

Key information for your AQA Double Award GCSE Science

This booklet tells you all the key information you need to know for your Science GCSE exams.

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Outline of GCSE Science Double Award Science

You are following the **AQA Trilogy Science GCSE** specification.

The content is equivalent to 2 GCSEs, so you will end up with a double award, 2 grades. They could be both the same, e.g. 55 or if you are in between grade 5 and 6 you will be awarded 56.

You will spend equal time studying, Biology, Chemistry and Physics. Below are the units for the Biology, Chemistry and Physics and in which exam paper they are tested in. Chemistry has more units as they are shorter.

All exams are 1 hour 15 minutes long. Each is worth 16.7% of the Double Award.

They are listed in the order you will sit them.

Your Science counts as 2 GCSEs

Subject	Paper	What's assessed
Biology	Paper 1	B1 Cell Biology; B2 Organisation; B3 Infection and response; B4 Bioenergetics
Chemistry	Paper 1	C1 Atomic structure in the periodic table; C2 Bonding, structure, and the properties of matter; C3 Quantitative chemistry; C4 Chemical changes; C5 Energy changes.
Physics	Paper 1	P1 Energy, P2 Electricity; P3 Particle model of matter; P4 Atomic structure.
Biology	Paper 2	B5 Homeostasis and response; B6 Inheritance, variation and evolution; B7 Ecology.
Chemistry	Paper 2	C6 The rates and extent of chemical change; C7 Organic chemistry; C8 Chemical analysis; C9 Chemistry of the atmosphere; C10 Using resources.
Physics	Paper 2	P5 Forces; P6 Waves; P7 Magnetism and electromagnetism.

How will you be examined?

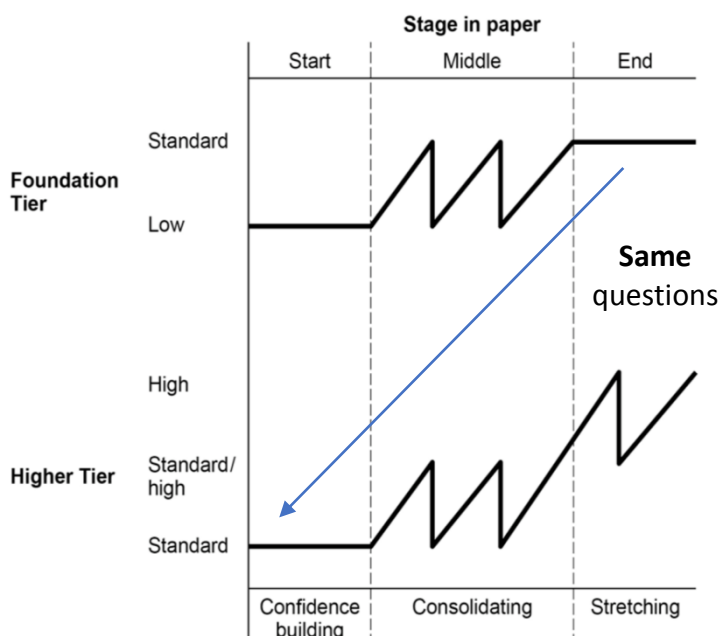
You will take 6 exams at the end of the course, each lasting 1 hour 15 minutes

- 2 Biology, 2 Chemistry and 2 Physics
- Each exam is out of 70 marks and counts to 16.7% of the GCSE
- There are higher and foundation papers (You cannot mix and match these)
- Foundation tier allows you to gain grades from 1-1 to 5-5
- Higher tier allows you to gain grades from 4-4 to 9-9. If you get a mark below the grade boundary for a 4 you will be given U (unclassified), unless you are very close when you will be awarded 4-3.

What is in each exam paper?

- Each exam will test different units. Below are listed the content of each of the papers.
- Also at least 15% of the exam questions will test your understanding of the 21 required practicals you have carried out in your GCSE. This will include describing the method, explaining how to present results (graph to plot) and what information can be obtained from the graph. (Refer to your separate revision booklet we have produced to help you with your required practical revision).
- You also must learn of by heart 21 out of 28 equations, so you can recall them in the exam. Refer to your equation sheet to know which ones to learn.

How will the exams be structured?



Foundation Tier papers have the following structure:

- At the start. low demand questions (grades 1-3)
- In the middle, questions that start at low demand and rise to standard demand (grades 4-5). Dropping back to start at low demand for the next question.
- Final questions have all parts at standard demand (grades 4-5). These final questions are the same questions that start the higher paper.

Higher Tier papers have the following structure:

- At the start. Standard demand questions (grades 4-5). These questions are the same as those at the end of the foundation level paper.
- In the middle, questions that start at standard demand and rise to high demand (grades 6-7). Dropping back to start at standard demand for the next question.
- Final questions are high demand questions (grades 8-9)

What resources can I use to help me revise?

- You have a revision guide. Use it to revise for end of topic tests and to help with homework, so you start to familiarise yourself with it.
- Key notes in your exercise book
- Revision booklet outlining the required practicals (available for summer exams)
- Personal Learning checklists for each topic, so you know what you need to be able to do and can self assess which parts your need to focus on more in your revision.
- Equation booklet with all the equations you need to learn (ones not shaded) as well as the prefixes like milli (m), kilo (k) etc.
- Collated exam papers with answers for each module for final practice and revision (available for summer exams)
- KS4 Bitesize website.
- New Doodle revision PowerPoints and quizzes.

What equations do I need to learn and which ones will be given to me in the exam?

These 21 equations you **MUST LEARN** and be able to recall in the exam.
(HT = higher tier paper only)

Equation number	Word equation	Symbol equation
1	weight = mass \times gravitational field strength (g)	$W = m g$
2	work done = force \times distance (along the line of action of the force)	$W = F s$
3	force applied to a spring = spring constant \times extension	$F = k e$
4	distance travelled = speed \times time	$s = v t$
5	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{\Delta v}{t}$
6	resultant force = mass \times acceleration	$F = m a$
7 HT	momentum = mass \times velocity	$p = m v$
8	kinetic energy = $0.5 \times \text{mass} \times (\text{speed})^2$	$E_k = \frac{1}{2} m v^2$
9	gravitational potential energy = mass \times gravitational field strength (g) \times height	$E_p = m g h$
10	power = $\frac{\text{energy transferred}}{\text{time}}$	$P = \frac{E}{t}$
11	power = $\frac{\text{work done}}{\text{time}}$	$P = \frac{W}{t}$
12	efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
13	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	
14	wave speed = frequency \times wavelength	$v = f \lambda$
15	charge flow = current \times time	$Q = I t$
16	potential difference = current \times resistance	$V = I R$
17	power = potential difference \times current	$P = V I$
18	power = (current) $^2 \times$ resistance	$P = I^2 R$
19	energy transferred = power \times time	$E = P t$
20	energy transferred = charge flow \times potential difference	$E = Q V$
21	density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$

These equations will be given to you in the exam.

Students should be able to select and apply the following equations from the *Physics equation sheet*.

Equations required for higher tier papers only are indicated by HT in the left-hand column.

Equation number	Word equation	Symbol equation
1	(final velocity) ² – (initial velocity) ² = 2 × acceleration × distance	$v^2 - u^2 = 2 a s$
2	elastic potential energy = 0.5 × spring constant × (extension) ²	$E_e = \frac{1}{2} k e^2$
3	change in thermal energy = mass × specific heat capacity × temperature change	$\Delta E = m c \Delta \theta$
4	period = $\frac{1}{\text{frequency}}$	
5 HT	force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length	$F = B I l$
6	thermal energy for a change of state = mass × specific latent heat	$E = m L$
7 HT	potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_s I_s = V_p I_p$

What required practicals do I need to know about?

Below is a list of the required practicals you need to know. Refer to the revision booklets to learn the method and outcome of them.

Subject	In which paper?	What does the required practical activity involve?
Biology	Paper 1	Using a light microscope to observe, draw and label selection of plant and animal cells. Magnification scale must be included.
Biology	Paper 1	Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.
Biology	Paper 1	Use reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's tests the sugar; iodine test for starch; and Biuret reagent of protein.
Biology	Paper 2	Investigate the effect of pH on the rate of reaction of amylase enzyme.
Biology	Paper 2	Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism, such as pondweed.
Biology	Paper 2	Plan and carry out an investigation into the effect of a factor, on human reaction time.

Biology	Paper 2	Measure the population size of common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species.
Chemistry	Paper 1	Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.
Chemistry	Paper 1	Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis.
Chemistry	Paper 1	Investigate the variables that affect temperature changes in reacting solutions such as; acids plus metals, acid plus carbonates, neutralisations, displacement of metals.
Chemistry	Paper 2	Investigate how changes in concentration affect the rates of reactions by a method involving measuring volume of a gas produced and a method involving a change in colour or turbidity.
Chemistry	Paper 2	Investigate how paper chromatography can be used to separate and tell the difference between coloured substances. You should also calculate R _f values.
Chemistry	Paper 2	Analysis and purification of the water samples from different sources, including pH, dissolved solids and distillation.
Physics	Paper 1	An investigation to determine the specific heat capacity of one or more materials.
Physics	Paper 1	Use circuit diagrams to set up and investigate the factors affecting resistance of electrical circuits. This should include: <ul style="list-style-type: none"> • The length of a wire at constant temperature • Combinations of resistors in series parallel
Physics	Paper 1	Use circuit diagrams to construct appropriate circuits to investigate the current – Voltage (I –V) characteristics of the following components; filament lamp, diode and resistor at a constant temperature.
Physics	Paper 1	Use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solids and liquids.
Physics	Paper 2	Investigate the relationship between force and extension of a spring.
Physics	Paper 2	<ul style="list-style-type: none"> • Investigate the effect of varying the force, on the acceleration of an object with constant mass. • Investigate the effect of varying the mass of an object on the acceleration produced by a constant force.
Physics	Paper 2	Make observations and take appropriate measurements, to measure the frequency and wavelength of waves in a ripple tank and waves in solid. Use the frequency and wavelength measured to calculate the speed of the waves.
Physics	Paper 2	Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.

Key maths skills tested in your Science GCSE

Standard form

Helps us to easily manage very large and very small numbers.

0.00000093 is 9.3×10^{-7} in standard form

It has two components:

1. The number written between 1 and 9

2. The power of 10 number

Negative powers shift the digit to the right →

← Positive powers shift the digit to the left

$$10^1 = 10 \quad 10^3 = 1000 \quad 10^7 = 10000000 \quad 10^{-3} = 0.001 \quad 10^{-7} = 0.0000001 \quad 10^0 = 1$$

- If the exponential number is positive, the number is **LARGE** because you are multiplying by 10 each time;

$$2.3 \times 10^7 = 23\,000\,000$$

Moving the decimal point 7 to the left

- If the exponential number is negative, the number is **SMALL** because you are dividing by 10 each time;

$$2.3 \times 10^{-7} = 0.00000023$$

Moving the decimal point 7 to the right

Entering standard form into your calculator



e.g. $3 \times 10^6 \times 4 \times 10^{-8} = 0.12$

Press the calculator buttons in this order:



Examples:

1. Write the number 4540 million in standard form.

$$4\,540\,000\,000 = 4.54 \times 10^9$$

2. Write the number 0.00072 in standard form.

$$0.00072 = 7.2 \times 10^{-4}$$

Significant figures

Often you have to write answers to the correct number of significant figures.

3.28034

↓ ↓ ↓ ↓ ↓ ↓
1st 2nd 3rd 4th 5th 6th

This number is quoted to 6 significant figures.

0.00760

↓ ↓ ↓ ↓ ↓ ↓
⊗ ⊗ ⊗ 1st 2nd 3rd

This number is quoted to 3 significant figures. Zeros before any number are NOT significant.

Round 2.837076 to 3 s.f.

Number the significant figures

1st 2nd 3rd 4th 5th 6th 7th
2.837076

There are two options:

2.83 2.84

Round 0.03601 to 3 s.f.

Number the significant figures...

1st 2nd 3rd 4th
0.03601

There are two options:

0.0360 0.0361

Estimating and significant figures

When you estimate, you first round the numbers, before you do the calculation.

In 2015, the longest scheduled passenger flight was between New York and Singapore. It took 19 hours to fly 9531 miles.

a) Make an estimate the average speed of the plane.

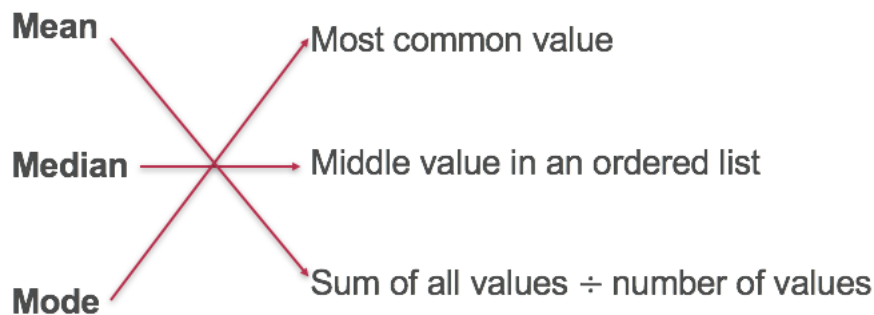
Estimate: speed = distance ÷ time = 10 000 ÷ 20 = 500 mph

b) Calculate the average speed on the plane and round your answer to 3 significant figures.

Actual: speed = distance ÷ time = 9531 ÷ 19 = 501.63 = 502 mph (3 s.f.)

Mean, Median and Mode for repeat readings.

Make sure you **spot** and **eliminate outliers first!!!!**



Examples of how to use the Mean, Median and Mode:

1. A student investigates how much stripes of the same rubber stretch, before they snapped. Their results are shown below.

Sample number	Length (mm)
1	21
2	20
3	22
4	25
5	27
6	26
7	25

- a) Calculate the mean length before the strip snapped.

$$(21 + 20 + 22 + 25 + 27 + 26 + 25) \div 7 = 23.7 = 24\text{mm}$$

- b) Calculate the median length reached by the strip.

Put the numbers in order; 20 21 22 25 25 26 27

Middle value is 25

- c) What is the mode? The mode is 25 as this occurs twice.

2. **Using the mode.** A study was carried out to find the average height of children in a certain class, the results are shown below.

Height, h , (cm)	Number of females	Number of males	Total number of students
$140 < h \leq 144$	4	-	4
$144 < h \leq 148$	5	-	5
$148 < h \leq 152$	4	4	8
$152 < h \leq 156$	1	6	7
$156 < h \leq 160$	2	3	5
$160 < h \leq 164$	-	1	1

What is the **modal** height of a student in this class?

The most common height is $148 < h \leq 152$ with 8 students

How does this compare to the modal height of a male students and a female students?

Modal height for males is $152 < h \leq 156$ and for females is $144 < h \leq 148$

Algebra symbols you need to know.

<	<<	>	>>
Less than	Much less than	Greater than	Much greater than
e.g.	$6 < 8 << 80$	$80 >> 8 > 6$	

~ **Weak approximation** e.g. $54 \times 2 \sim 100$

\propto **proportional** e.g. distance \propto speed (double speed you double distance)

How to solve questions with equations (Re-arranging)

Identify and write down the quantities in the question including “?” for the one they are asking for.

2nd - Find/Remember the equation that has all those quantities in it. Write the equation down.

3rd - Rearrange the equation if necessary. Write the arrangement down.

4th - Insert the numbers into the correct places.

5th - Enter the numbers into the calculator (remembering Bodmas) and press =

e.g
Joseph and Emily are walking down the road hand in hand. They walk a distance of **210 metres** in **30 seconds**. What was their **average speed** in m/s?

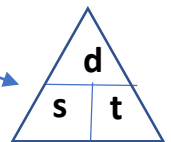
$$d = 210\text{m} \quad t = 30\text{s} \quad v = ?$$

$$d = s \times t$$

Need to re-arrange for speed, s.
Put in a triangle with the two that are multiplied on the bottom.

$$\text{so } s = \frac{d}{t} = \frac{210}{30} = 7 \text{ m/s}$$

Cover up s, d is above t
so this means $d \div t$.

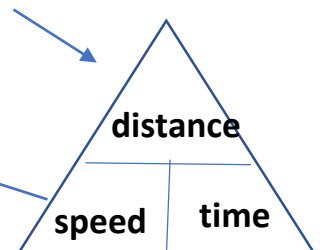


If you are not confident with symbols do it in words.

$$\text{distance} = 210\text{m} \quad \text{time} = 30\text{s} \quad \text{speed} = ?$$

$$\text{distance} = \text{speed} \times \text{time}$$

$$\text{speed} = \text{distance} \div \text{time} = 210 \div 30 = 7$$



Prefixes and converting to base units

Name	Symbol	Value (how to convert)	What it is
Giga	G	$\times 10^9$	billion (1,000,000,000)
Mega	M	$\times 10^6$	million (1,000,000)
Kilo	K	$\times 10^3$	thousand (1,000)
milli	m	$\times 10^{-3}$	thousandth (0.001)
micro	μ	$\times 10^{-6}$	millionth (0.000001)
nano	N	$\times 10^{-9}$	billionth (0.000000001)

Base units. These are the units all numbers need to be converted to before you calculate a value. Prefixes before the unit is a way of displaying a very large or small number in an easier way.

The best way to convert back to base units is to put the value in as above into your calculator

e.g. Force $500 \text{ kN} = 500 \times 10^3 \text{ N}$ (or 500,000 N) (base unit is a Newton)

Current $25 \text{ mA} = 25 \times 10^{-3} \text{ A}$ (or 0.025A) (base unit is an Amp)

Energy $435 \text{ MJ} = 435 \times 10^6 \text{ J}$ (435,000,000 J) (base unit is a Joule)

Charge $45 \mu\text{C} = 45 \times 10^{-6} \text{ C}$ (0.000045 C) (base unit is a Coulomb)

Watch out !!!!

- The base unit for mass is kilograms (kg) don't convert this.
- Convert grams to kilograms by $\div 1000$ e.g. $30 \text{ g} = 30 \div 1000 = 0.030 \text{ kg}$.

Example question: What is the potential difference across a $220 \text{ k}\Omega$ resistor, with a current of $50 \mu\text{A}$ flowing through it?

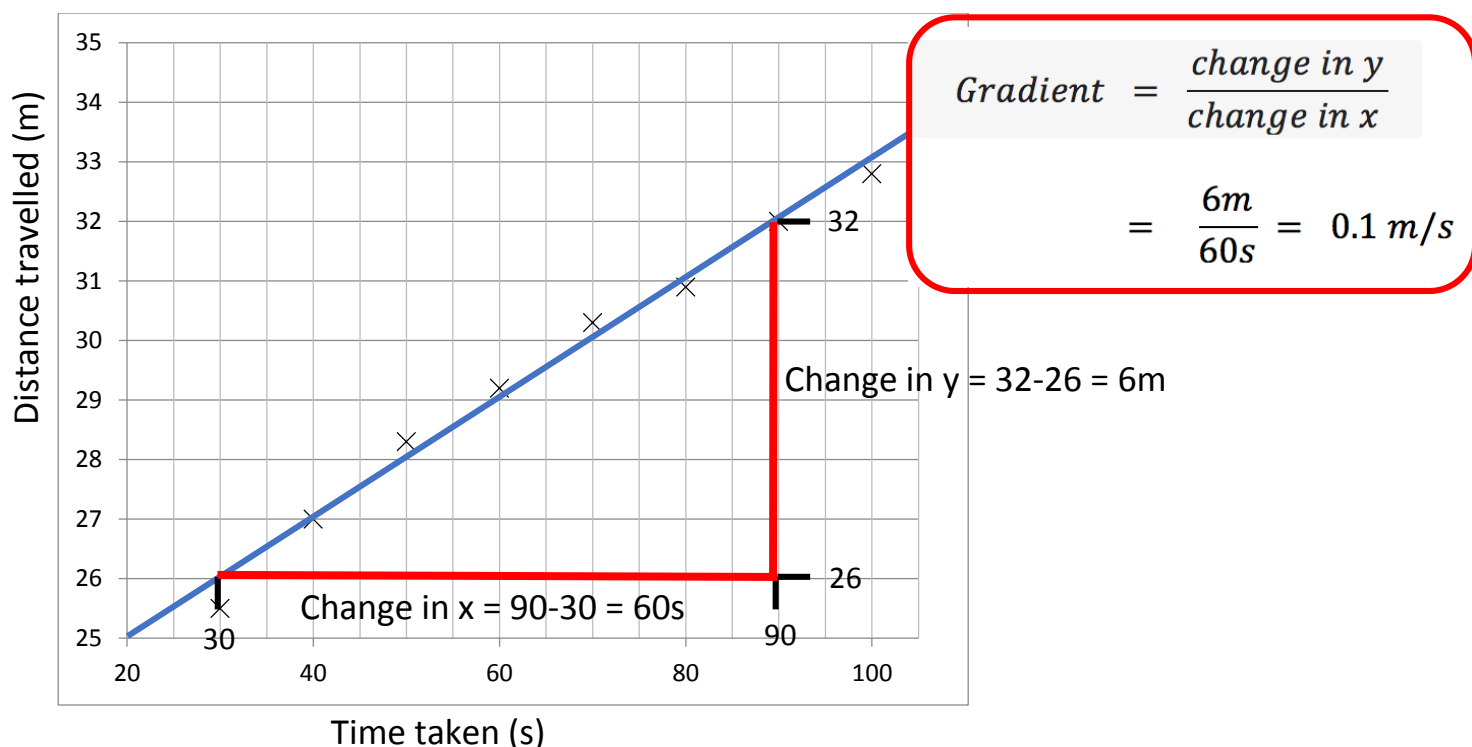
$$\text{Potential difference} = \text{current} \times \text{resistance} = 220 \times 10^3 \times 50 \times 10^{-6} = 11 \text{ V}$$

(see earlier pages for how to enter this into your calculator)

Graph skills and relationships

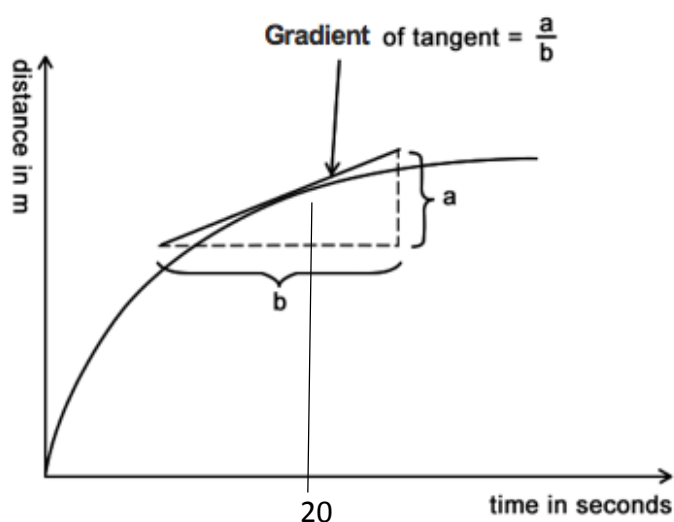
Measuring a gradient and showing your working

1. Draw a best fit line, with the same number of points on one side as the other.
2. Draw a large triangle on the board squares, to where it meets the best fit line.
3. Mark the values at the end of each length of the triangle
4. Calculate the length of the two sides of the triangle.
5. Calculate the gradient and include the units. (Gradient = change in y ÷ change in x)



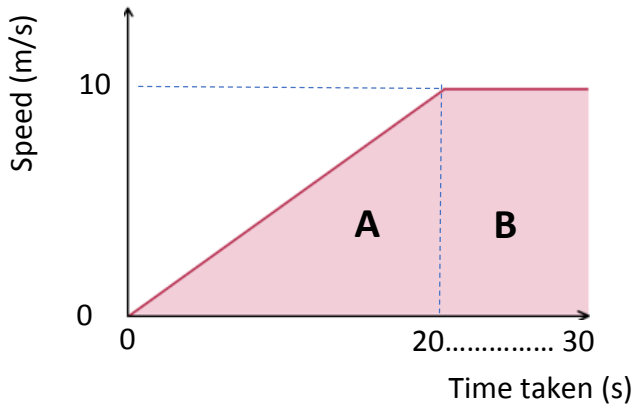
Measuring the gradient of a curve at a particular point (Higher paper only)

Most of the time, the graph will have time on the bottom axis. This means the gradient tells us how fast something is changing against time (s). (The **rate** of change)



1. Draw a line where you are asked to measure the gradient (e.g. 20 seconds)
2. Draw the tangent to the curve at this point.
3. Measure the gradient as shown in the above example.

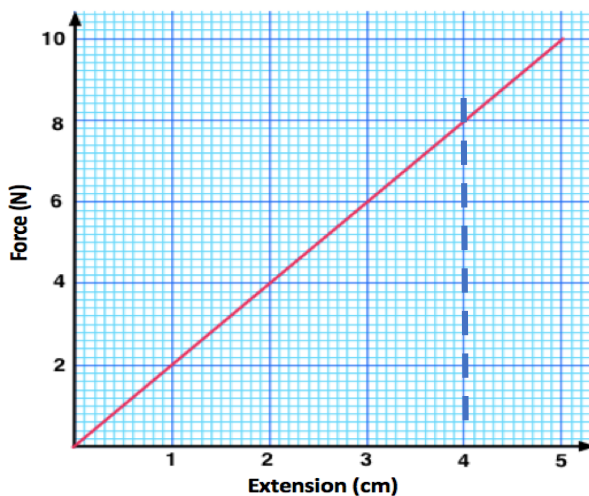
Finding the area under a graph and what does it mean



Area under a speed - time graph is speed x time
= distance travelled

Area = Area A (triangle) + Area B (rectangle)

$$\text{Area} = \frac{1}{2} \times 20 \times 10 + 10 \times 10 = 200\text{m}$$



The area under a Force extension graph. Is:

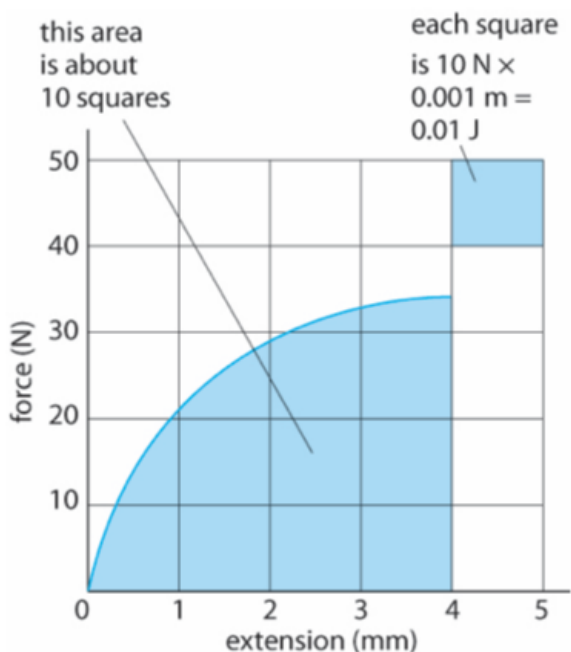
Force x distance = work done

This is the elastic potential energy stored in the spring.

Elastic potential energy stored with an extension of 4 cm

$$\dots \text{Area of triangle} = \frac{1}{2} \times 8 \times 4 = 16 \text{ J}$$

If the graph is a curve!!



Step 1: Calculate energy stored in each square:

$$\begin{aligned} \text{Energy stored} &= \text{Force (N)} \times \text{extension (m)} \\ &= 10\text{N} \times 0.001 \text{ m} = 0.01 \text{ J} \end{aligned}$$

Step 2:

Count how many squares are covered by counting the whole squares and then estimating the rest.

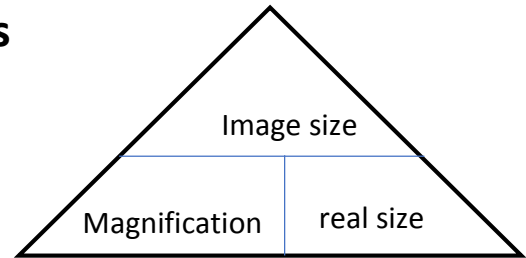
Step 3: About 10 squares in total

Multiply the number of squares under your graph by how much energy is stored in each square in J

$$\text{Energy stored} = \text{number of squares} \times \text{energy of each square} = 10 \times 0.01 = 0.1 \text{ J}$$

Magnification in Microscope calculations

$$\text{magnification} = \frac{\text{image size}}{\text{real size}}$$



Example:

A scientist observed a cell using an electron microscope.

The size of the image was 25 mm.

The magnification was $\times 100\,000$

Calculate the real size of the cell and quote your answer in μm

Re-arranging the equation: $\text{real size} = \frac{\text{image size}}{\text{magnification}} = \frac{25}{100\,000} = 0.00025 = 0.25\mu\text{m}$

Using a graticule scale on a microscope to calculate the real size of an object

When you look through a microscope there is a graticule, which is a ruler with divisions. The actual size of the division, measure in μm (millionth of a metre), depends on the magnification. See the table below.

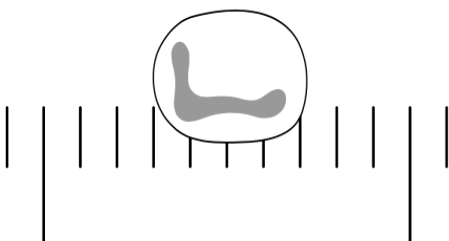
Magnification	Size of each graticule division (μm)
x10	20 μm
x40	5 μm
x100	2 μm
x400	0.5 μm

To calculate the actual size of the object you need to:

- measured the objects size using the graticule scale, by counting the number of divisions.
- Multiply the number of divisions with the graticule division scale.

SIZE OF OBJECT = SIZE OF GRATICULE DIVISION (μm) x LENGTH OF OBJECT (divisions)

Example:.....



What is the actual size of this cell viewed under the microscope with a magnification of $\times 100$?
(Refer to the table above for the size of the graticule divisions).

Cell is 4 divisions long. Each division is actually $2\mu\text{m}$

$$\text{Actual size} = 4 \times 2\mu\text{m} = 8\mu\text{m}$$

Calculating percentage difference in data

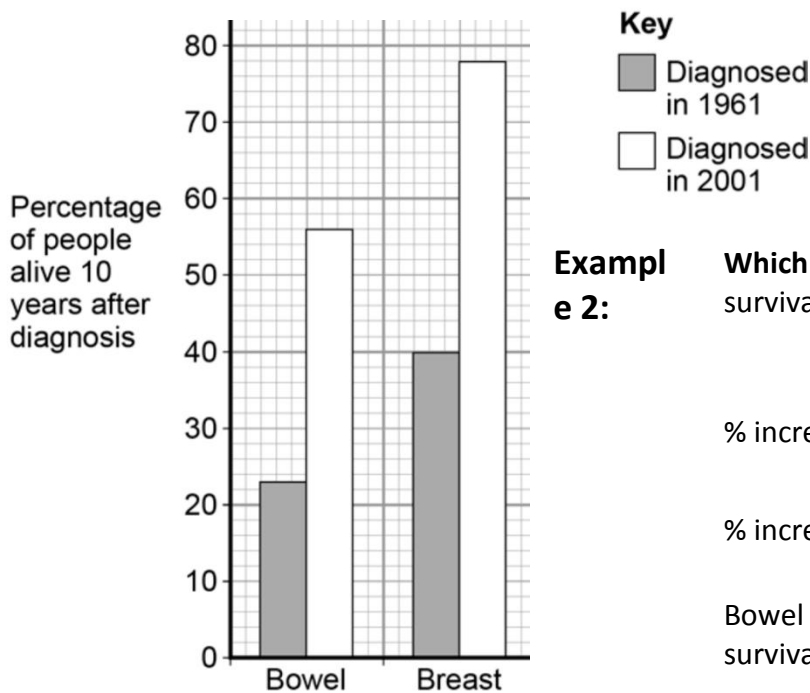
When data increases or decreases, we often want to compare this amount of change with the original value to see if this change is significant. We use percentage difference to do this.

$$\text{Percentage change} = \frac{\text{end value} - \text{start value}}{\text{start value}} \times 100$$

If the value is positive then it is a percentage increase.

If it is negative it is a percentage decrease.

Example 1:



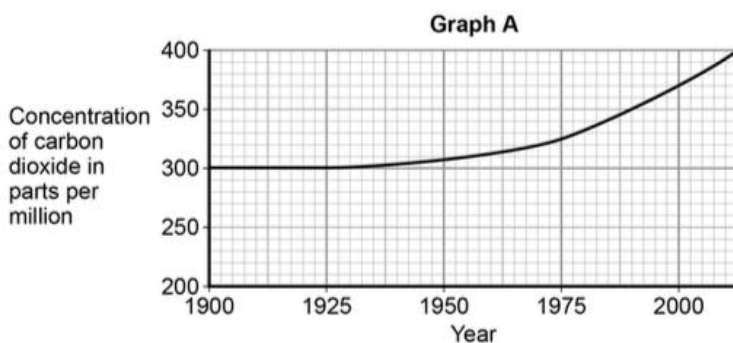
Example 2:

Which has the greater percentage increase in the survival rate from 1961 to 2001, Bowel or Breast cancer?

$$\% \text{ increase in bowel cancer} = \frac{56-23}{23} \times 100 = 143\%$$

$$\% \text{ increase in breast cancer} = \frac{78-40}{40} \times 100 = 95\%$$

Bowel cancer has the greatest percentage increase in survival rates.



Calculate the percentage increase in carbon dioxide concentration between 1975 and 2000.

$$\% \text{ increase} = \frac{370-325}{325} \times 100 = 13.8\%$$

Means, ranges, uncertainties and percentage uncertainty in repeat readings

Temperature (°C)	Time taken for reaction to finish (s)			Mean average time (s)	Range (s)	Estimated uncertainty	Percentage uncertainty (%)
	1	2	3				
10	99	101	97	99	4	2	4.04

Mean = $\frac{\text{Add up all values}}{\text{Total number of values}}$

$$\text{Mean} = \frac{99 + 101 + 97}{3} = 99$$

Range = highest measurement – lowest measurement

$$\text{Range} = 101 - 97 = 4$$

Estimated uncertainty = $\frac{\text{range}}{2}$

$$\text{Uncertainty} = \frac{4}{2} = 2$$

Percentage uncertainty = $\frac{\text{range}}{\text{mean}} \times 100$

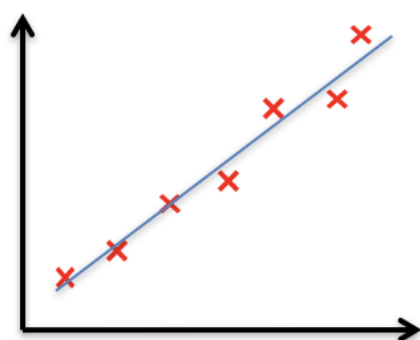
$$\text{Uncertainty} = \frac{4}{99} \times 100 = 4.04$$

If there is an outlier in the results, ring it and do NOT use it. When calculating the mean you would only use 49 and 51, so mean = $(49 + 51)/2$. You would also not use 39 in any of the other calculations above.

49	39	51				
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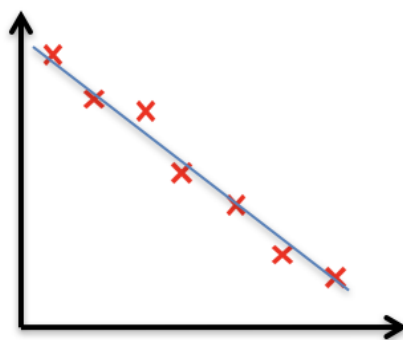
Describing the trend of results.

Use the name/title on the axes to describe the pattern.



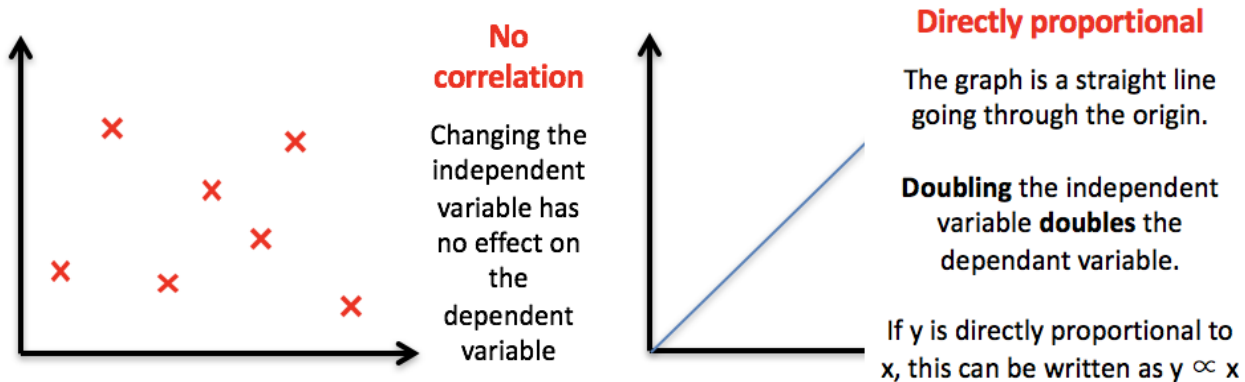
Positive correlation

As the independent variable increases, so does the dependent variable



Negative correlation

As the independent variable increases, the dependent variable decreases



Accuracy and Precision in data collected

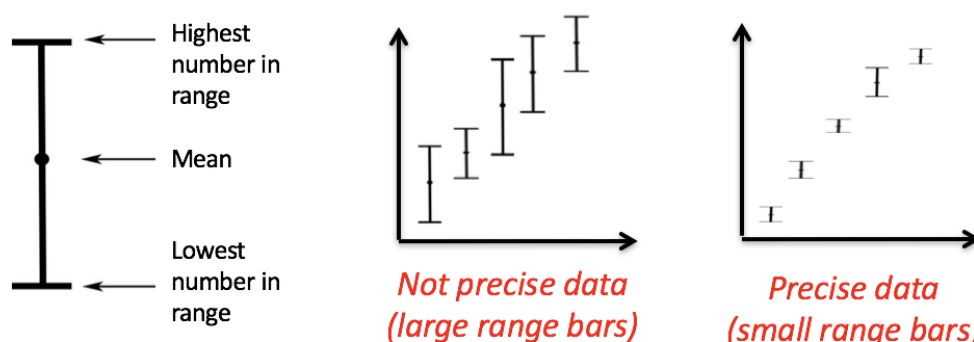
Accuracy.

An accurate measurement is one that is close to the true value.



Precision.

Precise measurements are ones where there is very little spread about the mean value.



- In a table of results, look at the repeat reading, the closer they are together the more precise the data. You can also look at the value for the range, the smaller the range the more precise the data.
- Intergraph that has range bars, the smaller the range bar the more precise the value.

Command words (tells you what you need to do in the question)

Word	What you should do.
Calculate	You should use numbers given in the question to work out the answer.
Choose	You should select from the range of alternatives.
Compare	You should describe the similarities and/or differences between things, not just write about one of them.
Complete	This means writing answers in in the space provided. For example on the diagram, in this spaces in a sentence, or in a table
Define	You need to specify the meaning of something
Describe	You need to say what something is like, e.g. the shape of a graph..
Design	You need to set out how something will be done, e.g. an experiment.
Determine	You need to use the data or information given to answer the question
Draw	You need to produce, or add to, the diagram.
Estimate	You need to give an approximate value
Evaluate	You should use the information supplied, as well as your knowledge and understanding, to consider evidence for and against.
Explain	Use science to explain why something happened.
Give	Only write a short answer is required, not an explanation or description.
Identify	You need to name or otherwise characterise
Justify	You need to use evidence from the information supplied to support your answer.
Label	You should write appropriate names on the diagram
Measure	You should find an item of data for a given quantity (e.g. from a graph or for scale drawing).
Name	Only write a short answer is required, not an explanation or description. Often it can be answered with a single word, phrase what sentence.
Plan	You should write a method.
Predict	You should write a plausible outcome.
Show	You should provide structured evidence to reach a conclusion.
Sketch	You should draw an approximate diagram, e.g the pattern of the graph without scales.
Suggest	This word is used when they want you to apply your knowledge and understanding to a new situation.
Use	Your answer must be based on the information given in the question, include figures to show this.
Write	Only a short answer is required, not an explanation or a description.

Subject specific vocabulary

Accuracy	The measurement is considered accurate if it is close to the true value
Calibration	Marking scale on a measured instrument. For example, placing a thermometer in melted ice to see whether it read zero, in order to check if it has been calibrated correctly.
Data	Information that has been collected.
Measurement error	The difference between a measured value and the true value. For example, measuring the length of the spring = 6.2cm, when the true value = 5.9cm. The measurement error is $6.2 - 5.9 = 0.2\text{cm}$.
Anomalies	These are values in a set of repeat results that are outside the variation caused by random uncertainty. (This used to be called an outlier)
Random error	<ul style="list-style-type: none"> • These are practical errors that cause repeat readings to be spread around the true value. • Random errors are present when any measurement is made and cannot be corrected. • The effect of random errors can be reduced by making more measurements (eliminating anomalies) and calculating a new mean.
Systematic error	<ul style="list-style-type: none"> • This causes readings to differ from the true value by the same amount (consistent amount) each time and measurement is made. • Sources of systematic error can include the environment, methods observation or instruments used. • Systematic errors cannot be dealt with by simple repeats. • If a systematic error is suspected, the data collected should be repeated using a different technique or a different set of equipment, and the results compared.
Zero error	Any measuring equipment that gives a false reading, when the true value should be zero. E.g. the needle of an ammeter not reading zero when no current flows. A zero error maybe cause a systematic uncertainty.
Evidence	This is data which has shown to be valid.
Fair test	A fair test is one which only the independent variable has been allowed to affect the dependent variable. All other variables that might affect the dependant variable have been controlled.
Hypothesis	A proposal intended to explain certain facts or observations.
Interval	This is the quantity between readings, e.g. a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres.
Precision	Precise measurements are ones in which there is very little spread about the mean value. Precision depends only on the extent of random errors. It does not tell you how close the results are to the true value (that is accuracy).
Prediction	You should write what you think would happen.
Range	This is the maximum and minimum values of the independent or dependent variables. For example a range of distances may be quoted is either; 'from 10 cm to 50 cm' or 'from 50 cm to 10 cm'.