle split into parts of a whole, usually percentages.
Interpolation	Reading a value from a graph between the points you plotted.
Extrapolation	Extending the line beyond the points you plotted, to predict a value.
Gradient	How steep a straight line is: the change in y ÷ the change in x. On a graph against time, the gradient is a rate.

Checklist for every table and graph

My table

[ ] **Independent variable first.** Put what you changed in the first column, in order from smallest to largest.
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[ ] **No units in the body.** Write 35, not 35 s. The unit is already in the heading.
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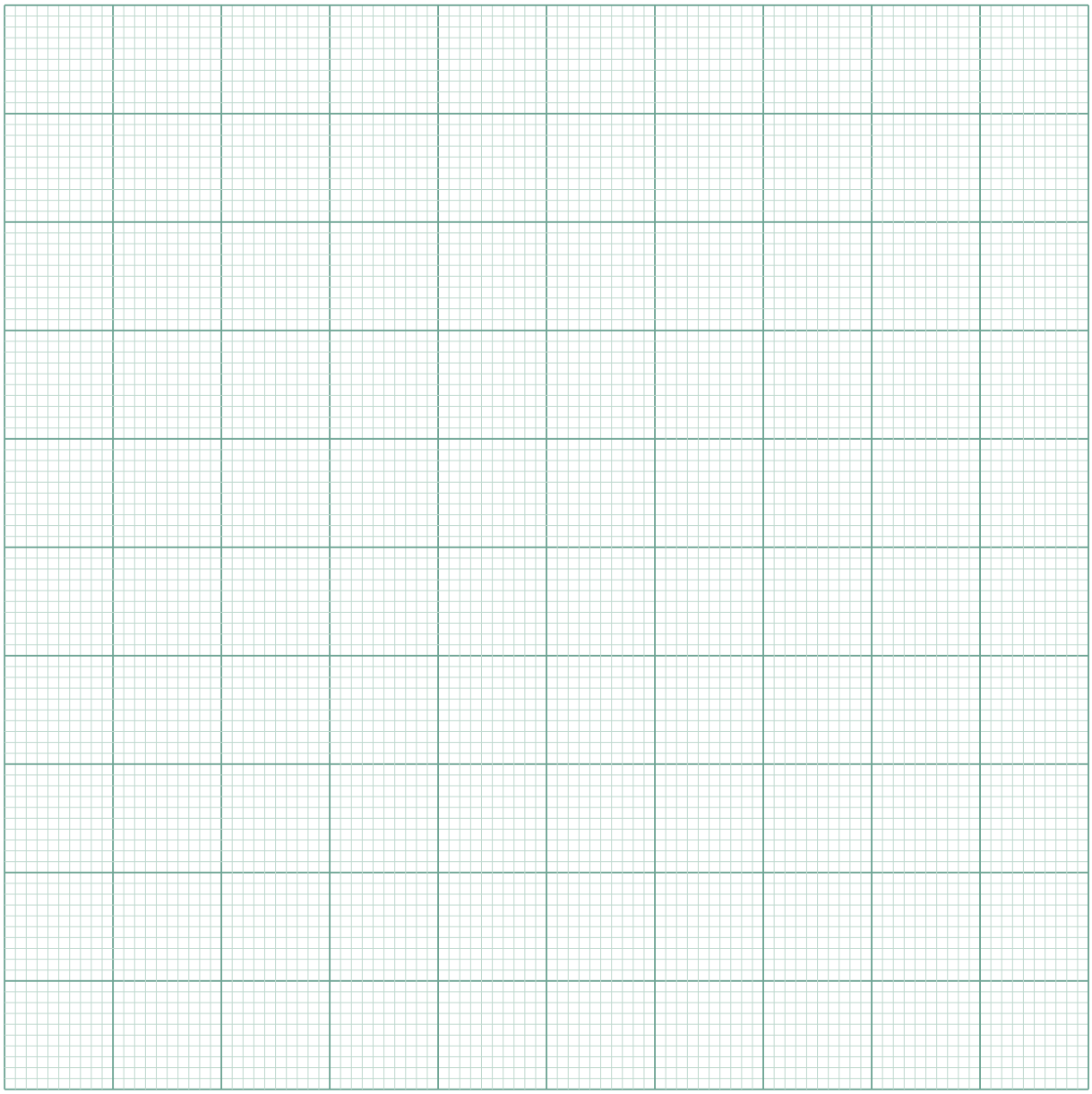
My graph

[ ] **Independent variable on the x-axis.** The variable you changed goes across. The one you measured goes up.
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Use this checklist with the graph grid on the next page, with the online graph plotter, or with your own results from a practical.

Graph grid

Use this grid for question 6, or for your own results. Each large square has 10 small squares.



Tables and graphs questions

14 original questions, 49 marks. Answer on paper, then mark your work with the answers at the end. The results in every question are made up.

Q1. Variables [3 marks]

A student investigates the effect of temperature on the time taken for an enzyme to digest some protein. (a) State the independent variable. [1] (b) State the dependent variable. [1] (c) State one variable the student should keep the same. [1]

Q2. Draw a results table [4 marks]

A student counts the bubbles given off by pondweed in one minute, with a lamp at 10 cm, 20 cm, 30 cm and 40 cm. Each count is done three times and a mean is worked out. Draw a results table the student could use. Do not fill in any results.

Q3. Means and anomalous results [3 marks]

(a) A student records 18 s, 21 s and 21 s. Calculate the mean. [1] (b) A second set of readings is 25 s, 26 s and 41 s. State which reading is anomalous. [1] (c) Calculate the mean of the second set, leaving out the anomalous result. Give your answer to one decimal place. [1]

Q4. Spot the faults [4 marks]

Time	Temperature / °C
62 s	10
45	20
34.5	30
31	40

The table shows how a student recorded some results. State four faults in the table.

Q5. Choose the chart [4 marks]

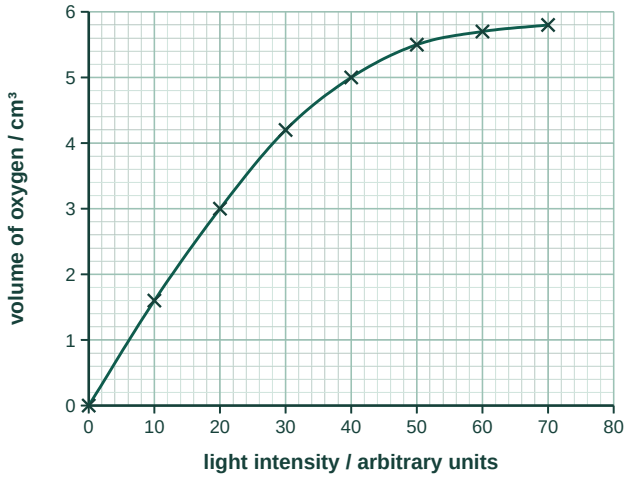
State the best type of chart or graph for each set of data. (a) The number of each type of tree in a wood. [1] (b) The heights of 50 seedlings, sorted into groups of 10 mm. [1] (c) The percentage of each gas in the air breathed out. [1] (d) The mass of a seedling, measured every day for two weeks. [1]

Q6. Plot a line graph [5 marks]

Temperature / °C	Seeds germinated / %
5	8
10	30
15	62
20	84
25	92
30	94

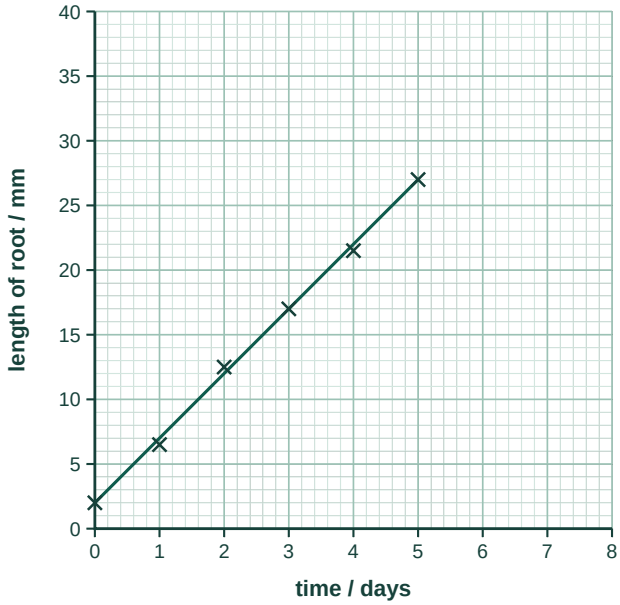
The table shows the percentage of seeds that germinated at different temperatures. Plot a line graph of the results on a grid 10 large squares across and 10 large squares up, and draw a curve of best fit. Use the graph grid in this PDF.

Q7. Read a value from a graph [2 marks]



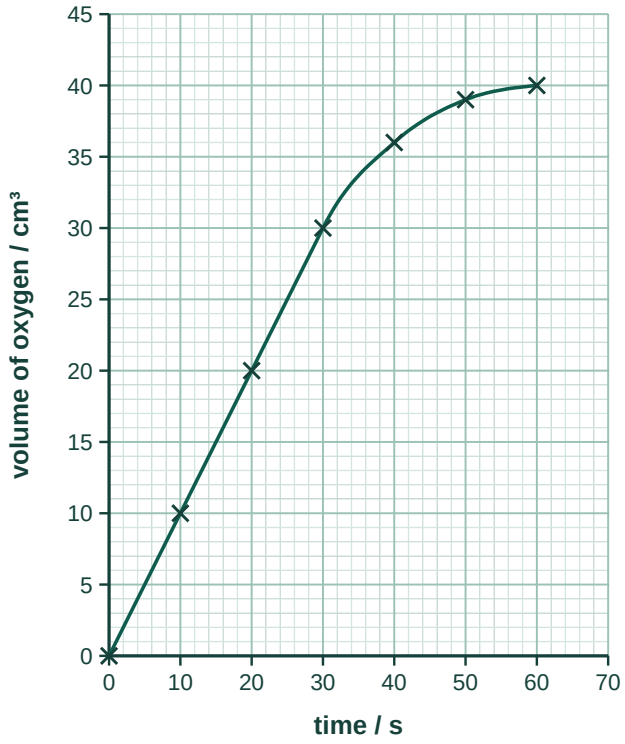
(a) Use the graph to find the volume of oxygen released at a light intensity of 25 arbitrary units. [1] (b) Find the light intensity at which 4.6 cm³ of oxygen is released. [1]

Q8. Extend a line and find a rate [4 marks]



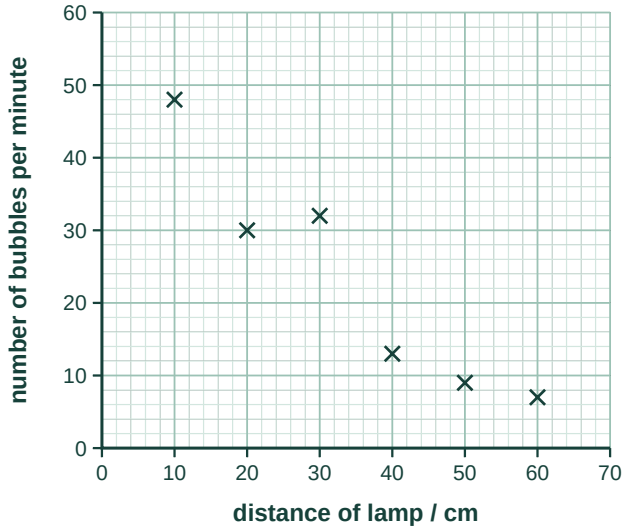
(a) Extend the line to predict the length of the root on day 7. [1] (b) Suggest why this prediction may not be correct. [1] (c) Use the graph to calculate the rate of growth of the root, in mm per day. Show your working. [2]

Q9. A rate from a curve [3 marks]



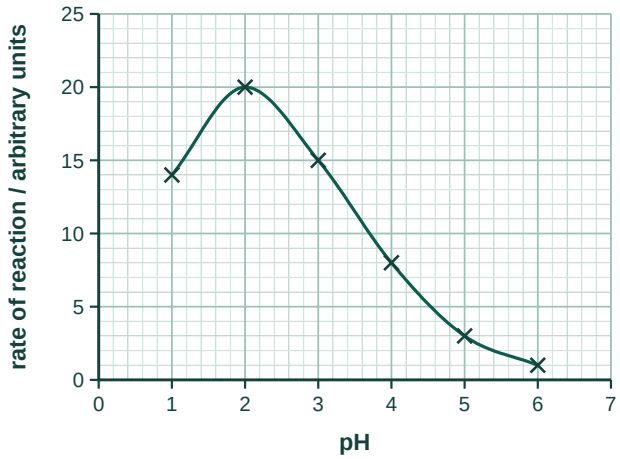
(a) Calculate the rate at which oxygen was collected during the first 30 s. Give the unit. [2] (b) Suggest why the curve levels off. [1]

Q10. An anomalous result [4 marks]



(a) State the distance at which the anomalous result was recorded. [1] (b) State how the anomalous result should be treated when the line is drawn. [1] (c) Suggest one cause of the anomalous result. [1] (d) State what the student should do about it. [1]

Q11. Describe and explain a graph [5 marks]



(a) Describe the effect of pH on the rate of reaction. Use data from the graph in your answer. [3] (b) Explain why the rate is very low at pH 6. [2]

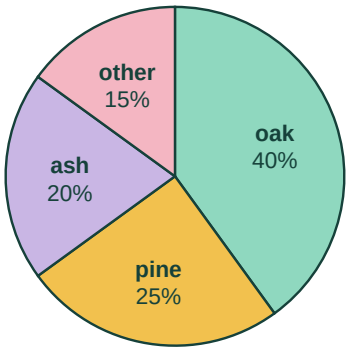
Q12. Choose a scale [4 marks]

A student has a grid 10 large squares up. The largest value to plot is 38. (a) Choose the best scale from: 3, 4, 5 or 10 units for each large square. [1] (b) Explain why each of the other three scales is less suitable. [3]

Q13. Bar chart or histogram? [2 marks]

(a) Explain why the bars of a histogram touch. [1] (b) Explain why the bars of a bar chart do not touch. [1]

Q14. A pie chart [2 marks]



(a) Calculate the angle of the sector for pine trees. [1] (b) Explain why a pie chart suits these data. [1]

Answers

Q1. Variables

- (a) One mark for temperature.
- (b) One mark for the time taken for the protein to be digested.
- (c) One mark for any one of: the volume or concentration of enzyme, the volume or concentration of protein, the pH.

Q2. Draw a results table

- One mark for lamp distance in the first column.
- One mark for headings with units after a solidus, such as distance of lamp / cm.
- One mark for three columns for the counts, then a column for the mean.
- One mark for all four distances in order: 10, 20, 30, 40.

Q3. Means and anomalous results

- (a) One mark for 20 s.
- (b) One mark for 41 s.
- (c) One mark for 25.5 s.

Q4. Spot the faults

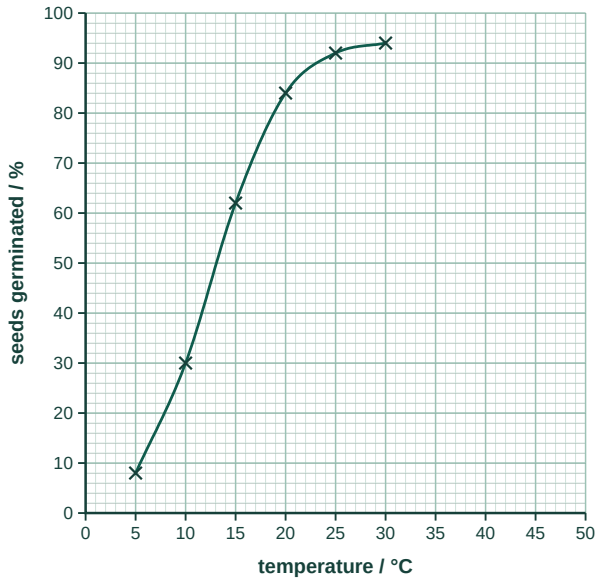
- One mark for the temperature, the independent variable, not being in the first column.
- One mark for the time heading having no unit.
- One mark for the unit s being written in the body of the table.
- One mark for the readings not all having the same number of decimal places.

Q5. Choose the chart

- (a) One mark for a bar chart.
- (b) One mark for a histogram.
- (c) One mark for a pie chart. A bar chart is also fine.
- (d) One mark for a line graph.

Q6. Plot a line graph

- One mark for temperature on the x-axis and percentage of seeds germinated on the y-axis.
- One mark for both axes with a label and a unit: temperature / °C and seeds germinated / %.
- One mark for even scales that use more than half the grid, such as 5 °C and 10% for each large square.
- One mark for all six points plotted to within half of a small square.
- One mark for one smooth curve of best fit.



Numrahedu.com: model answer graph.

Q7. Read a value from a graph

- (a) One mark for 3.6 cm^3. A reading from 3.5 to 3.7 cm^3 is fine.
- (b) One mark for 34 arbitrary units. A reading from 33 to 36 is fine.

Q8. Extend a line and find a rate

- (a) One mark for 37 mm. A reading from 36 to 38 mm is fine.
- (b) One mark for: day 7 is outside the range measured, so the root may not keep growing at the same rate.
- (c) One mark for reading two points from the line and dividing the change in length by the change in time, such as (27 - 2) ÷ (5 - 0).
- (c) One mark for 5 mm per day. An answer from 4.8 to 5.2 is fine.

Q9. A rate from a curve

- (a) One mark for 30 ÷ 30.
- (a) One mark for 1 cm^3 per s.
- (b) One mark for the hydrogen peroxide (the substrate) being used up.

Q10. An anomalous result

- (a) One mark for 30 cm.
- (b) One mark for ignoring it: the line does not go through it.
- (c) One mark for any one of: bubbles counted for longer than a minute, a miscount, light from a window, the water getting warmer.
- (d) One mark for repeating the reading at 30 cm.

Q11. Describe and explain a graph

- (a) One mark for: the rate increases from pH 1 to pH 2.
- (a) One mark for: the highest rate is at pH 2, 20 arbitrary units.
- (a) One mark for: the rate then decreases, to 1 arbitrary unit at pH 6.
- (b) One mark for: the enzyme is denatured, because the shape of its active site changes.
- (b) One mark for: the substrate no longer fits the active site, so fewer enzyme-substrate complexes form.

Q12. Choose a scale

- (a) One mark for 5 units for each large square.
- (b) One mark for 3: it only reaches 30, so 38 does not fit.
- (b) One mark for 4: it is an awkward step, so values between the lines are hard to plot and read.
- (b) One mark for 10: the points would fill less than half of the grid.

Q13. Bar chart or histogram?

- (a) One mark because the data are continuous, so each group runs straight into the next.
- (b) One mark because the data are in separate categories, with nothing between one category and the next.

Q14. A pie chart

- (a) One mark for 25 × 3.6 = 90°.
- (b) One mark because the data are parts of a whole: the percentages add up to 100.

Find the six faults: answers

- **The independent variable is in the last column.** Temperature is what was changed, so it goes in the first column.
- **A heading with no unit.** Write mean time / s. Every heading needs its unit.
- **A unit in the body of the table.** Write 35, not 35 s. The unit belongs only in the heading.
- **A reading with a different number of decimal places.** The stopwatch was read to the nearest second, so write 41, like the others.
- **A mean worked out wrongly.** (30 + 32 + 34) ÷ 3 = 32, not 33.
- **The temperatures are not in order.** List the independent variable from smallest to largest: 10, 20, 30, 40.

Choose the chart: answers

1. **Line graph.** Lamp distance and number of bubbles are both numbers, so draw a line graph.
2. **Bar chart.** The insects are categories, so draw a bar chart with bars that do not touch.
3. **Histogram.** Height is continuous and has been grouped, so draw a histogram with bars that touch.
4. **Pie chart.** These are parts of a whole that add up to 100%, so a pie chart suits them. A bar chart would also be fine.
5. **Line graph.** Time and mass are both numbers, so draw a line graph.
6. **Bar chart.** Each team is a category, so draw a bar chart.
7. **Histogram.** Mass is continuous and has been grouped, so draw a histogram.
8. **Line graph.** pH and time are both numbers, so draw a line graph.

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