My mathematical journey

What do I need to remember from before?

Number lines (NP1, 2, 3, and 6)

Decimals (NP1, 2, and 3)

Fractions (NP7)

Finding a fraction of a number (NP7)

What will I learn about in this unit?

Equivalent fractions, decimals and percentages

Terminating and recurring decimals

Working with percentages

Where does this lead?

Proportional reasoning (NP10)

Contextual graphs (A9)

Percentage change (NP10, NP13)

Recurring decimals to fractions (NP14)

Key words and symbols: what I need to say and write accurately

32% means $\frac{32}{100}$

"percent" means "out of 100"

A terminating decimal has a finite (fixed) number of decimal places,
e.g. 0.215
e.g. 0.3

A recurring decimal has an infinite number of decimal places and its digits have a repeating pattern. The repetend is the repeating part. We use dots to show the start and end of the repetend.
e.g. $0.333333333\ldots = 0.\dot{3}$
e.g. $0.804804804\ldots = 0.\dot{8}0\dot{4}$

Fingertip facts: what I need to learn by heart

Tenths and fifths:

Fraction	$\frac{1}{10}$	$\frac{2}{10}=\frac{1}{5}$	$\frac{3}{10}$	$\frac{4}{10}=\frac{2}{5}$	$\frac{5}{10}=\frac{1}{2}$	$\frac{6}{10}=\frac{3}{5}$	$\frac{7}{10}$	$\frac{8}{10}=\frac{4}{5}$	$\frac{9}{10}$	$\frac{10}{10}=1$
Decimal	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Percentage	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Eighths and quarters:

Fraction	$\frac{1}{8}$	$\frac{2}{8}=\frac{1}{4}$	$\frac{3}{8}$	$\frac{4}{8}=\frac{2}{4}=\frac{1}{2}$	$\frac{5}{8}$	$\frac{6}{8}=\frac{3}{4}$	$\frac{7}{8}$	$\frac{8}{8}=\frac{4}{4}=\frac{2}{2}=1$
Decimal	0.125	0.25	0.375	0.5	0.625	0.75	0.875	1
Percentage	12.5%	25%	37.5%	50%	62.5%	75%	87.5%	100%

Ninths and thirds:

Fraction	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{3}{9}=\frac{1}{3}$	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}=\frac{2}{3}$	$\frac{7}{9}$	$\frac{8}{9}$	$\frac{9}{9}=1$
Decimal	$0.\dot{1}$	$0.\dot{2}$	$0.\dot{3}$	$0.\dot{4}$	$0.\dot{5}$	$0.\dot{6}$	$0.\dot{7}$	$0.\dot{8}$	$0.\dot{9}=1$
Percentage	$11.\dot{1}\%$	$22.\dot{2}\%$	$33.\dot{3}\%$	$44.\dot{4}\%$	$55.\dot{5}\%$	$66.\dot{6}\%$	$77.\dot{7}\%$	$88.\dot{8}\%$	$99.\dot{9}\%=100\%$

My mathematical journey

What do I need to remember from before?

Arithmetic strategies (NP1, 2, 3, 4)

Order of operations (NP5)

Negative numbers (NP6)

Algebraic expressions (A1, 2, 3)

Solving equations (A4)

What will I learn about in this unit?

Substituting numbers into expressions and formulae

Writing and using formulae

Rearranging formulae to change the subject

Where does this lead?

All further algebra units

Using formulae in geometry (GM3 onwards)

Advanced proportion (NP13)

Advanced probability and statistics (A Level)

Key words and symbols: what I need to say and write accurately

Word	Explanation
variable	A letter that represents many numbers (a letter whose value can vary) e.g. x, y, θ
constant	A fixed number e.g. 2, -1.8, π
expression	A collection of any variables, constants and operations e.g. $2x + 5$, $a - b$, $3p$, $\frac{n+5}{7}$, $3 \times 4 - 2^3$
substitute	Replace a variable with a constant e.g. When $x = 3$, the value of $2x - 1$ is $2 \times 3 - 1$, or 5.
evaluate	Work out the value of a calculation. e.g. "Evaluate 2 + 3" means "Work out the value of 2 + 3."
formula (pl. formulae or formulas)	A set of instructions to work something out. A formula can be written in words, as an expression or as an equation. Here is a formula in words: Area = length × width Here is the formula as an expression: lw Here is the formula as an equation: $A = lw$
subject	The subject of a formula is the variable that is 'on its own' on one side of the equation. e.g. In the formula $A = lw$, the subject is A.
rearrange	Rearranging a formula means changing its subject. e.g. $A = lw$ can be rearranged to make l the subject: $l = \frac{A}{w}$

My mathematical journey

What do I need to remember from before?

Area of a rectangle (KS2)

Area of rectilinear shapes (NP3)

Perimeter (KS2 & NP2)

Types of polygons (GM2)

What will I learn about in this unit?

Units of length and of area

Area of a triangle

Area of quadrilaterals

Area of a circle

Where does this lead?

Area and circumference of a circle (GM6)

Surface area and volume (GM8)

Advanced area (GM9)

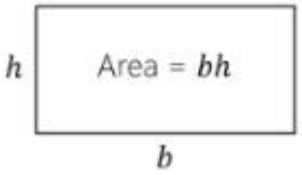
Solving geometric problems (GM11)

Key words and symbols: what I need to say and write accurately

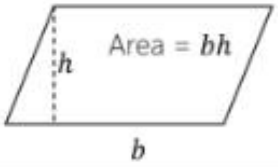
Word	Explanation
Area	A measure of the two-dimensional space inside a shape.
Perimeter	A measure of the one-dimensional boundary that creates a shape.
Perpendicular height	The height of a shape which is at a right angle to its base.
Radius	The length from the centre of a circle to its edge.
Diameter	The length straight across the centre of a circle from edge to edge. Double the radius.

Fingertip facts: what I need to learn by heart

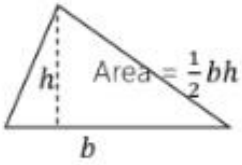
Area of a rectangle = base × perpendicular height



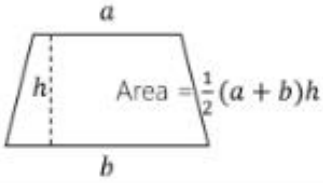
Area of a parallelogram = base × perpendicular height



Area of a triangle =
$\frac{1}{2}$ × base × perpendicular height

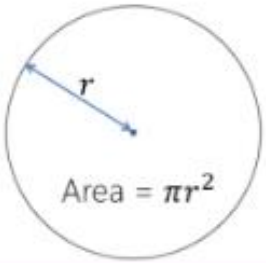


Area of a trapezium =
$\frac{1}{2}$ × sum of the parallel sides × perpendicular height



The area of other polygons can be found by splitting them into triangles.

Area of a circle = pi × square radius



My mathematical journey

What do I need to remember from before?

Inequality symbols, < and > (KS2)

Solving linear equations (A4)

Plotting vertical and horizontal graphs (A6)

What will I learn about in this unit?

Reading, writing and interpreting inequalities

Solving linear inequalities, including in contexts

Plotting simple inequalities in 2D

Where does this lead?

Inequalities in 2D (A??)

Quadratic inequalities (A??)

Non-linear inequalities (A Level Maths)

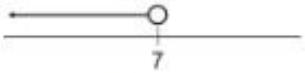
Linear programming (A Level Further Maths)

Key words and symbols: what I need to say and write accurately

Word or symbol	Explanation
>	is greater than
<	is less than
≥	is greater than or equal to
≤	is less than or equal to
equation	a statement that two quantities have equal value, e.g. 5 + 2 = 10 − 3
Inequality	a statement that two quantities do not have equal value, e.g. 5 + 2 < 12 + 1
comparative inequality	an inequality that compares two values, e.g. 4 > 1 or $x > 8$ or $1 \leq x$
restrictive inequality	a 'double' inequality that puts an upper and lower limit on a number, e.g. $5 \leq x < 10$

Phrases meaning 'less than'

$x < 7$



any number which is...

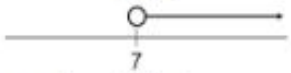
less than 7

up to (but not including) 7

up to (and excluding) 7

Phrases meaning 'greater than'

$x > 7$



any number which is...

greater than 7

exceeding 7

Phrases meaning 'less than or equal to'

$x \leq 7$

any number which is...

less than or equal to 7

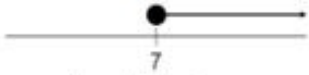
at most 7

no greater/more than 7

up to (and including) 7

Phrases meaning 'greater than or equal to'

$x \geq 7$



any number which is...

greater than or equal to 7

at least 7

no less than 7

Fingertip facts: what I need to learn by heart

Inequalities can be read in both directions.
These two statements mean the same thing.

$5 > 3$ — *read this way* → *5 is greater than 3*

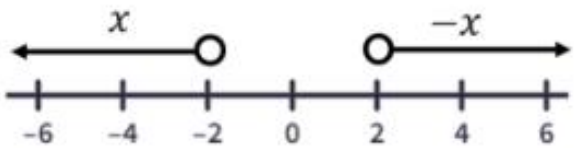
$3 < 5$ — *read this way* → *5 is greater than 3*

3 is less than 5 ← *read this way*

3 is less than 5 ← *read this way*

If we multiply or divide an inequality by a negative number, the direction of the sign reverses due to the rotating effect of multiplication by negatives.

If $-x > 2$,
then $x < -2$



My mathematical journey

What do I need to remember from before?

Place value, multiplication and division by powers of 10 (NP1)

Operations (NP2, NP3, NP4)

Laws of indices (NP5)

What will I learn about in this unit?

Writing large and small numbers in standard form.

Calculating with numbers in standard form.

Where does this lead?

Compound units (NP13)

Index laws (NP15)

Exponential growth (NP16)

You will apply this knowledge in Physics, Chemistry and Biology

Key words and symbols: what I need to say and write accurately

Numbers in standard form look like this.

$$x \times 10^{n}$$

$1 \leq x < 10$

n is an integer

The power of 10 tells us how many place value columns up or down to move.

e.g. 123 000 = $\mathbf{1.23 \times 10^{5}}$

0.000 012 3 = $\mathbf{1.23 \times 10^{-5}}$

Fingertip facts: what I need to learn by heart

Prefixes for SI units

Standard form	Amount	Prefix	Symbol
1×10^{12}	1 000 000 000 000	tera	T
1×10^{9}	1 000 000 000	giga	G
1×10^{6}	1 000 000	mega	M
1×10^{3}	1 000	kilo	k
1×10^{2}	100	hecto	h
1×10^{1}	10	deca	da
1×10^{0}	1		
1×10^{-1}	0.1	deci	d
1×10^{-2}	0.01	centi	c
1×10^{-3}	0.001	milli	m
1×10^{-6}	0.000001	micro	μ
1×10^{-9}	0.000000001	nano	n
1×10^{-12}	0.000000000001	pico	p

My mathematical journey

What do I need to remember from before?

Plotting graphs (A6)

$y = mx + c$ (A6)

Finding gradient (A6)

Ratio tables and direct proportion (NP10, NP11)

What will I learn about in this unit?

Reading, drawing and interpreting graphs used in various contexts

Finding speed

Distance-time and speed-time graphs

Where does this lead?

Compound units: speed, density, pressure and more (NP13)

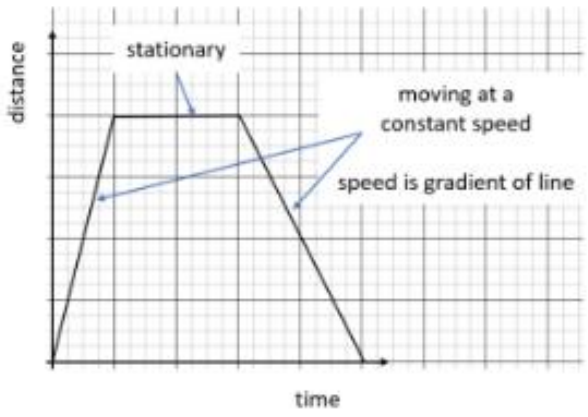
Gradient of and area under of non-linear graphs (A16)

Key words and symbols: what I need to say and write accurately

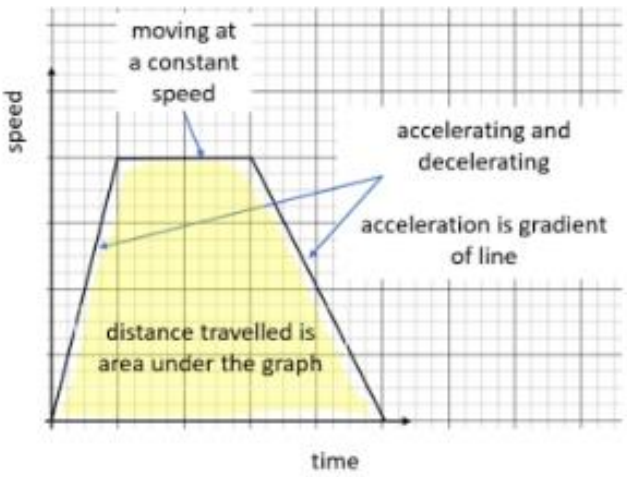
Word	Explanation
gradient	the steepness of a line: for every one unit right, it is the number of units up/down. On a contextual graph, the gradient represents the change in the vertical quantity *per one unit* of the horizontal quantity e.g. the exchange rate between two currencies, or the cost per unit time.
y-intercept	where a graph crosses the y-axis On a contextual graph, the y-intercept represents the value of the vertical quantity when the horizontal quantity is 0 e.g. a fixed or standing charge
speed	a quantity that combines distance and time, working out the distance travelled *per one unit* of time. e.g. miles in 1 hour (miles per hour, mph), or metres in 1 second (metres per second, m/s)

Fingertip facts: what I need to learn by heart

A distance-time graph



A speed-time graph



My mathematical journey

What do I need to remember from before?

Number lines (NP1, 2, 3, and 6)

Decimals (NP1, 2, and 3)

Fractions (NP7)

Frequency tables (SP1)

What will I learn about in this unit?

Systematic listing and the product rule

Experimental and theoretical probability

Probability diagrams

Where does this lead?

Sets and Venn diagrams (SP5)

Sampling and data analysis (SP6)

Advanced probability problems (SP7)

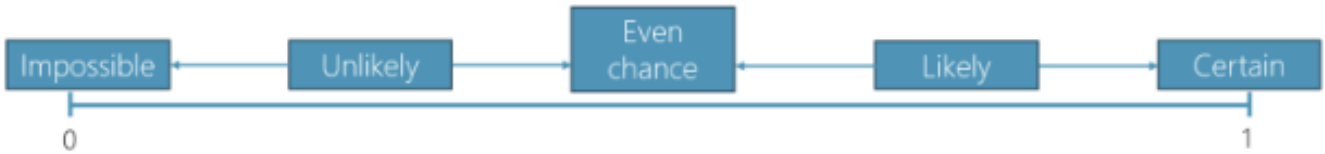
Key words and symbols: what I need to say and write accurately

Word	Explanation
systematic	working in an organised way
relative frequency	the proportion of times something happens
outcome	a result we could get from a probability experiment e.g. rolling a fair six-sided die gives the outcomes 1, 2, 3, 4, 5, and 6
event	one or more outcomes e.g. rolling a square number on a die
fair	all outcomes are equally likely
biased	some outcomes are more likely than others
mutually exclusive	events which cannot happen at the same time
independent	If events are independent, they do not influence or affect each other. e.g. if I flip a coin twice, the outcome of the first flip has no effect on the outcome of the second flip: the events are independent.

Fingertip facts: what I need to learn by heart

$$P(\text{event}) = \frac{\text{outcomes we want}}{\text{total outcomes}}$$

Probabilities can be represented by a number between 0 and 1.



The sum of all mutually exclusive events is 1.

If events A and B are mutually exclusive, $P(A \text{ or } B) = P(A) + P(B)$

$P(\text{not } A) = 1 - P(A)$. This can also be written $P(A') = 1 - P(A)$

My mathematical journey

What do I need to remember from before?

Multiplying to scale (NP3, NP10)

Reflective and rotational symmetry (GM2)

Properties of shapes (GM2)

What will I learn about in this unit?

Congruence and similarity

Congruent transformations: translation, reflection, rotation

Similar transformations: enlargement

Where does this lead?

Trigonometry (GM5)

Area and volume in similar solids (GM8)

Problems with congruence and similarity (GM11)

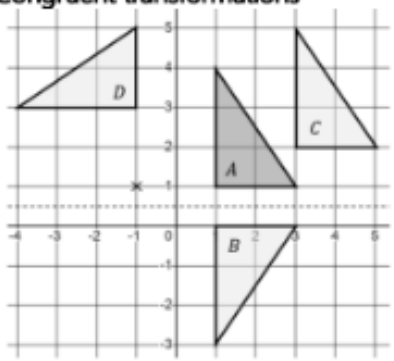
Transforming graphs (A15)

Key words and symbols: what I need to say and write accurately

Word	Explanation
congruent, ≅	identical in size and shape, but not necessarily orientation or direction
transformation	a mathematical change, using translation, rotation, reflection or enlargement
image	a shape *after* a transformation has happened
vector	a mathematical object that tells you how far to move and in what direction it can be shown with an arrow or with column notation e.g. this arrow and column vector both communicate "one left, two down" $\begin{pmatrix}-1\\-2\end{pmatrix}$ 
similar	same shape, all angles the same, but one an enlargement of the other (all corresponding sides in the same ratio)

Fingertip facts: what I need to learn by heart

Congruent transformations



A to **B** is a reflection in the line $y = \frac{1}{2}$.

A to **C** is a translation by the vector $\begin{pmatrix}2\\1\end{pmatrix}$

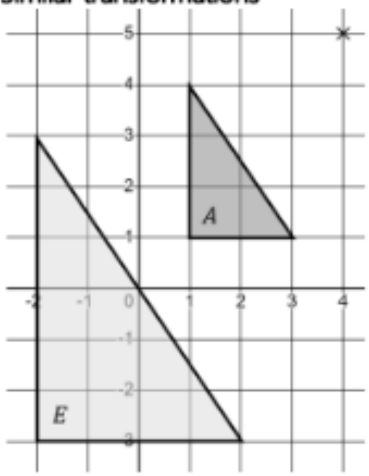
A to **D** is a rotation 90° anticlockwise around the centre $(-1, 1)$.

Reflections need a mirror line.

Translations need a vector.

Rotations need an angle, direction and centre.

Similar transformations



A to **E** is an enlargement of scale factor 2 from $(4, 5)$.

Enlargements need a scale factor and centre.

My mathematical journey

What do I need to remember from before?

Powers and roots (NP4)

Substitution and rearranging a formulae (A5)

Angles in triangles (GM2)

Similarity (GM4)

What will I learn about in this unit?

Pythagoras' Theorem

Trigonometry in right-angled triangles

Exact values in surd form

Where does this lead?

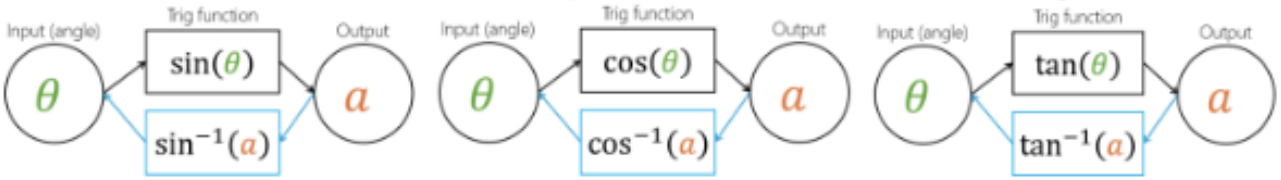
Advanced length and area (GM9)

Trigonometric graphs (A13)

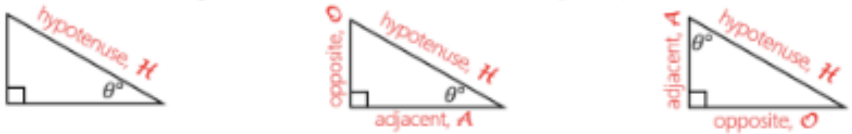
A Level mathematics, physics, engineering and more

Key words and symbols: what I need to say and write accurately

The trigonometric functions have angles as their input. Their inverse functions are written using $^{-1}$.



The **hypotenuse** is the longest side in a right-angled triangle, opposite the right angle.
The other two sides are called the **adjacent** and opposite. They change depending on the angle you look at.

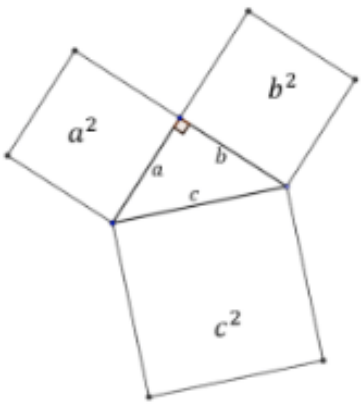


Fingertip facts: what I need to learn by heart

Pythagoras' Theorem

For any right-angled triangle,

$$a^2 + b^2 = c^2.$$



Trigonometry

Three equations:

$$\sin(\theta) = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos(\theta) = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan(\theta) = \frac{\text{opposite}}{\text{adjacent}}$$

A mnemonic to help you remember the equations:

$$S^{O}H \quad C^{A}H \quad T^{O}A$$

The exact values of sine, cosine and tangent for key angles:

Angle, θ	30°	45°	60°
$\sin\theta$	$\frac{\sqrt{1}}{2} = \frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$
$\cos\theta$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{1}}{2} = \frac{1}{2}$
$\tan\theta$	$\frac{1}{\sqrt{3}}$	1	$\frac{\sqrt{3}}{1} = \sqrt{3}$

My mathematical journey

What do I need to remember from before?

Angle facts (GM2)

Area and perimeter (GM3)

Rearranging formulae (A5)

What will I learn about in this unit?

Naming the parts of a circle

Finding the area and perimeter of circles and sectors of circles

Finding angles in circles using circle theorems

Where does this lead?

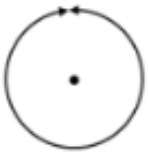
Surface area and volume (GM8)

Advanced length and area (GM9)

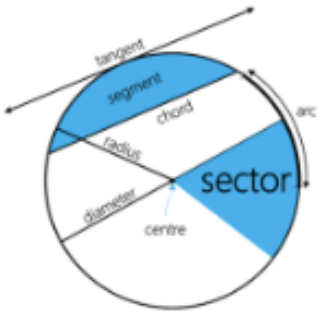
Key words and symbols: what I need to say and write accurately

The <u>circumference</u> is the perimeter of a circle.

We use C for 'circumference'.



We use d for 'diameter' and r for 'radius'.



<u>Semicircle</u>
A half circle

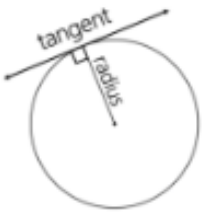
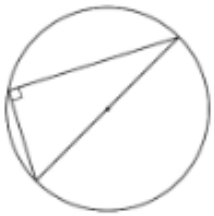
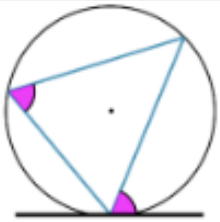
<u>Quadrant</u>
A quarter circle

<u>Concentric</u> circles share the same centre

Fingertip facts: what I need to learn by heart

$\pi \approx 3.14$	<u>Circle formulae</u> Circumference: $C = \pi d$ or $C = 2\pi r$ Area: $A = \pi r^2$	<u>Sector formulae</u> We use l for 'arc length'. Arc length: $l = \frac{\theta}{360}\pi d$ Sector area: $A = \frac{\theta}{360}\pi r^2$

<u>Circle theorems</u>

	A radius and a tangent are perpendicular.		The angle at the centre is twice the angle at the circumference (subtended by the same arc).
	The angle in a semicircle is 90°.		Angles at the circumference subtended by the same arc are equal. (Angles in the same segment are equal).
	Opposite angles in a cyclic quadrilateral are sum to 180°.		The Alternate Segment Theorem.

My mathematical journey

What do I need to remember from before?

Percentage multipliers (NP8, NP10)

Proportional reasoning (NP10)

Cartesian graphs (A6, A9, A10)

Manipulating algebra (A5, A10)

What will I learn about in this unit?

Reverse percentages

Simple interest

Direct and inverse proportion

Compound units

Combining ratios

Where does this lead?

Compound interest (NP16)

Proportion with squares, cubes and roots (NP16)

Instantaneous and average rates of change (A16)

Areas under graphs (A16)

Key words and symbols: what I need to say and write accurately

Word	Explanation
p.a.	*per annum*, Latin for *"every year"*
direct proportion	as one amount increases, the other increases at the same rate
k	the constant of proportionality, which is the rate of change
$\propto$	*is proportional to*
inverse proportion	as one amount increases, the other *decreases* at the same rate
density	a measure of how spread out particles in an object are
pressure	a measure of how spread out a force is
speed	a measure of distance per unit of time
compound units	a measure combining two other measures

Fingertip facts: what I need to learn by heart

To calculate a percentage: $\textbf{original} \times \textbf{multiplier} = \textbf{new}$

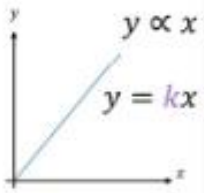
To return to the original whole: $\textbf{original} = \frac{\textbf{new}}{\textbf{multiplier}}$

Direct Proportion

As one increases, the other increases at the same rate.

y is proportional to x

x		
y		

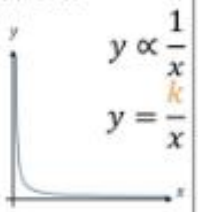


Inverse Proportion

As one increases, the other decreases at the same rate.

y is proportional to the reciprocal of x

x		
y		



$$\text{Density} = \frac{\text{mass}}{\text{volume}} \qquad \text{Pressure} = \frac{\text{force}}{\text{area}} \qquad \text{Speed} = \frac{\text{distance}}{\text{time}}$$