AS LEVEL BIOLOGY – FLYING START

Subject:	Qualification/Level:	Examination Board:
Biology	A-Level	AQA

The summer transition challenge:

- Cell structure: Understand the function of organelles and know the difference between plant, animal and bacterial cells
- Maths skills: Be able to use units, significant figures, standard form and calculate ratios

Students should complete the answers within the work book or on lined paper.

A mark scheme will be provided and should be marked with areas of weakness identified in green pen when students start the course in September.

Success criteria:

- Be able to identify the differences between plant, animal and bacterial cells and describe the function of each organelle
- Be able to convert in and out of standard form, use ratios and units

Where can I access help with this or ask any further questions regarding the course?

The internet – AQA Website, AS Biology head start book from CGP – ISBN – 978-1782942795 or Dr C Haycock

What equipment will I need for this subject?

- Scientific calculator (Casio fx-85 recommended)

- Purchase A level Biology book Year 1 book – ISBN – 978-78294 3198

To understand more about this subject at a higher level:

If you fancy buying an ***additional*** *book* ***to the one required for the course,*** *you should read –*

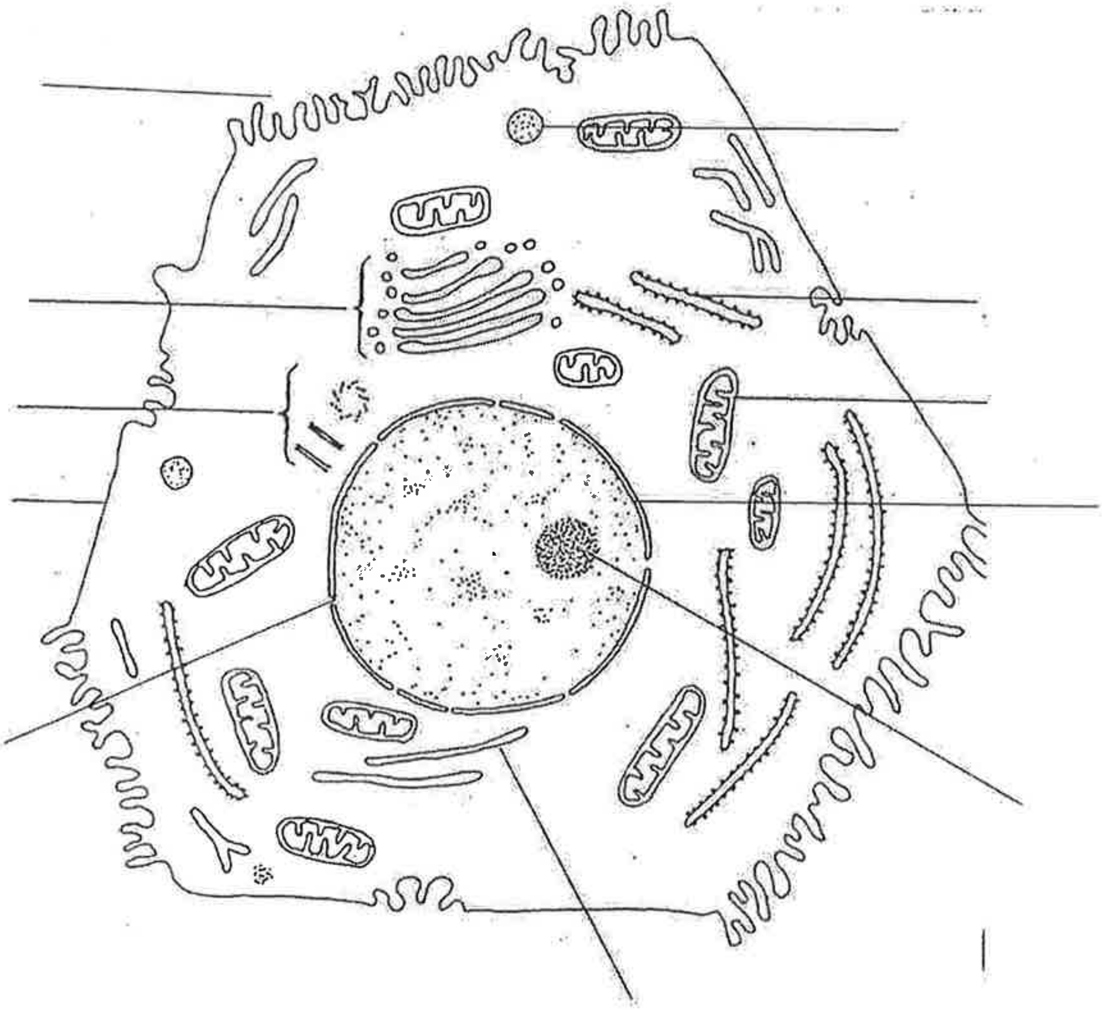
- *New A-Level Biology: AQA Year 1 & 2 Complete Revision & Practice with Online Edition* - ISBN - 978-1782942979
- *AQA Biology A Level Year 1 Second Edition Student Book* - 978-0198351764

Alternatively take a look at some of these websites –

- http://www.aqa.org.uk/subjects/science/as-and-a-level/biology-7401-7402
- http://www.s-cool.co.uk/a-level/biology
- http://www.biologymad.com/

Animal, Plant and Bacterial cells

Look at the diagram below and label all the organelles found in the cell.

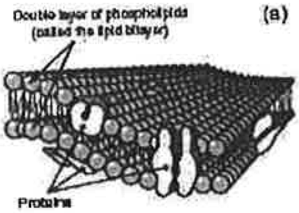
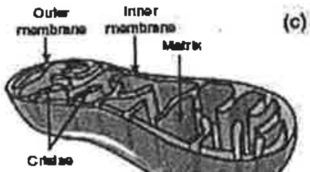


Is this an animal, plant or bacterial cell? How do you know?

Have a go at completing the following table stating the name, location and function of each organelle.

Cell Structures and Organelles

The table below provides a format to summarise information about structures and organelles of typical eukaryotic cells. Complete the table using the list provided and by referring to a textbook and to other pages in this topic. Fill in the final three columns by writing either 'YES' or 'NO'. The first cell component has been completed for you as a guide and the log scale of measurements (top of next page) illustrates the relative sizes of some cellular structures. **List of structures and organelles:** cell wall, mitochondrion, chloroplast, centrioles, ribosome, endoplasmic reticulum, Golgi apparatus.

<table>
<tr><th rowspan="2">Cell Component</th><th rowspan="2">Details</th><th colspan="2">Present in</th><th rowspan="2">Visible under light microscope</th></tr>
<tr><th>Plant cells</th><th>Animal cells</th></tr>
<tr><td>(a)
</td><td>Name: Plasma (cell surface) membrane
Location: Surrounding the cell
Function: Gives the cell shape and protection. It also regulates the movement of substances into and out of the cell.</td><td>YES</td><td>YES</td><td>YES
(but not at the level of detail shown in the diagram)</td></tr>
<tr><td>(b)
</td><td>Name:
Location:
Function:</td><td></td><td></td><td></td></tr>
<tr><td>(c)
</td><td>Name:
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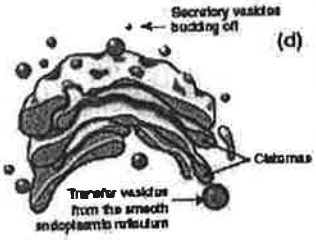
<tr><td>(d)
</td><td>Name:
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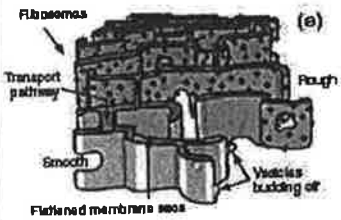
<tr><td>(e)
</td><td>Name:
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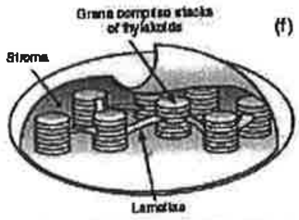
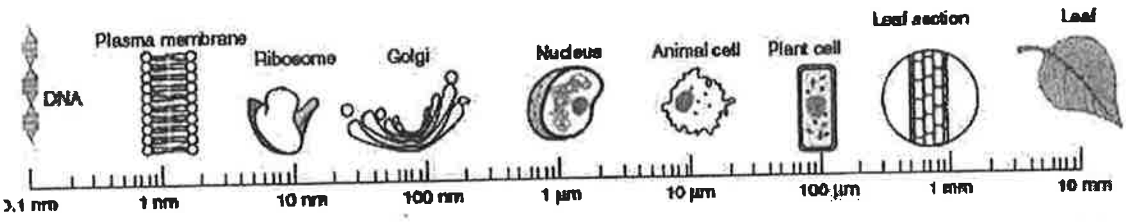
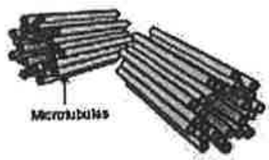
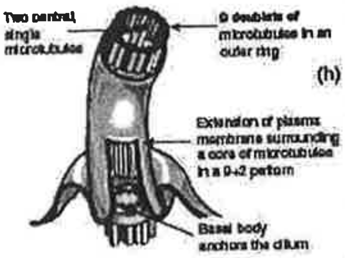
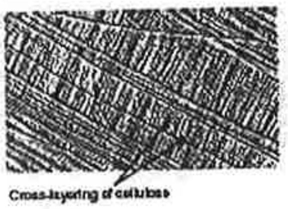
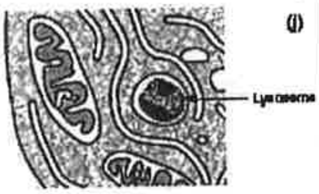
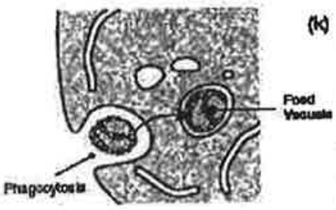
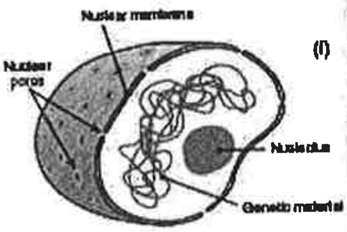
<tr><td>(f)
</td><td>Name:
Location:
Function:</td><td></td><td></td><td></td></tr>
</table>



Cell Component	Details	Present in		Visible under light microscope
		Plant cells	Animal cells	
(g) 	Name: Location: Function:			
(h) 	Name: Cilia and flagella (some eukaryotic cells) Location: Function:			
(i) 	Name: Location: Function:			
(j) 	Name: Lysosome Location: Function:			
(k) 	Name: Vacuole (a food vacuole is shown) Location: Function:			
(l) 	Name: Nucleus Location: Function:			

Place a tick in the box to indicate where the organelle is found. Some organelles can be found in both plant and animal cells.

Organelle	Plant Cell	Animal Cell
Cell Wall		
Chloroplast		
Cytoplasm		
Endoplasmic reticulum		
Golgi apparatus		
Lysosome		
Nucleolus		
Nucleus		
Plasma membrane		
Ribosome		
Vacuole		
Mitochondria		

Cells are categorised as either prokaryotes or eukaryotes. Find out what this means and give 1 example for each of these categories.

Prokaryote	Eukaryote

Maths skills for Biology

1. Units and pre-fixes

One of the reasons we use the international system of units is because it makes the conversion of units (especially those with different prefixes) mathematically simple.

We use prefixes as shorthand for standard form when using commonly occurring very large or very small numbers.

This makes it easier to discuss and talk about sets of these numbers.

For example, the length 0.0000000023 m may be written as 2.3×10^{-9} m

2.3 is the **digit number** and is kept. 10^{-9} is known as the **exponential number** and can be replaced with the prefix *'n'* pronounced as '**nano**'.

Hence

$$0.0000000023 \text{ m} = 2.3 \times 10^{-9} \text{ m} = 2.3 \text{ nm}$$

When measuring a variable in science we must consider the best unit (and prefix) to use. This often differs depending on the subject.

Variable	Prefix	Unit	Example
Length	centi (c)	metre (m)	15 cm
Volume	milli (m)	Litre (L)	330 mL
Force	kilo (k)	Newton (N)	0.8 kN
Area	centi	metre squared	624 cm^2

- Here are the common unit prefixes you are likely to encounter:

Number		Exponential number	Prefix	
billion	1 000 000 000	10^9	G	'giga'
million	1 000 000	10^6	M	'mega'
thousand	1000	10^3	k	'kilo'
ten	10	10^2	d	'deci'
hundredth	0.01	10^{-2}	c	'centi'
thousandth	0.001	10^{-3}	m	'milli'
millionth	0.000 000 1	10^{-6}	μ	'micro'

billionth	0.000 000 000 1	10^{-9}	n	'nano'

Example 1

The length of a DNA nucleotide is 0.6 nm.

a) Convert this number into standard form.

b) If a strand of DNA is 1.6 m long, how many nucleotides is it made up of?

Answers

a) 0.6 nm = 0.6×10^{-9} m

b) 1.8 m / 0.6 nm = 1.8 m / (0.6×10^{-9} m) = 3×10^{9} = 3 billion

Manipulating units

- A number and a unit (like 3 m) is a magnitude (3) multiplied by a unit (metre).
- The rules of algebra apply not only to the numbers you are manipulating, but also to the units attached to them. For example:

$3\text{ m} \times 3\text{ m} = 3 \times 3 \times \text{m} \times \text{m} = 9 \times \text{m} \times \text{m} = 9 \times \text{m}^2 = 9\text{ m}^2$

- Units can be multiplied and divided just like regular number. For example:

$$\frac{6\text{ m}^3}{2\text{ m}^2} = 3\frac{\text{m}^3}{\text{m}^2} = 3\frac{\text{m} \times \text{m} \times \text{m}}{\text{m} \times \text{m}} = 3\frac{\text{m} \times \text{m} \times \text{m}}{\text{m} \times \text{m}} = 3\text{ m}$$

- At A-level, rather than write m/s to mean metres per second, we will write ms^{-1}.
- This makes it easier to combine units via the following rules:

$$unit^a \times unit^b = unit^{a+b}$$

$$\frac{unit^a}{unit^b} = unit^{a-b}$$

- Nb This means that: $\frac{1}{\text{kg}^{-1}} = \text{kg}$ or more generally $\frac{1}{a^{-n}} = a^n$

Example 2

a) Calculate the following: $\frac{36\text{ cm}^3}{12\text{ cm}^2}$

b) Calculate the following: $\frac{36\text{ kg cm}^{-3}}{12\text{ cm}^{-2}}$

Answers

a) $\frac{36\text{ cm}^3}{12\text{ cm}^2} = 3\text{ cm}^{3-2} = 3\text{ cm}^1 = 3\text{ cm}$

b) $\frac{36\text{ kg cm}^{-3}}{64\text{ cm}^{-2}} = 0.5\frac{\text{kg cm}^{-3}}{\text{cm}^{-2}} = 0.5\text{ kg cm}^{-3-(-2)} = 0.5\text{ kg cm}^{-3+2} = 0.5\text{ kg cm}^{-1}$

(c) The table below shows some features of gas exchange of a fish at rest.

Volume of oxygen absorbed by the gills from each dm^3 of water / cm^3	7
Mass of fish / kg	0.4
Oxygen required by fish / cm^3 kg^{-1} $hour^{-1}$	90

(i) Calculate the volume of water that would have to pass over the gills each hour to supply the oxygen required by the fish. Show your working.

.... dm^3

(2)

Answer:

$\mathbf{90\ cm^3\ kg^{-1}\ hour^{-1}}$ means 90 cm^3 of oxygen required per kg per hour. Therefore,

$90\ cm^3\ kg^{-1}\ hour^{-1} \times 0.4\ kg = 36\ cm^3\ hour^{-1}$ of oxygen required

$\mathbf{7\ cm^3\ dm^{-3}}$ *means 7 cm^3 of oxygen absorbed per dm^3 of water passing over gills*

$$\text{Therefore} \quad \frac{36\ cm^3\ hour^{-1}}{7\ cm^3\ dm^{-3}} = 5.1\ dm^3\ hour^{-1}$$

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Units worksheet

Mathematics for A-level Science

Practice your understanding

Convert the following numbers into metres:

1. 3 km
2. 20 cm
3. 2.3 mm
4. 550 nm
5. 5.1 μm
6. 13.7 Gm
7. 0.0025 km
8. 1.001 km

Simplify the following units:

1. $\text{cm} \times \text{cm}$
2. $\text{km}^2 \times \text{km}$
3. $\text{nm}^2 \times \text{nm}^{-1}$
4. $\frac{\text{kg m}}{\text{m}}$
5. $\frac{\text{cm}^3}{\text{cm}}$
6. $\frac{\text{kg cm}^3}{\text{cm}}$
7. $\frac{\text{cm}}{\text{cm}^2}$
8. $\frac{\text{g cm}^2}{\text{cm}^{-1}}$

9. Concrete has a density of $2400\ \text{kg m}^{-3}$. What volume of concrete would have a mass of 96 kg?

10. What would this volume be in a) dm^3 and b) cm^3

2. Standard form

We use standard form to easily manage very large or very small numbers.

For example, the number 0.00000000000087 may be written as 8.7×10^{-13}

In this form, 8.7×10^{-13} is the product of two numbers: 8.7 is the **digit number**, and 10^{-13} is the **exponential number.**

A number is in standard form when it is written as $a \times 10^{n}$, where $1 \le a < 10$

Here are some further examples of numbers in standard form.

Decimal	Standard Form
134 000	1.34×10^{5}
0.0034	3.4×10^{-3}
82 000 000	8.2×10^{7}
270	2.7×10^{2}
0.000000000026	2.6×10^{-11}

In standard form, the power of 10 shows the number of places the decimal point must be shifted to give the number in decimal form. A positive power will shift to the **right**, and a negative power will shift to the **left.**

In standard form, the digit number also contains the number of **significant figures** in the number. The exponential number positions the decimal point.

$$8.7 \times 10^{-4} = 0.00087$$

Shift 4 left

To convert to standard form, shift the decimal until there is one non-zero digit left of the decimal point, and count the number of places the decimal point has "moved" (this will be negative if your initial number was less than one). This number is the power of 10.

$$328\ 000 = 3.28 \times 10^{5}$$

To type a number in standard form on your calculator,

- Input the digit number followed by the multiplication sign.
- Locate the "10^{x}" symbol, and use this to insert the exponent.
- Check your equation for any needed brackets.

To check, multiply 6.1×10^{4} and 2×10^{3}. The answer should be 1.22×10^{8}

Example 1

On July 14 2015, the space probe New Horizons passed by Pluto after travelling 4.7×10^{12} metres from Earth.

a) Write this number in decimal form.

Earlier, the space probe flew past Jupiter, which is 5.88×10^{8} metres from Earth.

b) How many times further did the space probe travel from Earth to Pluto than Earth to Jupiter?

a) 4 700 000 000 000 metres.

This was calculated by shifting the decimal point to the left 12 times.

b) $(4.7 \times 10^{12}) / (5.88 \times 10^{8}) \approx 8 \times 10^{3} \approx 8000$ times farther.

Example 2

0.0125 moles of a particular substance were dissolved in 2.5 dm^3 of water. What is the concentration of this substance? Give your answer in standard form.

$0.0125 / 2.5 = 0.005$ mol $dm^{-3} = 5 \times 10^{-3}$ mol dm^{-3}

Example 3

A cross section of an artery contains 9.2×10^{-9} m^3 of blood.

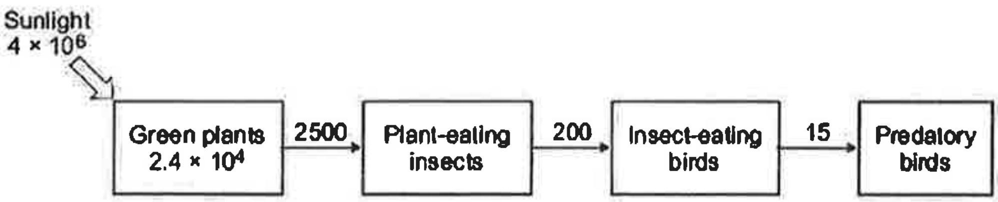
If this blood weighs 7.1×10^{-3} g, calculate the density of the blood. Leave your answer in standard form.

$(9.2 \times 10^{-9}) / (7.1 \times 10^{-3}) \approx 1.3 \times 10^{-6}$ kg m^{-3}

Exam question

The diagram shows the annual flow of energy through a habitat.

The figures are in kJ m^{-2}.



(a) (i) Calculate the percentage of the energy in sunlight that was transferred into energy in the green plants.

Show clearly how you work out your answer.

....

....

....

....

Answer = ...

(2)

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Standard form worksheet

Mathematics for A-level Science

Practice your understanding

Convert the following numbers into standard form:

1. 32 000
2. 0.0006
3. 104 000
4. 18 200 000
5. 9 230 000
6. 0.0000405
7. 0.002019
8. 30 200

Convert the following numbers from standard form into decimal notation:

9. 3.26×10^4
10. 8.4×10^{-3}
11. 7.29×10^7
12. 1.26×10^2
13. 8×10^{-6}
14. 1.3×10^8
15. 2.3×10^{-4}
16. 5.001×10^6

17. Using the formula Circumference = 3.14 × radius, and given that the mean radius of the Earth is 6 378 000 m, calculate the approximate circumference of the Earth leaving your answer in standard form to two significant figures.

18. There are 86 400 seconds in a day. Calculate the number of seconds in a year leaving your answer in standard form to two significant figures.

19. The current world population is approximately 7.4×10^9 people. The United Kingdom population accounts for 0.88% of the total world population. Using this information, approximate the number of people living in the United Kingdom leaving your answer as a decimal number.

3. Ratios

Understanding ratio allows us to easily compare separate quantities. We can then examine patterns, comment on the relationship, or use ratios to help us solve equations.

For example:

- Use 3 parts red paint to 1 part white paint.
- Use 1 teabag to 250 ml of water.
- Use 1 shovel of cement to 2 shovels of sand.

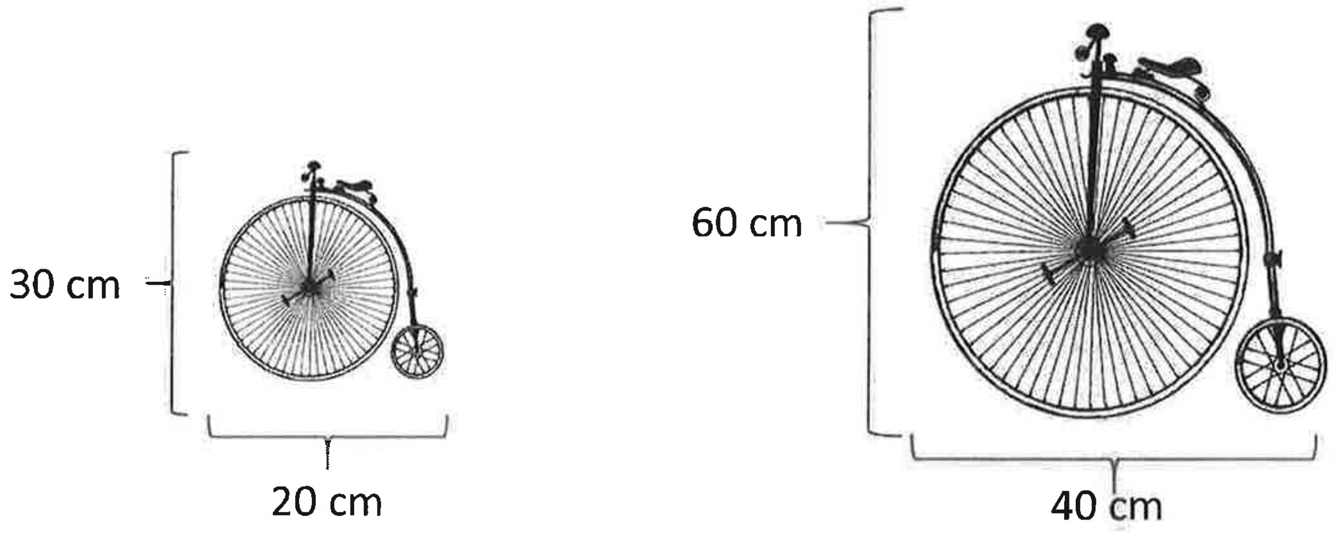
The order of the ratio is very important.

The number of teabags used per ml of water would be **1:250**. Saying that the answer was 250:1 would mean something very different.

We can use ratios to scale measurements, drawings, and calculations up and down.

The height to width ratio of a picture is **3:2**. For every 3 cm of height there is 2 cm of width.

We could increase the size of the picture so that it is 30 cm high. If we do this, the picture should be 20 cm wide. If we made the picture 60 cm high, it should be 40 cm wide, which is still in the ratio **3:2**.



We can write a ratio as a fraction by scaling the ratio so that it is divided by the total number of parts.

Example: To make mortar, we need 1 part cement, and 2 parts sand. The total number of parts for one batch of mortar is $1 + 2 = \mathbf{3}$. Thus the ratio for creating mortar is **1:2** which can also now be expressed as $\frac{1}{3}:\frac{2}{3}$

From this form, it is easy to see how much of the total mixture is sand ($\frac{2}{3}$) and how much is concrete ($\frac{1}{3}$).

Here is a list of ingredients.

Serves 4 people	
Bacon	50 g
Minced beef	450 g
Chopped tomatoes	400 g
Button mushrooms	100 g
Beef stock	125 ml

Marco is making a meal for 14 people using these ingredients.

Work out the number of grams of minced beef he needs.

The ratio is 14:4 which is equal to 7:2

If 450 g of minced beef represents 2 parts of the total amount,

1 part is equal to 225 g, and 7 parts would be equal to 7 × 225=1575g

Researchers investigated some characteristics of people from different parts of England. In the north of England they selected 200 people and recorded their phenotypes for three different characteristics.

Their results are shown in the figure below.

Phenotype produced by dominant allele	**Number of people**	**Phenotype produced by recessive allele**	**Number of people**
Tongue roller	131	Non-tongue roller	58
Right-handed	182	Left-handed	14
Straight thumb	142	Hitch-hiker thumb	50

Calculate the ratio of straight thumb to hitch-hiker thumb in this study.

The ratio is simply **142:50**. This should be simplified to **2.84:1**

AQA
Realising potential

Ratio worksheet

Mathematics for A-level Science

Practice your understanding

Simplify the following ratios (Example $6:4 = 3:2$):

1. $120:50$
2. $64:24$
3. $13:52$
4. $100:10\,000$
5. $24:72$
6. $18:90$
7. $56:88$
8. $36:144$

Find x by scaling the ratio.

9. $1:2 = 4:x$
10. $8:3 = x:9$
11. $25:10 = x:2$
12. $x:160 = 2:8$
13. $49:x = 2:4$
14. $58.5:18 = x:4$

15. A toy is made from red bricks and yellow bricks.
Number of red bricks: Number of yellow bricks = 5:2.
There are 210 more red bricks and yellow bricks.

    How many red bricks are in the toy?

16. There are 100 balls in a bag. The balls are red, blue, green or white. The ratio of blue to red is 5:1. There are twice as many blue as green. $\frac{1}{4}$ of the balls are green.

    How many white balls are in the bag?

17. One day, 460 people visit a zoo. 280 are adults. The ratio of women to men is 4:3.
180 are children. $\frac{3}{5}$ of them are boys. Jane says that altogether there were more females visiting the zoo.

    Show that she is correct.