Prior Knowledge

Integer – a whole number can be positive or negative

..... -4, -3, -2, -1, 0, 1, 2, 3, 4, ...

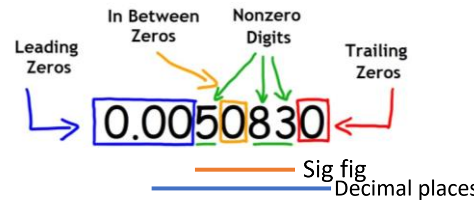
Terminating Decimal – a decimal that ends

0.5, 1.2, 1.245, 1.689

Recurring Decimal – the digits after the point continue for ever in some way (sequence or not in a sequence)

$0.333\dot{3}$, $0.\dot{3}4\dot{5}$, π, √2

Significant figures – the digits that carry meaningful contributions



Decimal places – the digits after the point

Multiplying with Decimal places – ignore the decimal places, do the multiplication then put decimal places back

3.2x2.4 do 32x24=768 put decimals back in 3.2x2.4=7.68

Dividing with decimal places – write as fraction then multiply top and bottom by 10, 100, 1000 until you get whole numbers – then divide

$6 \div 0.5 = \frac{6}{0.5} = \frac{60}{5} = 12$

5 > 3 3 < 5 2.01 < 2.1 etc.....

You can use the **>** and **<** signs to show which number is bigger

Add and subtract make common denominators. Multiply just multiply tops and multiply bottoms. Divide "KCF" – Keep, change, flip.

You can **add**, **subtract**, **multiply** and **divide** fractions.

HCF – Highest Common Factor – the biggest factor in both lists. LCM – Lowest Common Multiple – the smallest number in both lists.

Factors – Numbers that divide into a number exactly.

Multiples – Extended times tables

Venn Diagram – Circles that overlap to show relationships between 2 or more things.

B (brackets)
I indices²
D ÷ division
M multiplication x
A + addition
S subtraction –

BIDMAS – The order in which we do calculations. **Brackets** first then **indices**. **Division and multiplication** same time left to right. Finally **Addition and subtraction** same time left to right.

You can have positive and negative square roots. *√16 is 4 and -4*

Square root – Finding a number that times itself to given that number

Estimating – Rounding numbers before doing the calculation. Or finding a rough answer to the problem.

$3 \times 3 \times 3 \times 3 \times 3 = 3^5$

$2^4 = 2 \times 2 \times 2 \times 2 = 16$

You can use index notation and evaluate simple indices.

Key Concepts

Higher – Unit 1 - Number

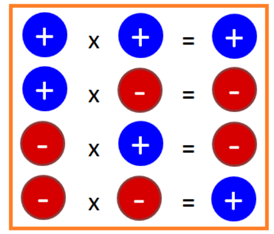
Number of ways of doing two tasks	**m** ways of doing one task and **n** ways of doing a second task, the total number of ways of doing the first task then the second task is **m x n**.	
Dealing with a fraction in BIDMAS	For $\frac{calculation\ 1}{calculation\ 2}$ treat as brackets work out (calculation 1) then (calculation 2) using the priority of operations (**BIDMAS**) before dividing.	$\frac{3+5\times 2}{3\times 4^2} = \frac{3+10}{3\times 16} = \frac{13}{48}$
Cube Root	Cube root is the inverse of cubing. "What number was multiplied by itself, then again to get this?	$\sqrt[3]{1}=1$ $\sqrt[3]{8}=2$ $\sqrt[3]{27}=3$
Base numbers	This is the number that is too the power	Base 2^7
Multiplying powers	Add the indices if base numbers the same	$5^3 \times 5^4 = 5^{3+4} = 5^7$
Dividing powers	Subtract the indices if base numbers the same	$5^6 \div 5^2 = 5^{6-2} = 5^4$
Power to a power	Multiply the indices	$(3^4)^2 = 3^{4\times 2} = 3^8$
Negative in a power	Means 1 over	$6^{-3} = \frac{1}{6^3} = \frac{1}{216}$
Anything to the power zero	Is one	$3^0 = 1$ $a^0 = 1$
A unit fraction in a power (e.g. ½)	Means a root. A ½ means the square root, 1/3 means the cube root etc...	$16^{\frac{1}{2}} = \sqrt{16} = 4$
A fraction in the power (e.g. 2/3)	Use the denominator for the root, and then the numerator is a power. E.g. for 2/3 do the cube root and then square it.	$27^{\frac{2}{3}} = (\sqrt[3]{27})^2 = 3^2 = 9$
Prefix	Some powers of 10 have a prefix – e.g. 1000 is kilo	1 **Kilo**gram (**K**g) = 1000 grams (g)
Standard form	Used to write big numbers quickly or small numbers quickly.	**(Between 1 and 10) x 10** $^{\text{power}}$
Not equal sign	The not equal to sign is an equal sign with a line through it.	$\neq$
Surd	A number written as a root.	$\sqrt{3}$ root of a whole number = 1.732050808 ... irrational number
Rational number	It can be written as a fraction	$0.5 = \frac{1}{2}$ $0.333\dot{3} = \frac{1}{3}$
Rationalising the denominator	Multiply by the denominator over the denominator (in other words by 1)	$\frac{3}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{5}}{5}$

Prior Knowledge

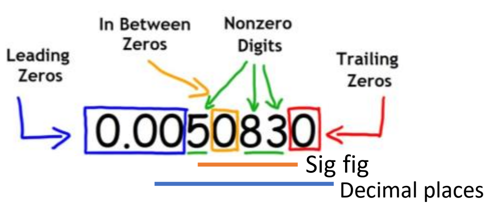
Integer – a whole number can be positive or negative ... -4, -3, -2, -1, 0, 1, 2, 3, 4 ...

Negative number: a real **number** that is less than zero.

Negatives: multiplying and dividing:
1. When the signs are different the answer is **negative**.
2. When the signs are the same the answer is positive.



Significant figures – the digits that carry meaningful contributions

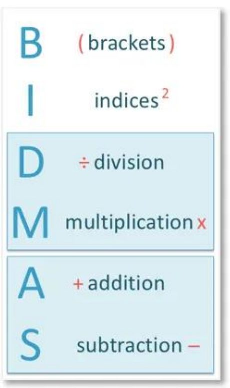


Factors – Numbers that divide into a number exactly.

Highest Common Factor (HCF): the biggest factor in both lists.

Multiples – Extended times tables

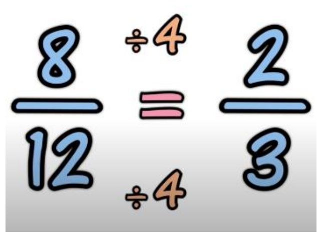
Lowest Common Multiple (LCM): the smallest number in both lists.



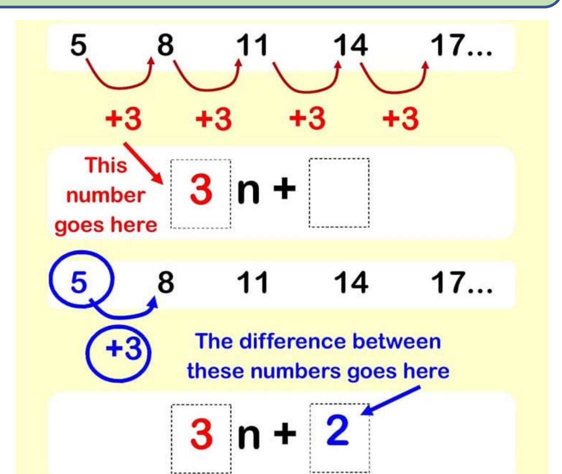
BIDMAS – The order in which we do calculations. **Brackets** first then **indices. Division and multiplication** same time left to right. Finally **Addition and subtraction** same time left to right.

Square root – Finding a number that times itself to given that number. You can have positive and negative square roots.

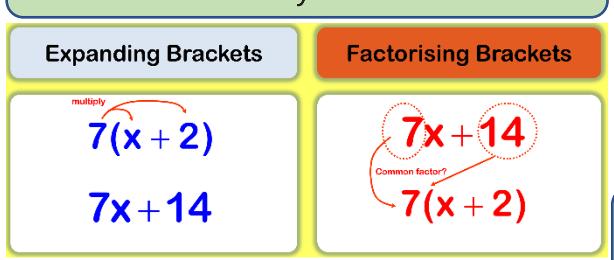
To simplify a fraction, divide the top and bottom by the highest common factor.



The nth term of an arithmetic sequence is common difference x n + zero term.

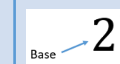
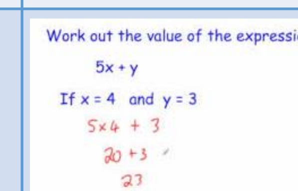
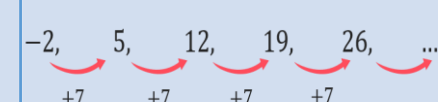
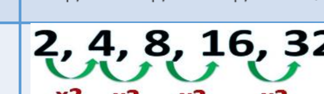
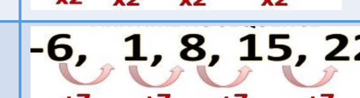


Expand brackets: multiply each term inside the bracket by the term outside.



Factorise: divide each term by the highest common factor, writing the HCF outside the bracket.

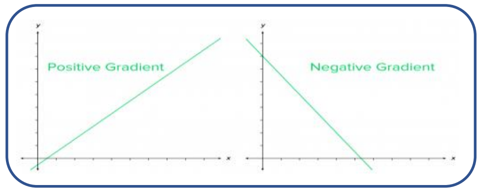
Key Concepts — Higher – Unit 2 - Algebra

Order of Operations	BIDMAS – The order in which we do calculations. Brackets first then indices. Division and multiplication same time left to right. Finally Addition and subtraction same time left to right.	
Base numbers	This is the number that is too the power	
Multiplying powers	Add the indices if base numbers the same	$5^3 \times 5^4 = 5^{3+4} = 5^7$
Dividing powers	Subtract the indices if base numbers the same	$5^6 \div 5^2 = 5^{6-2} = 5^4$
Negative in a power	Means 1 over	$6^{-3} = \frac{1}{6^3} = \frac{1}{216}$
Anything to the power zero	Is one	$3^0 = 1$ $a^0 = 1$
A unit fraction in a power (e.g. ½)	Means a root. A ½ means the square root, 1/3 means the cube root etc...	$16^{\frac{1}{2}} = \sqrt{16} = 4$
A fraction in the power (e.g. 2/3)	Use the denominator for the root, and then the numerator is a power. E.g. for 2/3 do the cube root and then square it.	$27^{\frac{2}{3}} = (\sqrt[3]{27})^2 = 3^2 = 9$
Expanding double brackets	Multiply each term in the first bracket by each term in the second.	**$(x+5)^2 = (x+5)(x+5) = x^2+10x+25$**
Consecutive Integers	One after the other.	**15, 16**
Even Integers	Any even integer is ibn the 2 times table and can be written as 2n.	**2n**
Substitution	Swapping an algebraic letter for its value.	
Standard Form	Used to write big numbers quickly or small numbers quickly.	**(Between 1 and 10) x 10 $^{\text{power}}$**
Linear Sequence	A list of numbers that increases or decreases by the same amount each time.	
Geometric Sequence	Terms increase (or decrease) by a constant multiplier.	
Arithmetic Sequence	Terms increase (or decrease) by a fixed number (common difference).	

Prior Knowledge

Midpoint of two numbers: add the two values and divide the result by 2.

$M = \frac{x_1 + x_2}{2}$



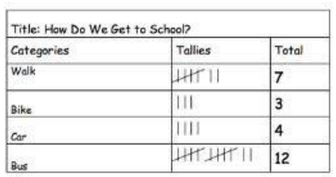
Mode – The mode is the value that appears most often in a set of data.

Mean – The mean is the total of all the values, divided by the number of values.

Median – The median is the middle number in a list of numbers ordered from lowest to highest.

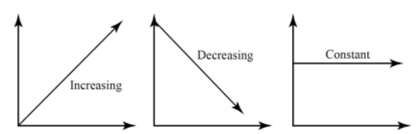
Range – The range is the difference between the lowest value and the highest value.

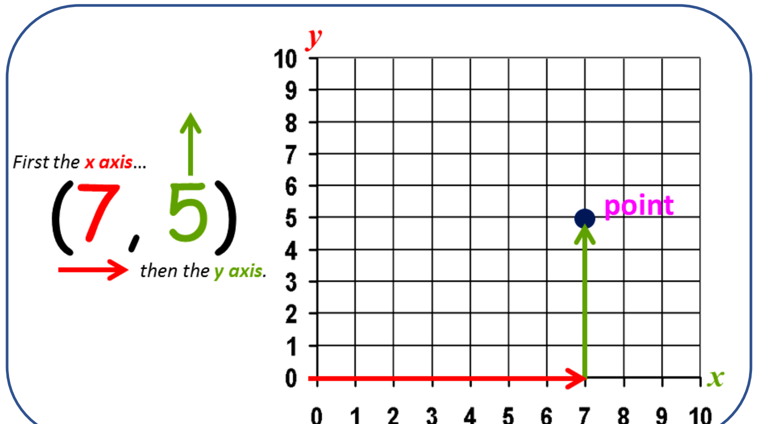
A tally chart should have titles on columns and clearly drawn tallies.



A year – contains 12 months
A **quarter** – refers to a 3 month period.

Increase – the values are going up.
Decrease – the values are going down.
Constant rate – going up or down by the same value each time.





Greater than $>$ Greater than or equal to $\geq$

Less than $<$ Less than or equal to $\leq$

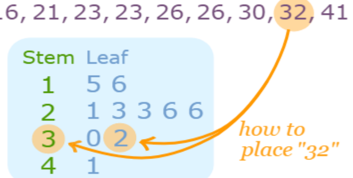
Not equal to $\neq$

Frequency – The amount of times something occurs

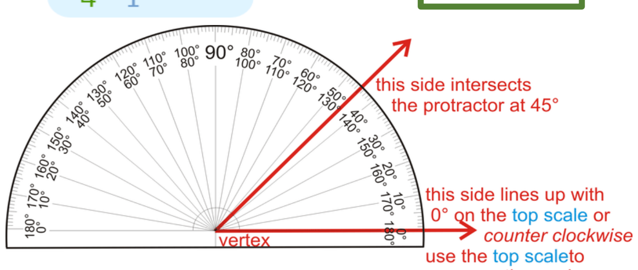
Stem and Leaf Diagram – Splits values by place value. Shows spread. Needs a key.

A bar chart should have a title, titles on both axes, equal scale on the y axis and gaps between the bars.

15, 16, 21, 23, 23, 26, 26, 30, 32, 41

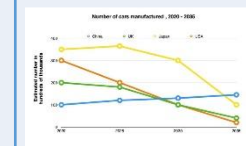
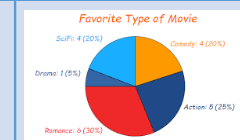
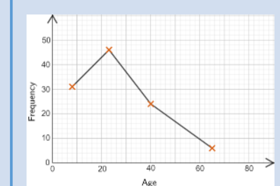
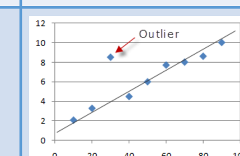
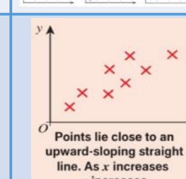
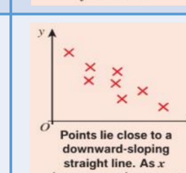
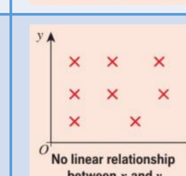


Key
1 | 2 = 12



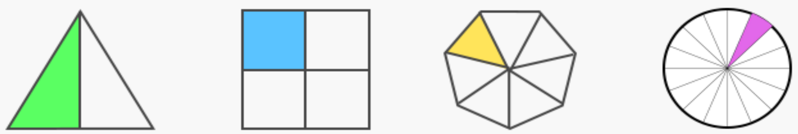
Key Concepts Higher – Unit 3 – Interpreting and Representing Data

<table>
<tr><td>Mean</td><td>Total of the set of values divided by the number of values.</td><td>$\overline{X} = \frac{\sum X}{N}$</td></tr>
<tr><td>Median</td><td>When n data values are written in order, the median is the $\frac{n+1}{2}th$ value.</td><td>1, 3, 3, 6, 7, 8, 9
Median = 6

1, 2, 3, 4, 5, 6, 8, 9
Median = (4 + 5) ÷ 2 = 4.5</td></tr>
<tr><td>Line Graphs</td><td>Useful for tracking changes over time.</td><td></td></tr>
<tr><td>Pie Charts</td><td>Useful when comparing parts of a whole.</td><td></td></tr>
<tr><td>Bar Charts</td><td>Used to compare the frequencies of two sets of data.</td><td></td></tr>
<tr><td>Frequency Polygon</td><td>You can join the midpoints of the tops of the bars in a frequency diagram with straight lines.
OR plot the midpoint for each class against the frequency.</td><td></td></tr>
<tr><td>Two Way Table</td><td>Divides data into groups in rows across the table and in columns down the table.</td><td><table><tr><td></td><td>English</td><td>Maths</td><td>Science</td><td>Total</td></tr><tr><td>Girls</td><td>20</td><td>13</td><td></td><td>50</td></tr><tr><td>Boys</td><td></td><td>15</td><td></td><td></td></tr><tr><td>Total</td><td>38</td><td></td><td>40</td><td></td></tr></table></td></tr>
<tr><td>Outliers</td><td>Individual points which are outside the overall pattern of a scatter graph. If they are likely to be from incorrect readings you can ignore them.</td><td></td></tr>
<tr><td>Correlation</td><td>A scatter graphs shows a relationship (correlation) between variables.</td><td></td></tr>
<tr><td>Positive Correlation</td><td>As one value increases, so does the other.</td><td></td></tr>
<tr><td>Negative Correlation</td><td>As one value increases, the other decreases.</td><td></td></tr>
<tr><td>No (or zero) Correlation</td><td>No linear relationship between x and y.</td><td></td></tr>
</table>

Prior Knowledge

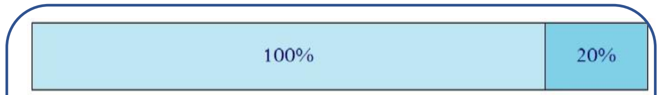
A **unit fraction** is a rational number written as a **fraction** where the numerator is one and the denominator is a positive integer.



$\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{7}$ $\frac{1}{16}$

B (brackets)
I indices²
D ÷ division
M multiplication x
A + addition
S subtraction –

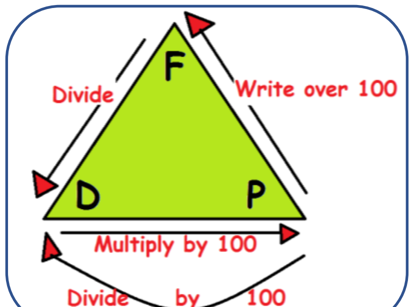
To get the **reciprocal** of a number, we divide 1 by the number.



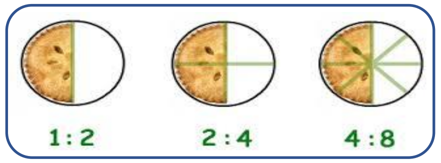
$$120\% = \frac{120}{100} = 1.20$$

The **multiplier** is the **single** decimal value used to multiply the amount you are working with. Firstly, consider what the overall percentage would be after the figure has had its percentage increase or decrease added or subtracted. Then convert this amount to a decimal, before finally multiplying by the number in question.

Ratios can be fully **simplified** just like fractions. To **simplify** a **ratio**, divide all of the numbers in the **ratio** by the highest common factor.



Two **ratios** that have the same value are called **equivalent ratios**. To find an **equivalent ratio**, multiply or divide both quantities by the same number.



Proper fraction	Mixed fraction	Improper fraction
$\frac{3}{5}$	$2\frac{3}{5}$	$\frac{5}{3}$

Types of fractions

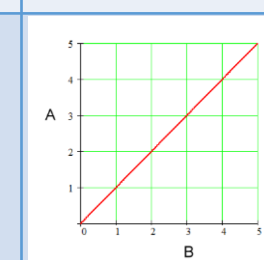
Proportions

A proportion is an equality of ratios:

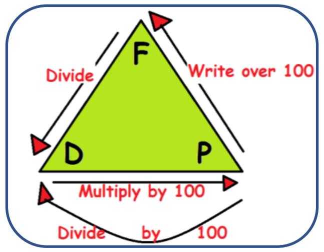
$$\frac{a}{b} = \frac{c}{d}$$

Key Concepts

Higher – Unit 4 - Fractions, Ratio and Percentages

Reciprocal	**The reciprocal of a number is 1 divided by the number.**	$\frac{1}{n}$ or n^{-1}
Unit Ratios	One part of the ratio is 1. Unit ratios make them easier to compare.	1:n or n:1
Appreciate	In financial terms means to gain value.	
Depreciate	In financial terms means to lose value.	
VAT (Value Added Tax)	VAT is tax charged at 20% on most goods and services.	
Ratio	A comparison of two or more quantities.	
Simplifying Ratios	Divide all of the numbers in the **ratio** by the highest common factor.	
Equivalent Ratios	Multiply or divide both quantities by the same number.	
Recurring Decimals	A **decimal** representation of a number whose digits are periodic (**repeating** its values at regular intervals).	0.66666… or 0.54545454…
Direct Proportion	As one amount increases, another amount increases at the same rate.	
Inverse Operations	They are the **operation** that reverses the effect of another **operation**.	Add ⟺ Subtract Multiply ⟺ Divide Square ⟺ Square Root Cube ⟺ Cube Root
Per Annum	Each year.	E.g. income per annum is amount earned each year.

Prior Knowledge



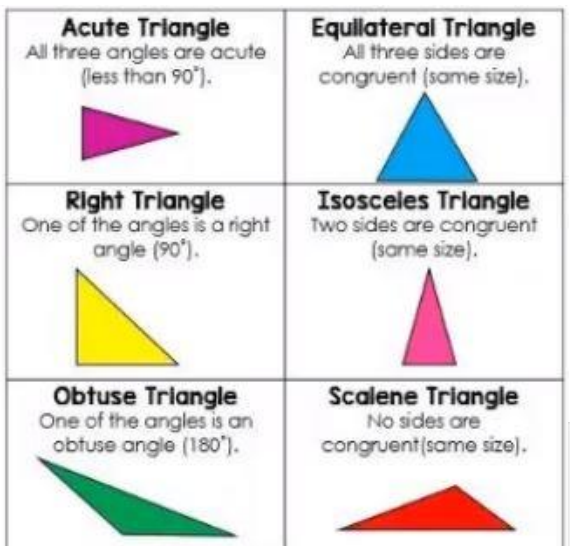
Angles in a triangle add to 180º.

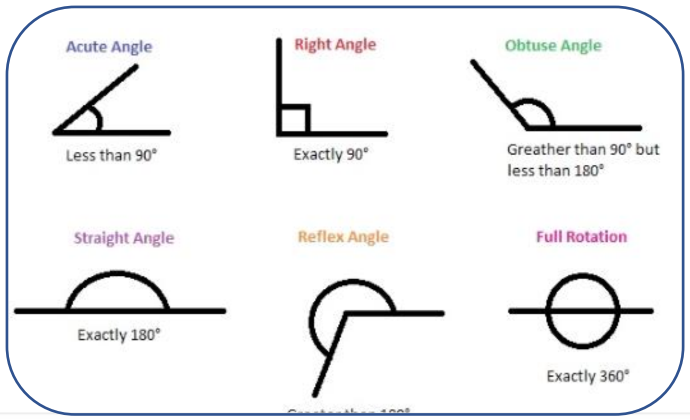
Angles in a quadrilateral add to 360º.

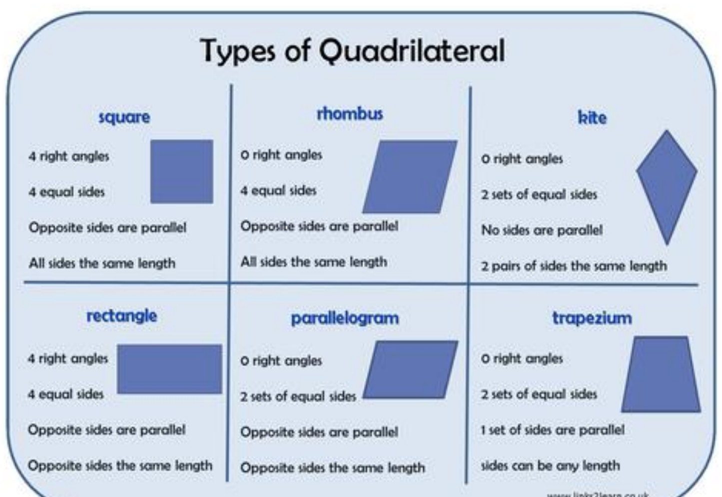
The **Exterior Angle** is the angle between any side of a shape, and a line extended from the next side.

An **Interior Angle** is an angle inside a shape.

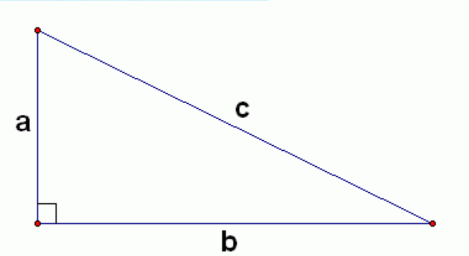
Number of Sides	Polygon Name
3	triangle
4	quadrilateral
5	pentagon
6	hexagon
7	heptagon
8	octagon
9	nonagon
10	decagon
12	dodecagon
n	n-gon



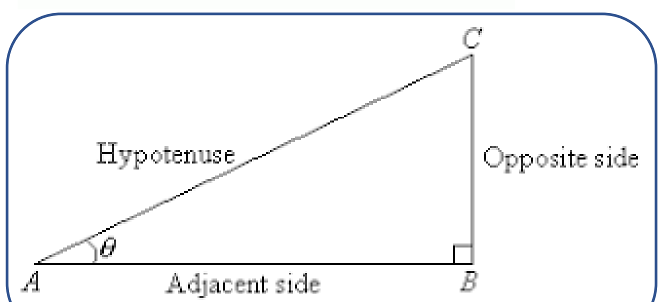


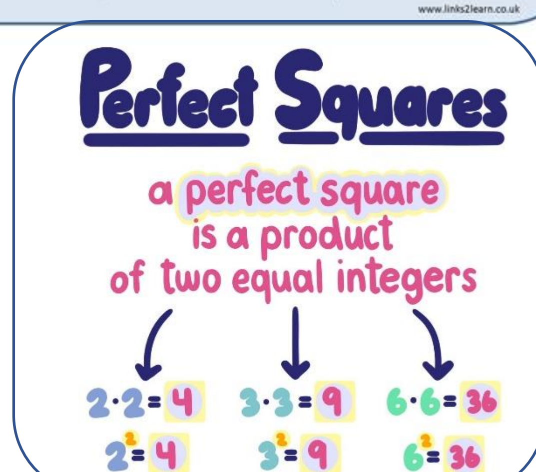


Pythagoras' Theorem



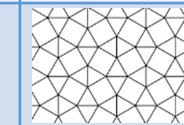
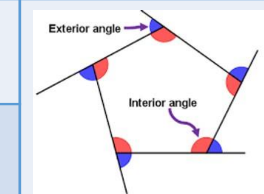
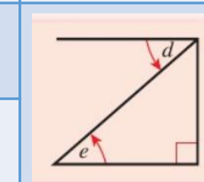
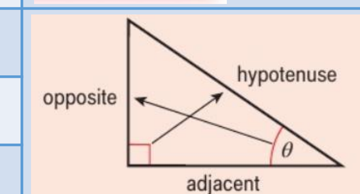
$a^2 + b^2 = c^2$





Key Concepts

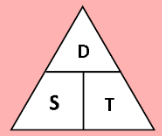
Higher – Unit 5 – Angles and Trigonometry

Sum of Interior Angles	Total sum of angles inside a polygon (n is the number of sides)	**(n – 2) x 180**
Tessellation	Shapes fit together. The angles where the shapes meet must add up to 360º.	
Interior Angle	An angle inside a shape.	
Exterior Angle	The angle between any side of a shape, and a line extended from the next side.	
Pythagoras' Theorem	Used to find missing lengths in a right-angled triangle. The square of the hypotenuse is equal to the sum of the squares of the other two sides.	$a^2 + b^2 = c^2$
Angle of Depression	Angle measured downwards from the horizontal.	
Angle of Elevation	Angle measured upwards from the horizontal.	
Hypotenuse	The side opposite the right angle.	
Opposite	The side opposite the angle θ.	
Adjacent	The side next to the angle θ.	
Sine	Ratio of the opposite side to the hypotenuse.	$\sin(\theta) = \frac{opp}{hyp}$
Cosine	Ratio of the adjacent side to the hypotenuse.	$\cos(\theta) = \frac{adj}{hyp}$
Tangent	Ratio of the opposite side to the adjacent side.	$\tan(\theta) = \frac{opp}{adj}$
Sin^{-1}	Inverse sine function, used to find missing angles.	$\theta = \sin^{-1}\frac{opposite}{hypotenuse}$
Cos^{-1}	Inverse cosine function, used to find missing angles.	$\theta = \cos^{-1}\frac{adjacent}{hypotenuse}$
Tan^{-1}	Inverse tangent function, used to find missing angles.	$\theta = \tan^{-1}\frac{opposite}{adjacent}$

Prior Knowledge

The equation of a straight line is given by y=mx+c.
Horizontal lines have the equation y=____
Vertical lines have the equation x=______

Speed Distance Time



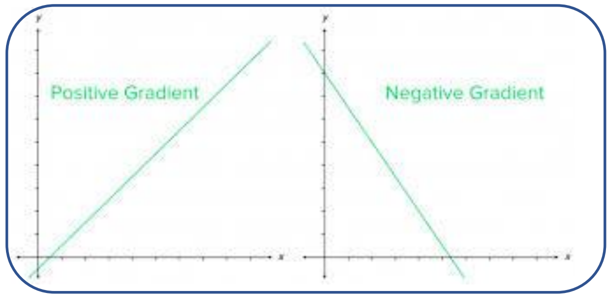
$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$

$\text{Distance} = \text{Speed} \times \text{Time}$

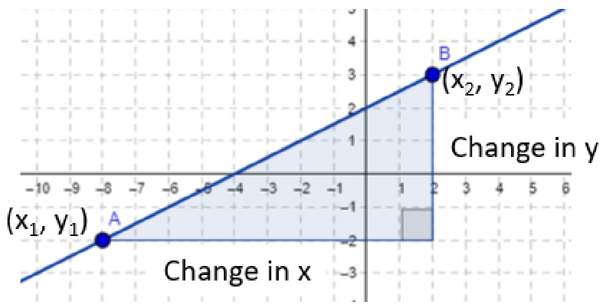
$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$

y = mx + c

gradient (m) y-intersect (c)

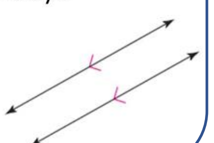


Gradient of a Straight Line

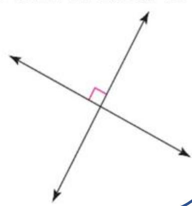


$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{Change in y}}{\text{Change in x}}$$

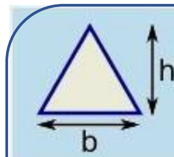
Parallel lines are lines in the same plane that never intersect. They are always the same distance apart.



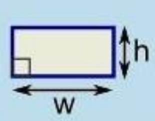
Perpendicular lines are lines that meet at a right angle, that is, at an angle that measures 90°.



A quadratic expression is an **expression** that has a variable that's squared and no variables with powers higher than 2 in any of the terms.



Triangle
Area = ½ × b × h
b = base
h = vertical height

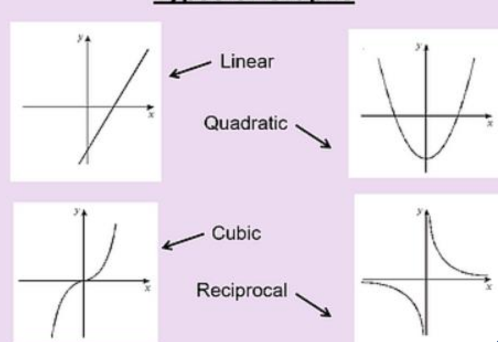


Rectangle
Area = w × h
w = width
h = height

A table of values is used to calculate the y value by substituting the x value into the equation.

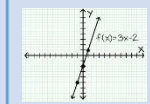
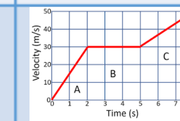
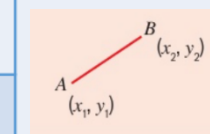
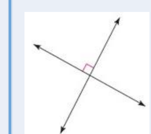
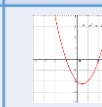
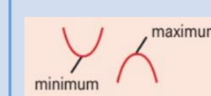
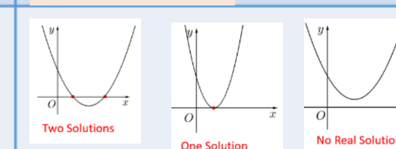
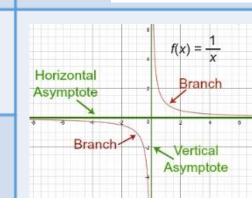
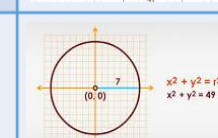
x	y = 2x+3	y	(x,y)
-3	y = 2(-3)+3	-3	(-3,-3)
-2	y = 2(-2)+3	-1	(-2,-1)
-1	y = 2(-1)+3	1	(-1,1)
0	y = 2(0)+3	3	(0,3)
1	y = 2(1)+3	5	(1,5)
2	y = 2(2)+3	7	(2,7)
3	y = 2(3)+3	9	(3,9)

Types of Graphs



Key Concepts

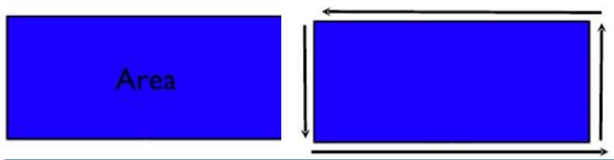
Higher – Unit 6 – Graphs

Linear Equation	Generates a straight-line (linear) graph. The equation for a straight line graph is written as y=mx+c.	y = mx + c — gradient, y-intersect
Linear Function	Has a graph that is a straight line,	
Velocity	Speed in a particular direction.	
Velocity-Time Graph	Shows how velocity changes over time.	
Line Segment	Section of a line.	 $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
Midpoint of a line segment	The point exactly in the middle.	
Perpendicular	Lines which cross at 90° The product of the two gradients is -1. When a graph has gradient m, the perpendicular gradient is -1/m	
Quadratic Equation	Contains a term in x^2 but no higher or negative power of x. The graph is a curve called a **parabola**.	$ax^2 + bx + c = 0$ A General Quadratic Equation
Quadratic Function	Has a graph which is a parabola.	
Minimum / maximum point	A quadratic graph has a point where the graph turns.	
Solutions	A quadratic equation can have 0, 1 or 2 solutions. A cubic equation can have 1, 2 or 3 solutions.	
Cubic Function	Contains a term in x^3 but no higher power of x. It can also have terms in x^2 and x, and number terms.	 $2x^3 + x^2 - 13x + 6 = 0$
Reciprocal Function	In the form k/x (where k is a number). The x and y axes are asymptotes to the curve.	
Asymptote	A line that the graph gets very close to but never actually touches.	
Equation of a circle	With a centre (0,0(and radius *r*, the equation of a circle is x^2 $y^2 = r^2$	

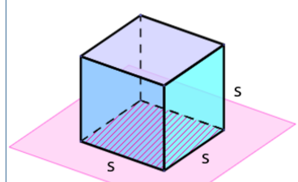
Prior Knowledge

Area is the amount of space an object takes up

Perimeter is the distance around an object

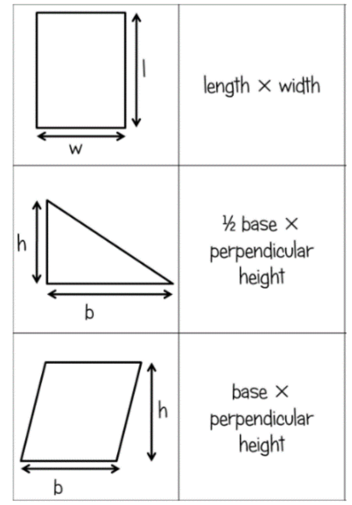


Volume of Cube



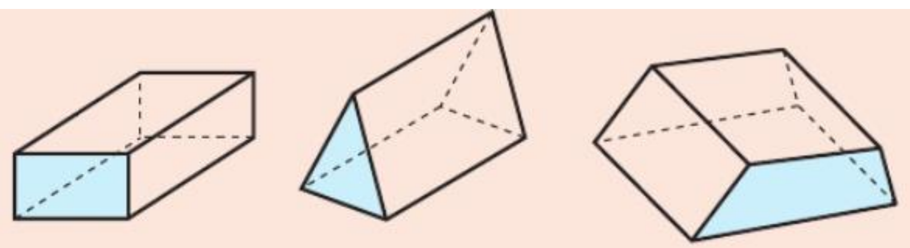
Volume of cube with side lengths s

$V = s \times s \times s = s^3$

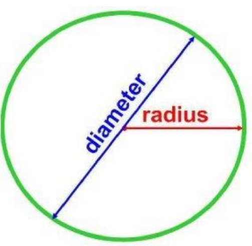


A prism is a 3D solid that has the same cross-section all through its length.

Volume is measured in mm³, cm³ or m³.
Volume of a prism = area of cross-section x length.



Greater than $>$	Greater than or equal to $\geq$
Less than $<$	Less than or equal to $\leq$
Not equal to $\neq$	



Area of a circle = π x **radius**²

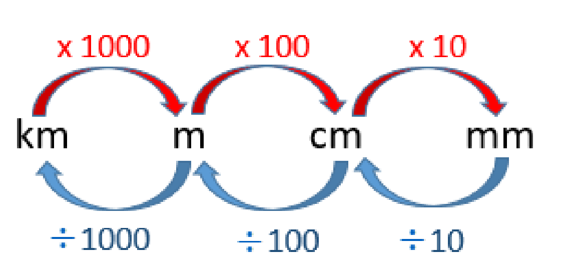
Circumference of a circle = π x **diameter**

remember that the **diameter** = **2** x **radius**

The **circumference** of a circle is its perimeter.

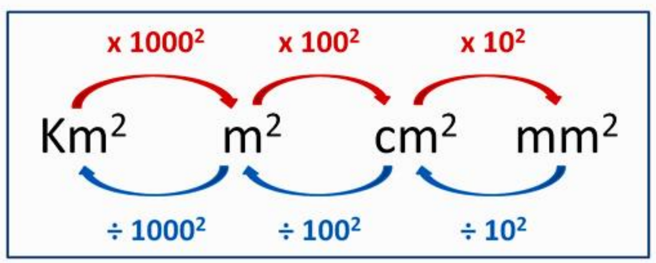
Angles around a point add up to 360º.

Converting Metric Lengths



Converting AREA Units

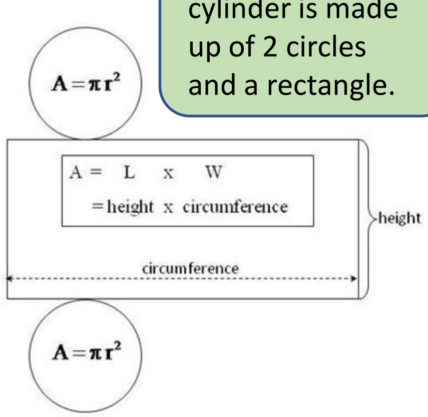
AREA consists of Square Units, so we need to SQUARE all our Lengths.



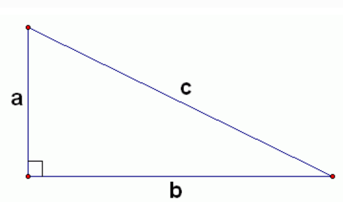
5km² = ? m² **Need to x 1000²** 5 x 1000 x 1000 = **5 000 000 m²** ✓

1200cm² = ? m² **Need to ÷ 100²** 1200 ÷ 100 ÷ 100 = **0.12 m²** ✓

The net of a cylinder is made up of 2 circles and a rectangle.



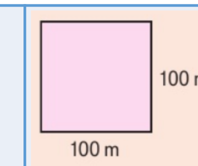
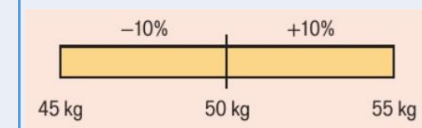
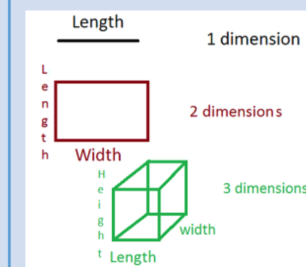
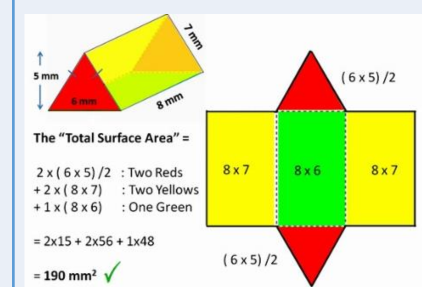
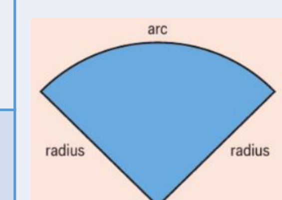
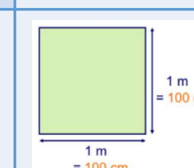
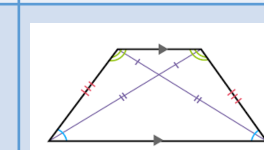
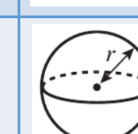
Pythagoras' Theorem: $a^2 + b^2 = c^2$ where c is the longest side in a right-angled triangle.



BIDMAS – The order in which we do calculations. **Brackets** first then **indices**. **Division and multiplication** same time left to right. Finally **Addition and subtraction** same time left to right.

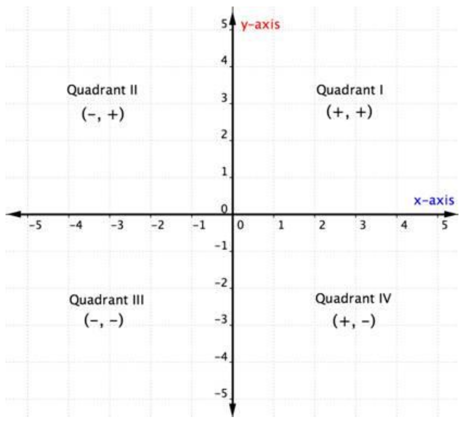
Higher – Unit 7 – Area and Volume

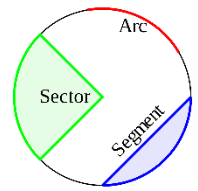
Key Concepts

1 Hectare	The area of a square 100m by 100m. 1 ha = 100m x 100m = 10000m² Areas of land are measured in hectares.	
Truncate	To truncate, remove the other digits **without** rounding.	5.694 truncated to 1 digit is 5.
Error Interval	A measurement could be 10% larger or smaller than the one given.	
Dimensions	Length, width, height. Measurements of the object.	
Surface area	The total area of all the faces of a 3D solid.	
Capacity	The amount of liquid 3D object can hold. Measure in millilitres and litres.	$1\,cm^3 = 1\,ml$ $1000\,cm^3 = 1$ litre
Arc	Part of the circumference of a circle.	
Sector	A slice of a circle, between an arc and two radii.	
Area conversion	1m = 100 cm 1m x 1m = 1m² 100cm x 100 cm = 10000cm² To convert cm² to m², divide by 10000.	
Isosceles Trapezium	A trapezium in which the non-parallel sides are equal in measure. The bases are parallel and the non-parallel sides are equal in length.	
Spheres	Volume of a sphere = $\frac{4}{3}\pi r^3$	

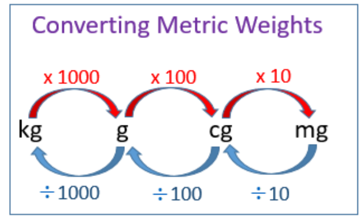
Prior Knowledge

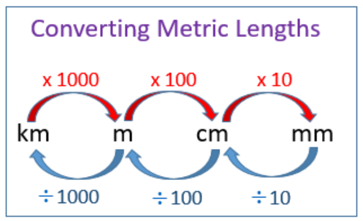
A **graph quadrant** is one of **four** sections on a Cartesian plane. Each of the **four** sections has a specific combination of negative and positive values for x and y.



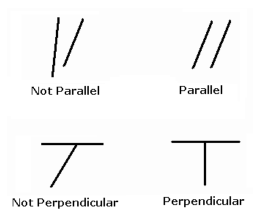


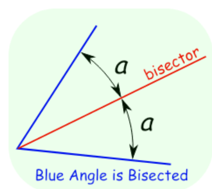
An **arc** is any smooth curve joining two points.



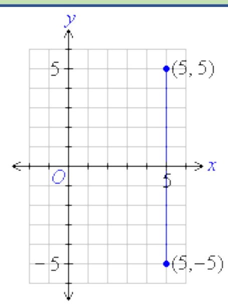


Parallel lines are always the same distance apart for their entire length. **Perpendicular lines** cross each other at right angles.

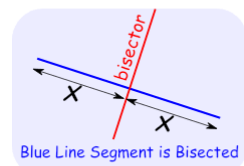




In **geometry**, bisection is the division of something into two equal or congruent parts, usually by a line, which is then called a **bisector**.



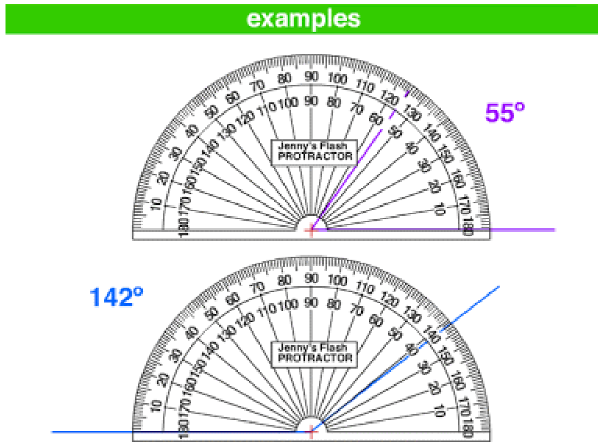
The graph of a relation of the form $x = 5$ is a line parallel to the y-axis because the x value never changes. A line parallel to the y-axis is called a **vertical line**.



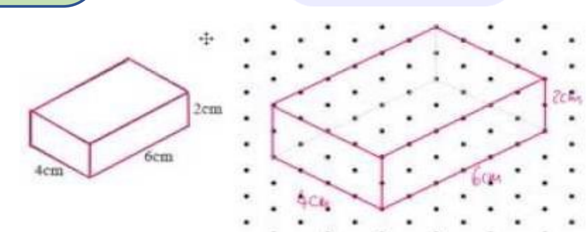
protractor ... placement

The crosshairs of the protractor need to be exactly lined up with the vertex of the angle. The vertex is the point where the two rays of the angle meet.

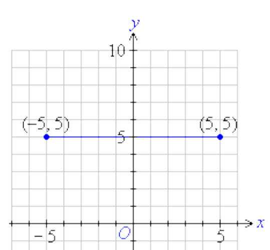
examples

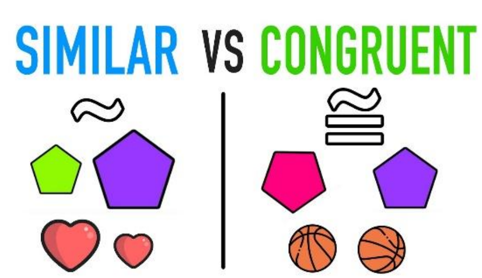


The protractor has two scales from 0° to 180°. Which scale to use depends on whether the angle is acute (less than 90°) or obtuse (90° to 180°).



Isometric drawing is way of presenting designs/**drawings** in three dimensions.

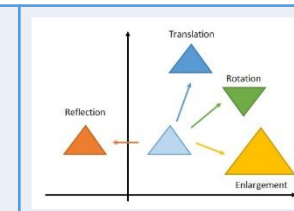
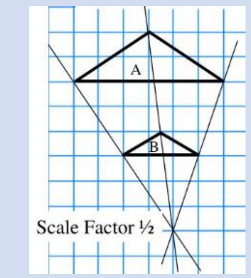
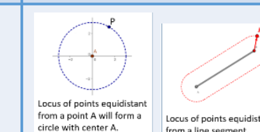
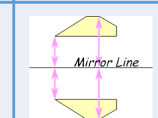
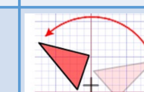
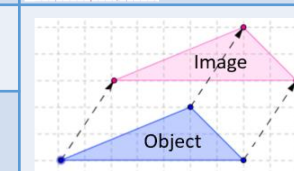
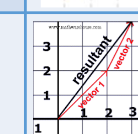
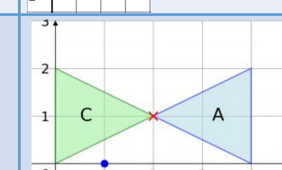
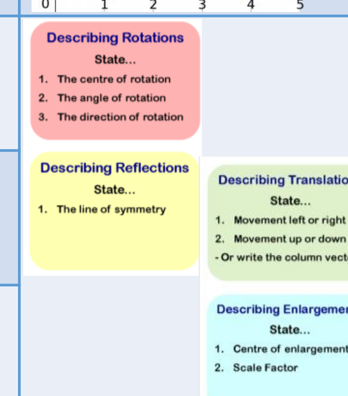




The graph of a relation of the form $y = 5$ is a line parallel to the x-axis because the y value never changes. A line parallel to the x-axis is called a **horizontal line.**

Higher – Unit 8 – Transformations and Constructions

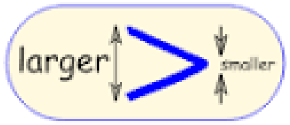
Key Concepts

Transformation	Move a shape to a different position.	
Enlargement	A transformation where all the side lengths of a shape are multiplied by the same scale factor.	
Scale factor	Describes the size of an enlargement or reduction.	
Fractional Scale Factor	Multiply all the side lengths by the scale factor.	
Locus/Loci	A locus is a set of points that all obey a certain rule. Often a locus is a continuous path.	
Centre of Enlargement	The position of the enlarged shape is described by the centre of enlargement.	
Reflection	A **reflection** can be thought of as folding or "flipping" an object over the line of **reflection**.	
Rotation	**Rotation** turns a shape around a fixed point called the centre of **rotation**.	
Object	An original shape.	
Image	When the object is transformed, the resulting shape is the image.	
Resultant Vector	The vector that moves the original shape to its final position after a number of translations.	
Invariant Point	Invariant point on a line or shape is a point that does not vary/move under a single transformation or combined transformation.	
Describing an enlargement	State it is an enlargement and give the scale factor and coordinates of the centre of enlargement.	
Describing a reflection	State is it a reflection and include the mirror line. The mirror line may require an equation.	
Describing a rotation	State it is a rotation, give the coordinate of the centre of rotation, and the angle and direction.	

Prior Knowledge

Inequalities are the relationships between two expressions which are not equal to one another.

Equality and Inequality



= equal
≠ not equal
> greater than
≥ greater than or equal
< less than
≤ less than or equal

Factors are numbers that divide exactly into another number.

2 × 4 = 8
Factors
Product

Factors of 12: 1, 2, 3, 4, 6, 12
Factors of 16: 1, 2, 4, 8, 16
Common Factors
4 is the Greatest Common Factor

When a value is square rooted, the answer can be positive or negative.

$$2 \times 2 = 4$$
positive × positive = positive

$$-2 \times -2 = 4$$
negative × negative = positive

Factorising is the reverse of expanding bracket. The first step of factorising an expression is to 'take out' any common factors which the terms have.

$$4x+16$$
4 is a factor of both 4 and 16.
$$4(x+4)$$

Solve a quadratic by factorising:
- **Step 1:** Rearrange the given quadratic so that it is **equal to zero**
- **Step 2:** Factorise the quadratic
- **Step 3:** Form two linear equations and solve each.

$$x^2+2x-3=0$$
$$(x-1)(x+3)=0$$
$$x-1=0 \qquad x+3=0$$
$$x=1 \qquad x=-3$$

BIDMAS

B	I	D M	A S
( )	x^y	÷ or ×	+ or −
Brackets	Indices	Divide & Multiply	Add & Subtract

Order of Operations →

Substitution is the name given to the process of swapping an algebraic letter for its value.

Evaluate the expression h + 5, for h = 3

h + 5 (h=3)

= 3 + 5

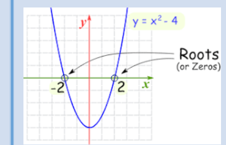
= 8 ✓

A bracket squared means the bracket times the bracket, and then expand it as you normally word for two brackets.

$$(a+b)^2 = a^2+2ab+b^2$$

$$(a-b)^2 = a^2-2ab+b^2$$

Key Concepts — Higher – Unit 9 – Equations and Inequalities

Solving an equation or inequality	Means find the values for the unknown that fit	$x+17=20$ $-17 \quad -17$ $x=20-17$ $x=3$
Roots of a function	Solution when it is equal to zero.	
Quadratic expression	In the form ax^2+bx+c, where a, b and c are numbers.	ax^2+bx+c $2x^2+4x+5$
Quadratic formula	Can be used to find solutions to a quadratic equation $ax^2+bx+c=0$	$x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$
Perfect Squares	A number made by squaring a whole number.	$(x+2)^2$, $(x-1)^2$ and $\left(x+\frac{1}{2}\right)^2$
Simultaneous Equations	When there are two unknowns, you need two equations to find their values.	$2x+y=12$ $6x+5y=40$
Elimination	Solving simultaneous equations – making the coefficients of one variable the same in both equations, and then adding or subtracting to eliminate this variable.	Use the elimination method to solve the given simultaneous equations $5x+y=20$ (×5) $4x+5y=37$ $25x+5y=100$ $4x+5y=37$ $21x=63$ (÷21) $x=3$ substitute $x=3$ into $5x+y=20$ $5(3)+y=20$ $15+y=20$ (−15) $y=5$ $\therefore x=3,\ y=5$
Substitution	Solving simultaneous equations – substituting and expression for x or y from one equation into the other equation.	① $3x+2y=21$ ② $y=x+3$ A) Substitute y and solve to find x. ① $3x+2(x+3)=21$ $3x+(2x+6)=21$ $5x+6=21$ $5x=15$ $x=3$ B) Input x to find y. ② $y=(3)+3$ $y=6$
Surd	When we can't simplify a number to remove a square root (or cube root etc) then it is a surd.	Example Solve $(x+2)^2=7$. $x+2=\pm\sqrt{7}$ — Square root both sides. ± means 'plus or minus'. $x=-2+\sqrt{7}$ — $+\sqrt{7}$ gives one solution. or $x=-2-\sqrt{7}$ — $-\sqrt{7}$ gives the other solution.

Prior Knowledge

A **ratio** says how much of one thing there is compared to another thing.

To write a **ratio** as **fractions**, add the total parts in the **ratio** to find the denominators and write each part of the **ratio** as the individual numerators.

$\frac{3}{10}$ yellow $\frac{7}{10}$ blue

10 in total

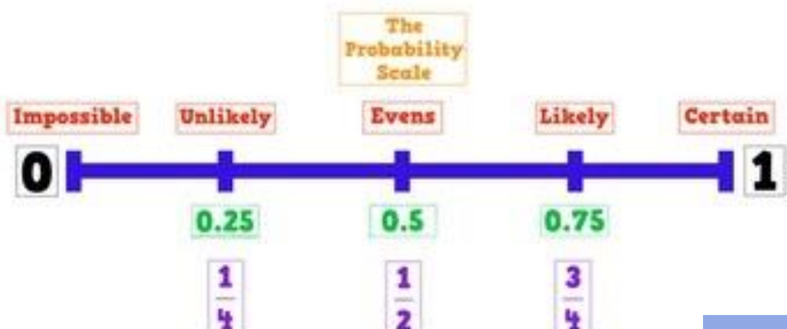
$$\frac{24 \div 2}{40 \div 2} = \frac{12}{20}$$

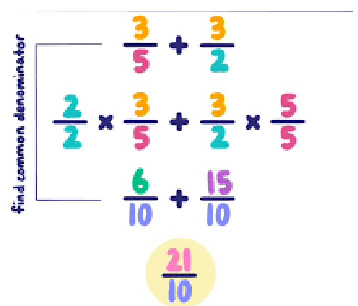
or $$\frac{24 \div 4}{40 \div 4} = \frac{6}{10}$$

or $$\frac{24 \div 8}{40 \div 8} = \frac{3}{5}$$

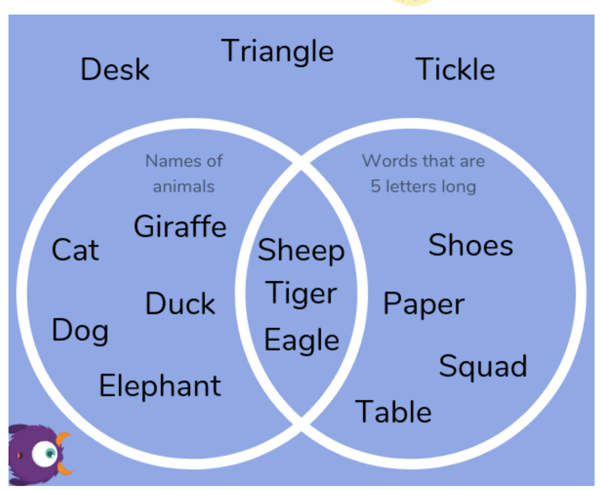
You can simplify a fraction if the numerator (top number) and denominator (bottom number) can both be divided by the same number.

To add fractions there are Three Simple Steps: Make sure the bottom numbers (the denominators) are the same. **Add** the top numbers (the numerators), put that answer over the denominator. Simplify the **fraction** (if needed)

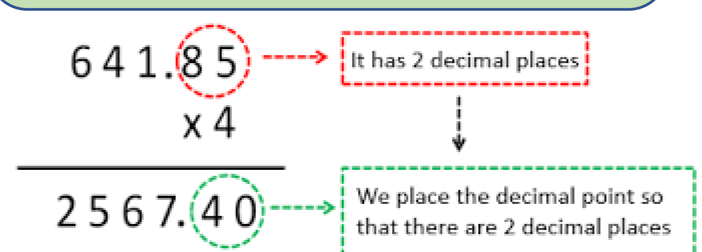




Probabilities can be written as fractions, decimals or percentages on a **scale** from 0 to 1.



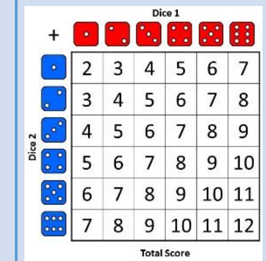
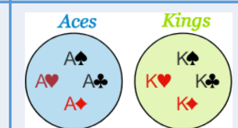
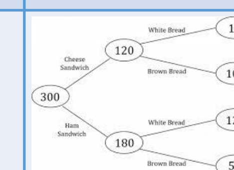
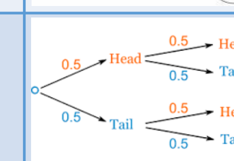
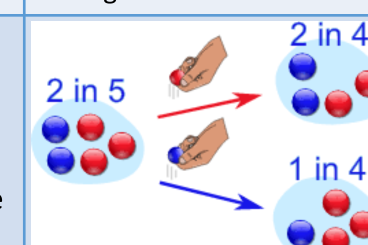
To **multiply decimals**, first **multiply** as if there is no **decimal**. Next, count the number of digits after the **decimal** in each factor. Finally, put the same number of digits behind the **decimal** in the product.



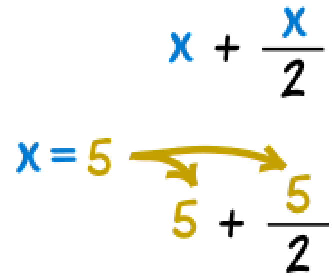
A **Venn diagram** shows the relationship between a group of different things (a set) in a visual way.

Key Concepts

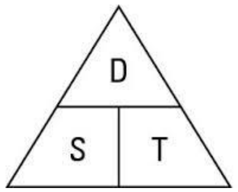
Higher – Unit 10 - Probability

Probability	$\frac{successful\ outcomes}{total\ possible\ outcomes}$	Outcome of die roll: 1, 2, 3 Probability: 1/6, 1/6, 1/6
Sample Space Diagram	Shows all possible outcomes of two events.	
Mutually Exclusive	Two events which cannot happen at the same time.	
Experimental Probability	$\frac{frequency\ of\ outcome}{total\ number\ of\ trials}$	Example: A coin is tossed 10 times: A head is recorded 7 times and a tail 3 times. $P(\text{head}) = \frac{7}{10}$ $P(\text{tail}) = \frac{3}{10}$
Theoretical Probability	The number of ways the event can occur (favorable outcomes) divided by the number of total outcomes.	Example: A coin is tossed. $P(\text{head}) = \frac{1}{2}$ $P(\text{tail}) = \frac{1}{2}$
Expected Outcomes	Number of trials x probability	A fair die is rolled 300 times. How many times would you expect it to land on a 5?
Frequency Tree	Shows two or more events and the number of times they occur.	
Probability Tree Diagram	Shows two or ore events and their probabilities.	
Dependent Events	If one event depends upon the outcome of another.	E.g. taking a red ball from a bag of red and blue balls would reduce the chance of taking another red ball.
Conditional Probability	The probability of a dependent even. The probability of the second outcome depends on what has already happened in the first outcome.	

Prior Knowledge

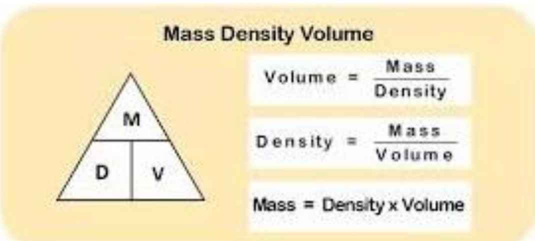


Substitution is the name given to the process of swapping an algebraic letter for its value.



D = S × T
S = D ÷ T
T = D ÷ S

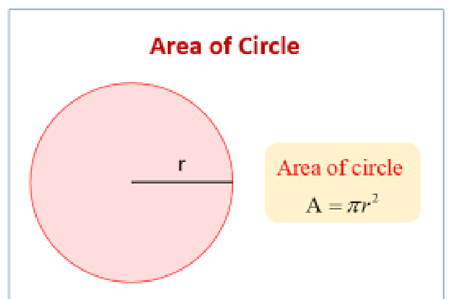
Distance = speed x time.
To work out what the units are for speed, you need to know the units for distance and time.



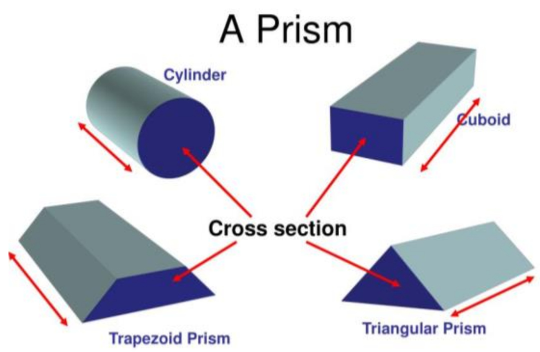
Mass = density x volume.
Density is normally measured using units of g/cm^3 for smaller amounts, and kg/m^3 for larger amounts.

y = mx + c
gradient
y-intersect

Area of a circle is π x radius^2. It is measured in ______^{2}.



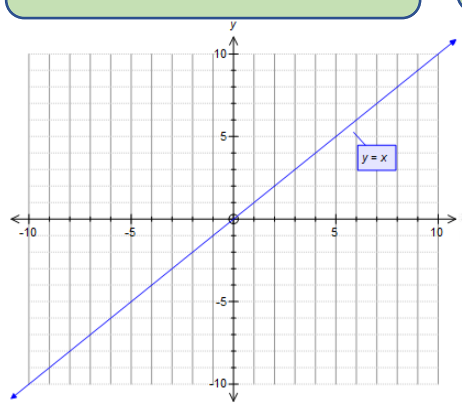
In a linear equation (equation of a straight line) the gradient is the coefficient of x.



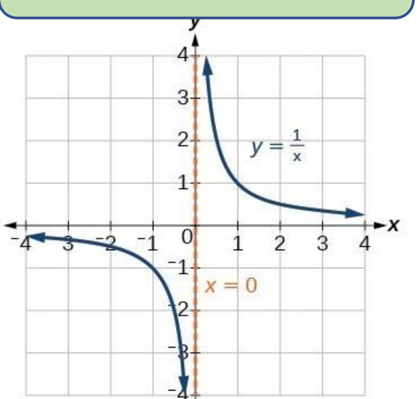
Volume of Prism = length x Cross-sectional area

A prism has the cross section the same all along its length, with sides that are all parallelograms (4-sided shape with opposites sides parallel).
Volume = area of cross section x length

Y=x



$y = \frac{1}{x}$

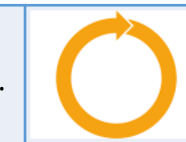
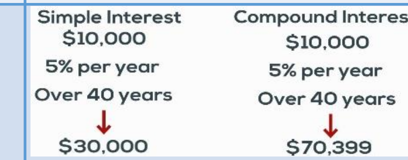
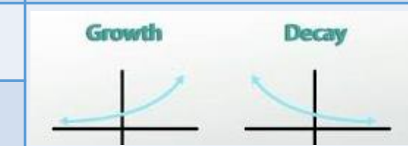
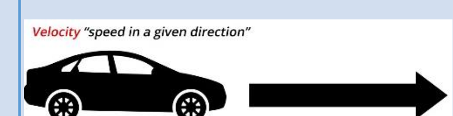
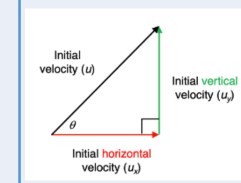
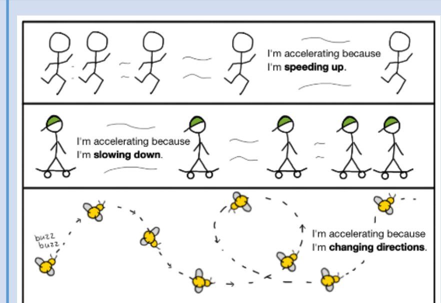


10% (Divide by 10)
5% (Divide 10% by 2)
1% (Divide 10% by 10) or (Divide by 100)

To calculate a percentage of an amount, use combinations of simple calculations.

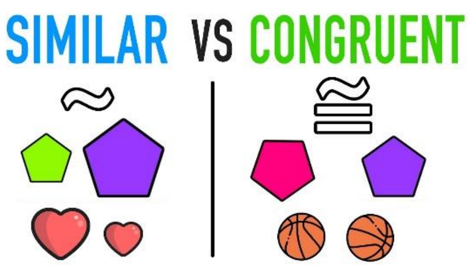
Higher – Unit 11 – Multiplicative Reasoning

Key Concepts

Iteration	Carry out a process repeatedly.	
Compound Interest	The interest earned each year is added to money in the account and earns interest the next year.	
Growth	Increases in quantity.	
Decay	Decreases in quantity.	
Density	The mass of a substance contained in a certain volume. It is usually measure in grams per cubic centimetre g/cm^3.	Density $= \frac{\text{mass}}{\text{volume}}$ or $D = \frac{M}{V}$
Pressure	The force of newtons applied over an area in cm^2 or m^2. It is usually measure in newtons N per square metre N/m^2 or square centimetre N/cm^2.	Pressure $= \frac{\text{force}}{\text{area}}$ or $P = \frac{F}{A}$
Kinematic Formulae	The features or properties of motion in an object.	These are kinematics formulae: $v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
Velocity, v	Speed in a given direction; possible units are m/s.	
Initial velocity, u	Speed in a given direction at the start of the motion.	
Acceleration, a	Rate of change of velocity, m/s^2	

Prior Knowledge

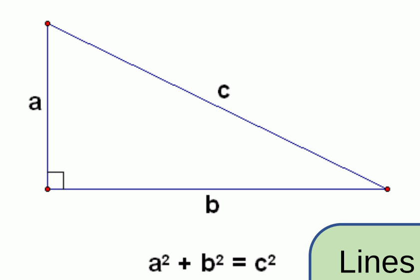
If one shape can become another using Turns, Flips and/or Slides, then the shapes are **Congruent**.



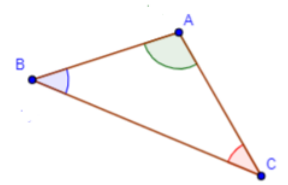
When two objects are similar then the length, area and volume scale factors are related with squaring and cubing.

Length Scale Factor	Area Scale Factor	Volume Scale Factor
k	k^2	k^3

The *Pythagorean* (or *Pythagoras'*) *Theorem* is **a² + b² = c²** where **c** is the hypotenuse while **a** and **b** are the legs of the triangle.



Sum of Angles in a Triangle

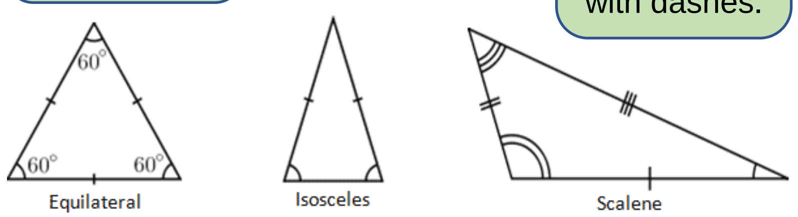


$\angle A + \angle B + \angle C = 180°$

The sum of the angles in a triangle is always 180°

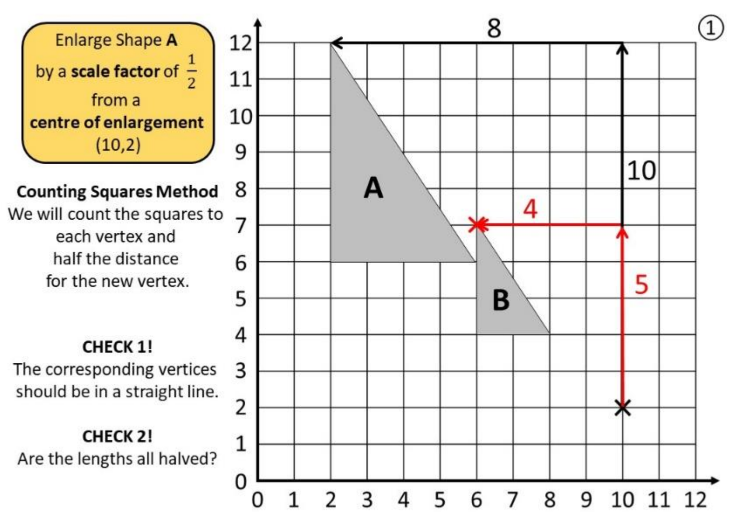
Angles in a triangle add to 180°.

Lines of equal length are marked with dashes.



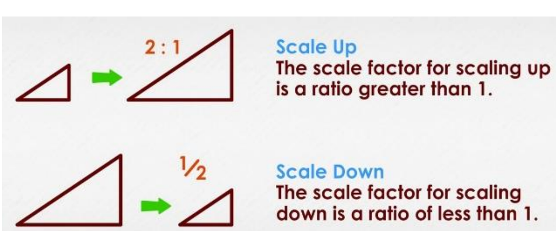
An equilateral **triangle** has 3 sides of equal length. The **dashes** on the **lines** show they are equal in length.

An isosceles **triangle** has 2 sides of equal length. The **dashes** on the **lines** show they are equal in length. The angles at the base of the equal sides are equal.



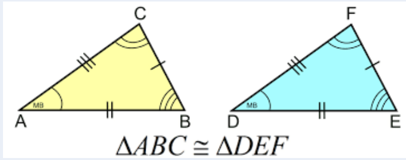
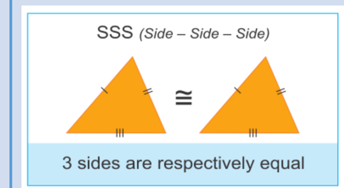
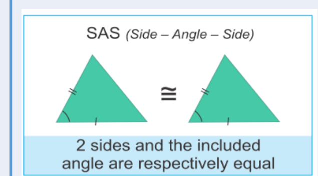
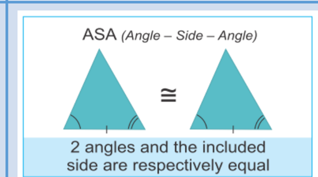
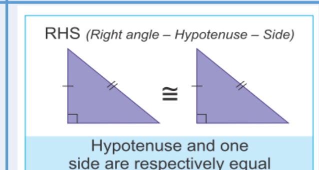
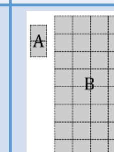
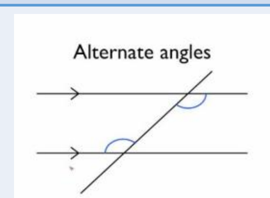
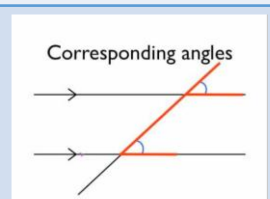
Enlarging a shape changes its size.

When the **scale factor** is fractional and the shape decreases in size, we still call it an enlargement.



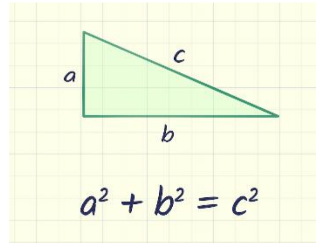
Key Concepts

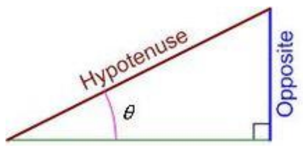
Higher – Unit 12 – Similarity and Congruence

Congruent Triangles	Triangles are congruent if they are the same shape and size but reflected, rotated or translated.	
SSS	Side, Side, Side: all three sides equal.	
SAS	Side, Angle, Side: two sides and the included angle are equal.	
AAS	Angle, Angle, Side: two angles and a corresponding side are equal.	
RHS	Right angle, Hypotenuse and Side: right angle, hypotenuse and one other side are equal.	
Perimeter	When a shape is enlarged by a linear scale factor, k, the perimeter is multiplied by scale factor k.	
Alternate angles	**Alternate angles are angles that** are in opposite positions relative to a transversal intersecting two lines.	
Corresponding Angles	When two lines are crossed by another line (which is called the Transversal), the **angles** in matching corners are called **corresponding angles**.	

Prior Knowledge

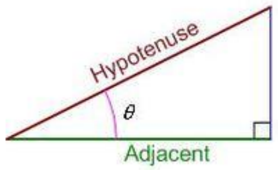
The Pythagorean (or **Pythagoras**') **Theorem** is the statement that the sum of (the areas of) the two small squares equals (the area of) the big one.



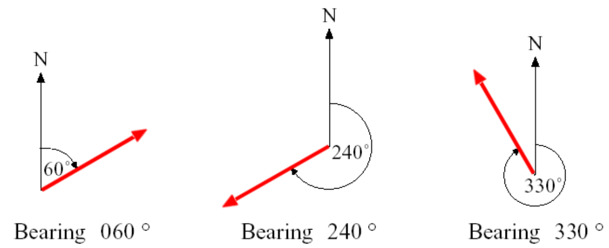


$\text{Sin}\,\theta = \dfrac{\text{Opposite}}{\text{Hypotenuse}}$

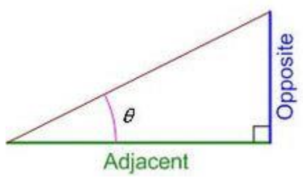
The trigonometric ratios are special measurements of a right triangle (a triangle with one angle measuring 90°).



$\text{Cos}\,\theta = \dfrac{\text{Adjacent}}{\text{Hypotenuse}}$

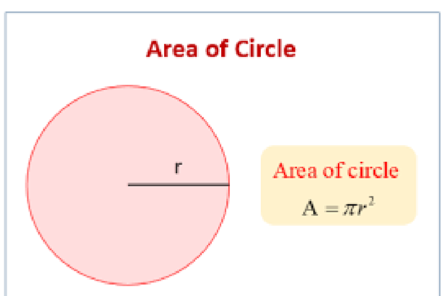


A bearing is the angle in degrees measured clockwise from north. Bearings are usually given as a three-figure bearing.

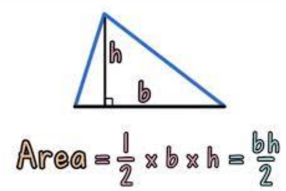


$\text{Tan}\,\theta = \dfrac{\text{Opposite}}{\text{Adjacent}}$

To calculate the **area** of a **triangle**, multiply the height by the width (this is also known as the 'base') then divide by 2.



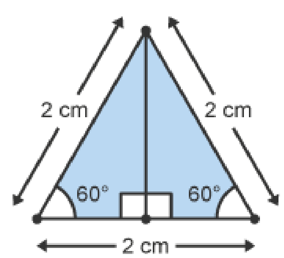
The area of a circle is:
π (Pi) times the
Radius squared: $A = \pi r^2$

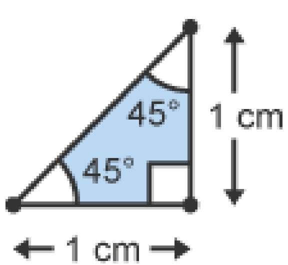


The trigonometric ratios for the angles 30°, 45° and 60° can be found using two special triangles.

A right-angled isosceles triangle with two sides of length 1 cm can be used to find exact values for the trigonometric ratios of 45°.

An equilateral triangle with side lengths of 2 cm can be used to find exact values for the trigonometric ratios of 30° and 60°.

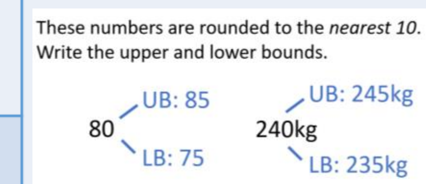
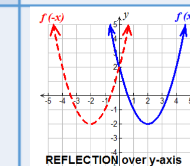
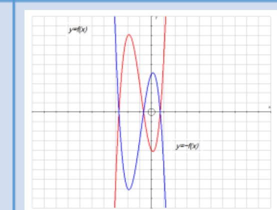
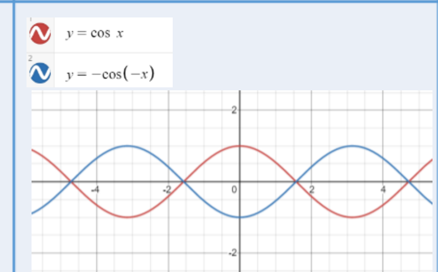
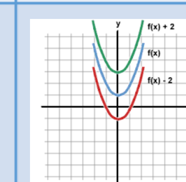
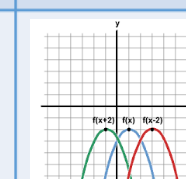
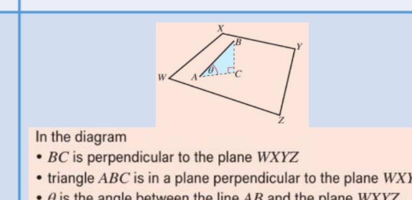




angle θ	0°	30°	45°	60°	90°
$\sin\theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	not defined

Key Concepts

Higher – Unit 13 – More Trigonometry

Upper Bound	The **upper bound** is the smallest value that would round up to the next estimated value.	
Lower Bound	The **lower bound** is the smallest value that would round up to the estimated value.	
Y= f (- x)	A reflection of y=f(x) in the y-axis.	
Y= - f (x)	A reflection of y=f(x) in the x-axis.	
Y= - f (- x)	A reflection of y=f(x) in the x-axis and then the y-axis (or vie versa). These two reflections are equivalent to a rotation of 180° about the origin.	
Y= f (x) + a	The translation of y= f(x) by $\binom{0}{a}$	
Y= f (x + a)	The translation of y= f(x) by $\binom{-a}{0}$	
Plane	A flat surface. For example the surface of your desk lies in a horizontal plane.	

Prior Knowledge

Discrete Data can only take certain values.

Continuous data is data that can take any value.

Examples	
Discrete	Continuous
• # of eggs in a basket • # of kids in a class • # of Facebook likes • # of diaper changes in a day • # of wins in a season • # of votes in an election	• Weight difference to 8 decimals before and after cookie binge. • Wind speed • Water temperature • Volts of electricity

To estimate the mean from grouped frequency: find the midpoint, multiply by the frequency for each class, add the total, divide by the total frequency,

class	f	x	fx
$12 \le t < 18$	3	15	45
$18 \le t < 24$	6	21	126
$24 \le t < 30$	1	27	27
	10		198

$198 \div 10 = \underline{19.8}$

There are many methods on how to multiply fractions with whole numbers. One method is:
1. Rewrite the whole number as a fraction.
2. Multiply the numerators of the fraction.
3. Multiply the denominators of the fraction.
4. Reduce/simplify the answer, if possible.

$\boxed{\frac{2}{7} \times 3}$

STEP ONE $\frac{2}{7} \times \frac{3}{1}$ = STEP TWO $\frac{2 \times 3}{7 \times 1}$ = STEP THREE $\frac{6}{7}$

Mode The mode is the value that appears most often in a set of data.

Mean The mean is the total of all the values, divided by the number of values.

Median The median is the middle number in a list of numbers ordered from lowest to highest.

Range The range is the difference between the lowest value and the highest value.

A **Stem and Leaf** Plot is a special table where each data value is split into a "stem" (the first digit or digits) and a "leaf" (usually the last digit).

Stems (tens)	Leaves (ones)
2	2 4 5 8
3	0 1 3
4	6 7
5	3 5 5

minimum point
Combine the tens and ones
20 + 2 = 22

maximum point
Combine the tens and ones
50 + 5 = 55

Minimum = 22 Maximum = 55 Range = 33 (55 – 22)

• Cross out the smallest and highest leaves together until you find the middle value.
• If there are 2 middle values, take the average of the 2.

Stems (tens)	Leaves (ones)
2	~~2~~ ~~4~~ ~~5~~ ~~8~~
3	~~0~~ 1 3
4	~~6~~ ~~7~~
5	~~3~~ ~~5~~ ~~5~~

31 + 33 = 64
64 ÷ 2 = 32

Median = 32

Inequality tells us about the relative size of two values.

Equality and Inequality

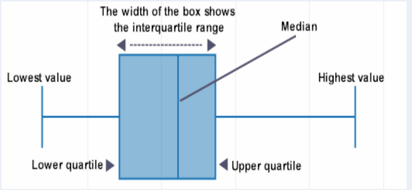
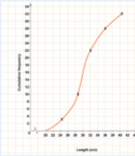
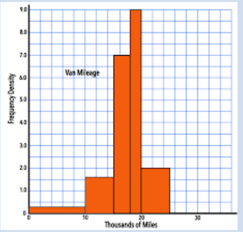
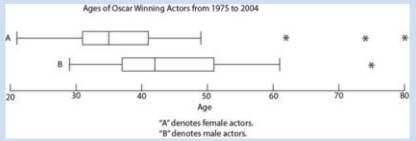
larger > smaller

= equal
≠ not equal
> greater than
≥ greater or equal
< less than
≤ less than or equal

The **modal class** is the group with the highest frequency.

Weight (Kg)	Frequency
60 up to 70	13
70 up to 75	2
75 up to 95	45
95 up to 100	7

Key Concepts — Higher – Unit 14 – Further Statistics

Box Plot (Box and whisker)	Displays data to show the median and quartiles.	
Summary Statistics	The averages, range and quartiles.	**Mode** The mode is the value that appears most often in a set of data. **Range** The range is the difference between the lowest value and the highest value. **Median** The median is the middle number in a list of numbers ordered from lowest to highest. **Mean** The mean is the total of all the values, divided by the number of values.
Cumulative Frequency Table	Show how many data values are less than or equal to the upper class boundary of each data class.	Height (cm) / Frequency / Cumulative Frequency: $90 < h \le 100$ / 5 / 5 $100 < h \le 110$ / 22 / 5 + 22 = 27 $110 < h \le 120$ / 30 / 27 + 30 = 57 $120 < h \le 130$ / 31 / 57 + 31 = 88 $130 < h \le 140$ / 18 / 88 + 18 = 106 $140 < h \le 150$ / 6 / 106 + 6 = 112
Upper Class Boundary	Highest possible value in each class.	Amount spent £x / Cumulative frequency: $0 < x \le 50$ / 6 $0 < x \le 100$ / 30 $0 < x \le 150$ / 80
Cumulative Frequency Graph	Data values on the x-axis and cumulative frequency on the y-axis.	
Histogram	A type of frequency diagram used for grouped continuous data. For unequal class intervals, the area of the bar represents the frequency,.	
Frequency Density	The height of each bar in a histogram.	$\text{Frequency density} = \frac{\text{frequency}}{\text{class width}}$
Comparative Box Plots	For two different sets of data drawn on the same diagram.	

Prior Knowledge

To solve a linear equation, use inverse operations.

To solve a quadratic equation, use either factorise, use the quadratic formula, or complete the square.

To solve a linear inequality, use inverse operations.

Greater than $>$ Greater than or equal to $\geq$

Less than $<$ Less than or equal to $\leq$

Not equal to $\neq$

The Quadratic Formula

$ax^2 + bx + c$ $\quad \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Solve $x^2 + 9x + 18 = 0$

a = 1
b = 9
c = 18

$\dfrac{-9 \pm \sqrt{9^2 - (4 \times 1 \times 18)}}{2 \times 1}$

$\dfrac{-9+3}{2}$ or $\dfrac{-9-3}{2}$

x = -3 or x = -6

Solve $5x^2 + 8x - 12 = 0$

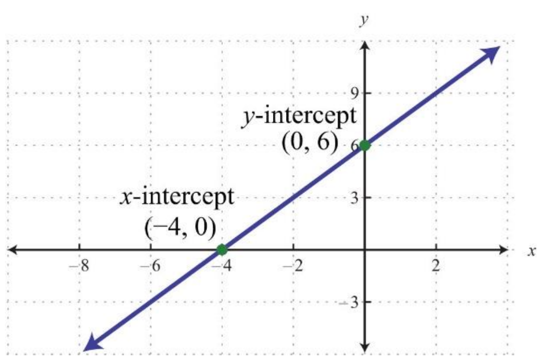
a = 5
b = 8
c = -12

$\dfrac{-8 \pm \sqrt{8^2 - (4 \times 5 \times -12)}}{2 \times 5}$

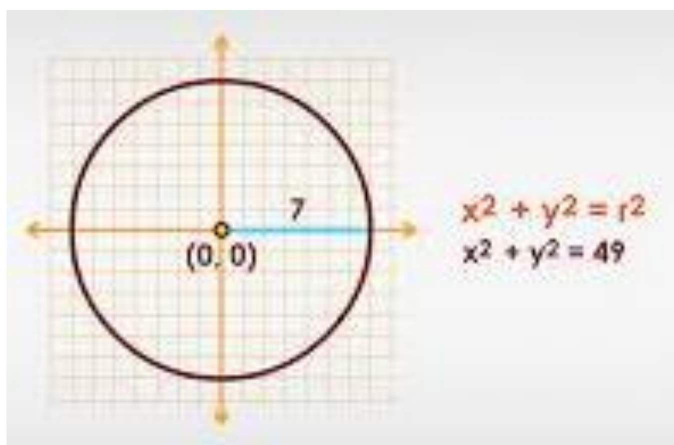
$\dfrac{-8+\sqrt{304}}{10}$ or $\dfrac{-8-\sqrt{304}}{10}$

x = 0.94 or x = -2.54

The y intercept is where a graph crosses the u axis. The x intercept is where a graph crosses the x axis.



When the graph of a circle has the centre at (0,0), the equation of the circle is $x^2+y^2=r^2$ where r is the radius.



Expand the brackets

F O I L
first outer inner last

multiply

$(x + 8)(x + 5)$

multiply

$x^2 + 5x + 8x + 40$

$x^2 + 13x + 40$

multiply

$(2y - 6)(y + 7)$

multiply

$2y^2 + 14y - 6y - 42$

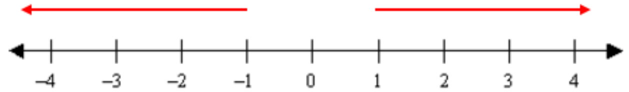
$2y^2 + 8y - 42$

To expand double brackets, multiply each term in one brackets by each term in the other bracket. Simplify where you can.

An integer is a whole number.

Integer Number Line

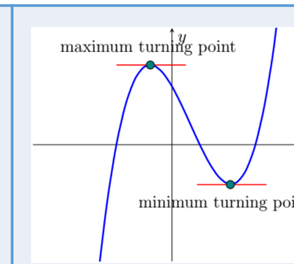
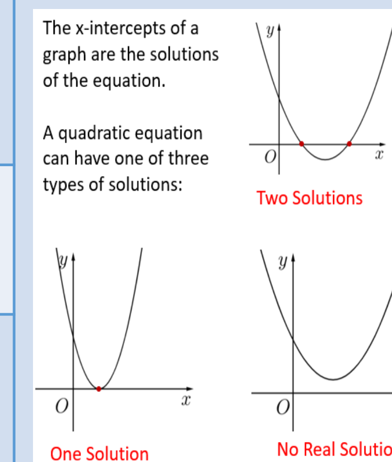
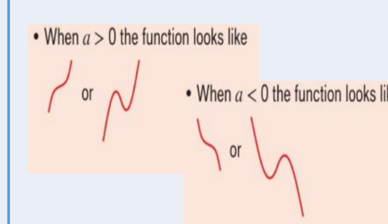
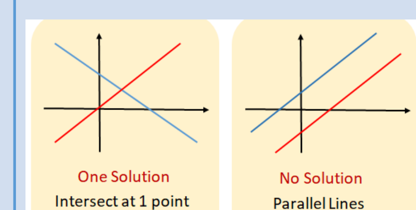
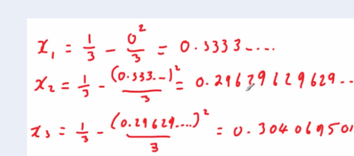
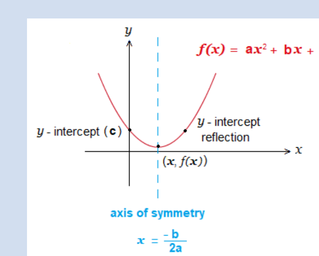
Negative Integers　　Positive Integers



Zero is neither positive nor negative

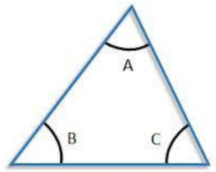
Key Concepts

Higher – Unit 15 – Equations and Graphs

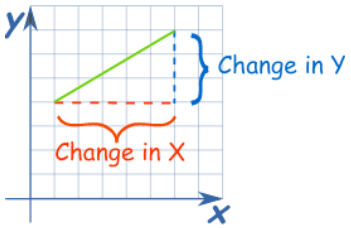
Turning Point	The lowest of highest point of the parabola where the graph turns. It is either a minimum or a maximum.	
Roots	The x-values where the graph intersects the x-axis are the solutions of the equation y=0.	
No Real Roots	If a graph does not cross the x-axis.	
One Repeated Root	If the graph just touches the x-axis.	
Cubic Function	Highest power of x is x^3. It is written in the form $y=ax^3+bx^2+cx+d$. The graph intersects the y-axis at y=d. The roots can be found by finding x when y=0.	
Simultaneous Equations	You can solve a pair of simultaneous equations graphically by plotting the graphs and finding the point(s) of intersection.	
Iterative Process	To find an accurate root of a quadratic equation you can use an iterative process. Iterative means carrying out a process repeatedly.	
Sketch a quadratic	Calculate the solutions to the equation y=0. Find the y-intercept. Find the coordinate of the turning point (maximum or minimum).	

Prior Knowledge

Angles in a triangle add to 180º.



A + B + C = 180°



To calculate the gradient of a line: $\dfrac{change\ in\ y}{change\ in\ x}$

The equation of a straight line is in the form y=mx+c where m is the gradient and c is the y-intercept.

y = mx + c

gradient y-intersect

You can use substitution to find missing parts of an equation of a straight line.

e.g. Find the equation of the line through the points $(2, -3)$ and $(-1, 3)$

Solution: First find the gradient:

$$\boxed{m = \frac{y_2 - y_1}{x_2 - x_1}} \Rightarrow m = \frac{3-(-3)}{(-1)-2}$$

$$\Rightarrow m = \frac{6}{-3} \Rightarrow m = -2$$

Now $\boxed{y = mx + c}$ $\Rightarrow y = -2x + c$

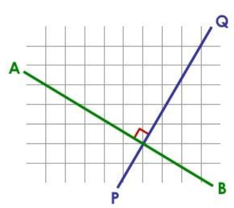
$(2, -3)$ on the line: $\Rightarrow -3 = -2(2) + c$

$\Rightarrow 1 = c$

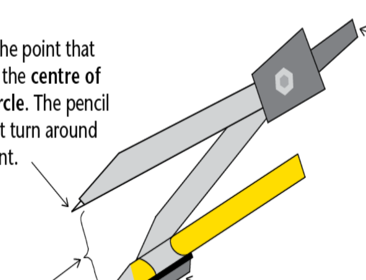
$\Rightarrow$ Equation of line is $y = -2x + 1$

Perpendicular lines cross at 90º. If two lines are perpendicular, the product of their gradients is -1.

$$m_1 = \frac{-1}{m_2}$$



To accurately draw a circle, you will need a pencil, ruler and compass.



This is the point that goes at the **centre of your circle**. The pencil tip must turn around this point.

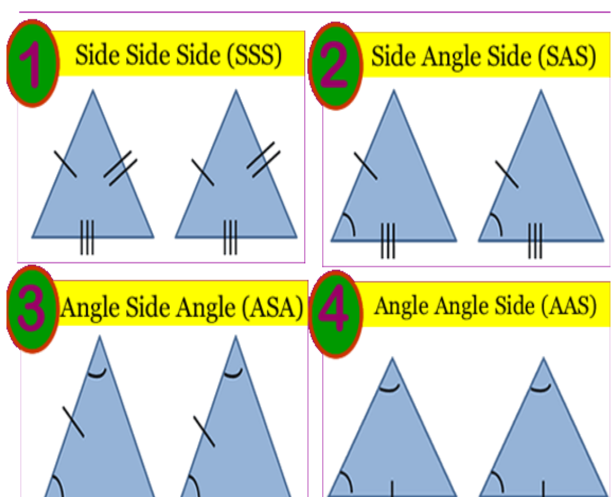
Here is the handle of the compass. You hold it between your forefinger and thumb. Only use one hand when you draw a circle. **Turn the compass by twisting it between your forefinger and thumb.**

This gap will be the **radius** of your circle. You can set the gap to the correct radius using your ruler. Change the gap by changing the angle between the arms of the compass.

Clamp your **sharpened** pencil tightly in here. The tip of the pencil must be next to the tip of the turning point when you push the arms together.

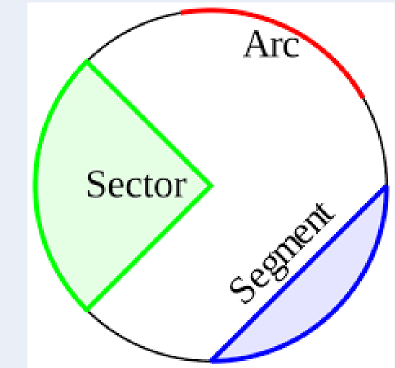
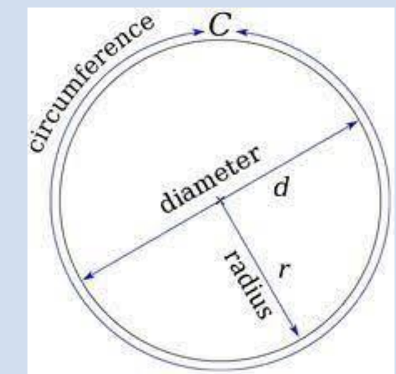
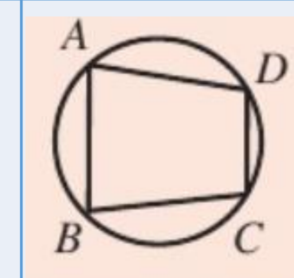
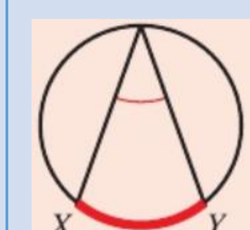
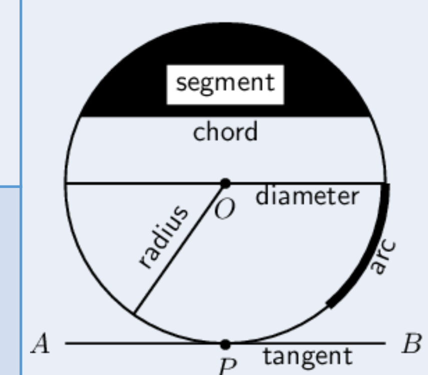
Congruent shapes are the same shape and size but reflected, rotated or translated.

Triangles are congruent if 1 of the 4 rules of congruence applies.



Higher – Unit 16 – Circle Theorems

Key Concepts

Arc	An arc is a part of the circumference.	
Sector	When an arc is bounded by two radii, a sector is formed.	
Segment	The area between an arc and a chord.	
Circumference	The distance around the outside of a circle (perimeter).	
Radius	Straight line from the centre to the edge or a circle.	
Diameter	Straight line across a circle through the centre.	
Cyclic quadrilateral	A quadrilateral with all four vertices on the circumference of a circle.	
Subtended	Opposite – and angle subtended by an arc is an angle opposite an arc.	
Chord	A straight line connecting two points on a circle.	
Tangent	A straight line which touches a circle at one point.	

Prior Knowledge

Subject of a formulae – is the variable that is being worked out. It can be recognised as the letter on its own on one side of the equals sign.

For example, in the formula for the area of a rectangle A = L x W , the subject of the formula is A.

We have changed the subject of the equation from "*v*" to "*u*"

$$\begin{aligned} v &= u + at \\ -at & \quad\; -at \\ v - at &= u \end{aligned}$$

You can change the subject of a formulae or an equation.

Factorising – Is when you put brackets back into your expression.

$25x^3 + 15x^2 + 20x = 5x(5x^2 + 3x + 4)$

Factorising a quadratic – Is when you put the expression into 2 brackets.

$x^2 + 7x - 8 = (x + 8)(x - 1)$

Adding/Subtracting Fractions – To add or subtract fractions you need common denominators.

Multiplying Fractions – Multiply the numerators and multiply the denominators.

Dividing Fractions – Dividing by a fraction is the same as multiplying by the reciprocal.

Keep, change, flip (KCF) is another way to remember

$2n$ = {2, 4, 6, 8, 10, ….} - even numbers
$2n - 1$ = {1, 3, 5, 7, ...} – odd numbers

You can use the **n^th^ term** to generate a sequence.

Equation and Identity – In an **identity** the two expressions are equal for *all* values of the variables. An **equation** is only true for certain values of the variable.

Identity $2(x + 5) = 2x + 10$ true for all values of *x*.

Equation $2x + 1 = 7$ only true for the value *x*= 3

A **surd** is a number written exactly using square or cube roots.
For example $\sqrt{3}$ and $\sqrt{5}$ are surds. $\sqrt{4}$ and $\sqrt[3]{27}$ are not surds, because $\sqrt{4} = 2$ and $\sqrt[3]{27} = 3$

$$\sqrt{mn} = \sqrt{m}\,\sqrt{n} \qquad \sqrt{\frac{m}{n}} = \frac{\sqrt{m}}{\sqrt{n}}$$

A **rational** number can be written as a fraction in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$.

2 is rational as it can be written as $\frac{2}{1}$. $0.\dot{2}$ is rational as it can be written as $\frac{2}{9}$. $\sqrt{2}$ is irrational.

To **rationalise the denominator** of $\frac{a}{\sqrt{b}}$, multiply by $\frac{\sqrt{b}}{\sqrt{b}}$. Then the fraction will have an integer as the denominator.

Substitution – Substitution is when you replace the letters in an expression with their correct value.

The Quadratic Formula

For $ax^2 + bx + c = 0$ where $a \neq 0$:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

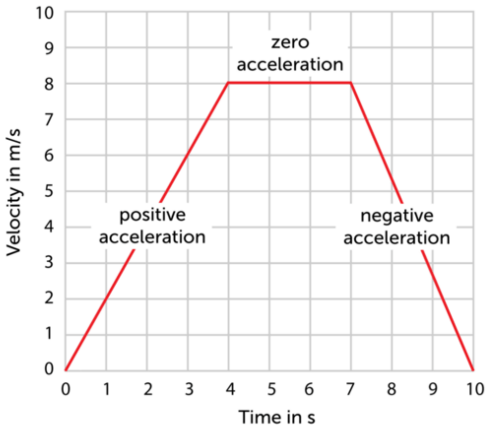
Key Concepts

Higher – Unit 17 - More Algebra

The wanted subject appears twice	When the letter to be made the subject appears twice in the formula you will need to **factorise**.
The wanted subject is part of a power	When the letter to be made the subject is part of a term involving a power or root, rearrange so that the whole term is on its own on one side of the equation. Use inverse operations to eliminate the power or root.
Multiplying algebraic fractions	When multiplying algebraic fractions, cancel common factors in numerators and denominators before multiplying the fractions together.
Simplifying algebraic fractions	To simplify an algebraic fraction, cancel any common factors in the numerator and denominator.
Factorising before simplifying algebraic fractions	You may need to factorise before simplifying an algebraic fraction: - Factorise the numerator and denominator. - Divide the numerator and denominator by any common factors.
Lowest Common Multiple	The lowest common denominator of two algebraic fractions is the lowest common multiple of the two denominators.
Proving and Identity	To show a statement is an identity, expand and simplify the expressions on one or both sides of the equals sign, until the two expressions are the same.
Proof	A proof is a logical argument for a mathematical statement.
Prove something true	To prove a statement is true, you must show that it will be true in all cases.
Dis-prove	To prove a statement is not true you can find a counter-example — an example that does not fit the statement.
Integer in a proof	For an algebraic proof, use n it to represent any integer.
Even/odd in a proof	*Even numbers = 2n Odd numbers =2n+1 or 2n-1*
Integers in a proof	*Consecutive integers n, n+1, n+2, …*
Evens/odds in a proof	*Consecutive Even = 2n, 2n+2, 2n+4, .. Consecutive Odd = 2n+1, 2n+3, 2n+5, …*
Rationalise the denominator	To rationalise the fraction $\frac{1}{a\sqrt{b}}$, multiply by $\frac{\sqrt{b}}{\sqrt{b}}$. To rationalise the fraction $\frac{1}{a \mp \sqrt{b}}$, multiply by $\frac{a \pm \sqrt{b}}{a \pm \sqrt{b}}$.
Solve equations with fractions	To solve an equation involving algebraic fractions, first write one side as a fraction in its simplest form.
Solve quadratic	To solve a quadratic equation, rearrange it into the form $ax^2 + bx + c = 0$.
Function notation	A function is a rule for working out values of y for given values of x. The notation f(x) is read as 'f of x'. f is the function. f(x) = 3x means the function of x is 3x.
Composite function	fg is a composite function. To work out fg(x), first work out g(x) and then substitute your answer into f(x).
Inverse function	The inverse function reverses the effect of the original function. $f^{-1}(x)$ is the inverse function of f(x).

Prior Knowledge — Maths

A velocity-time graph **shows the speed and direction an object travels over a specific period of time**. Velocity-time graphs are also called speed-time graphs.



The vertical axis of a velocity-time graph is the velocity of the object.

The horizontal axis is the time from the start.

The slope of a velocity graph represents the acceleration of the object.

Substitution – replacing a variable with a value or other variable.

Two quantities are said to be in **direct proportion** if they increase or decrease in the same ratio.

Negative Exponents

$a^{-n} = \frac{1}{a^n}$ For $a \neq 0$

a^{-n} is a reciprocal of a^n

Example:

$3^{-2} = \frac{1}{3^2}$ $\left(\frac{2}{5}\right)^{-6} = \left(\frac{5}{2}\right)^{6}$

Fractional Indices

Numerator – Power

$a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m$

Denominator - Root

Examples:

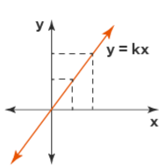
$8^{\frac{1}{3}} = \sqrt[3]{8} = 2$

$25^{\frac{3}{2}} = \left(\sqrt[2]{25}\right)^3 = 5^3 = 125$

Direct Proportion

$y \propto x$

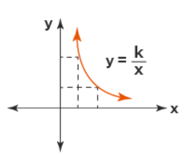
$y = kx$ for a constant k



Inverse Proportion

$y \propto \frac{1}{x}$

$y = \frac{k}{x}$ for a constant k



Work out the value of the expression

$5x + y$

If $x = 4$ and $y = 3$

$5 \times 4 + 3$

$20 + 3$

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Function Notation

Example: $f(x) = 3x + 1$

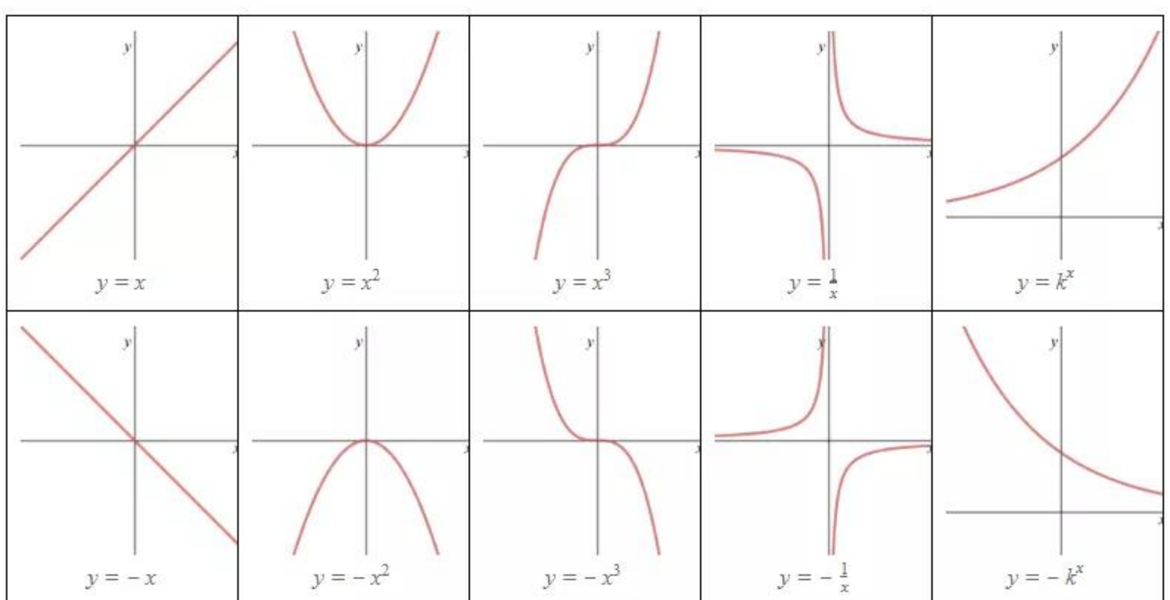
name of function (f of x)

Input (domain)

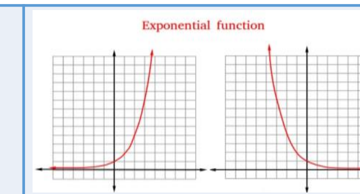
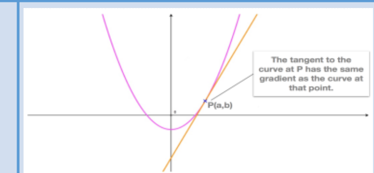
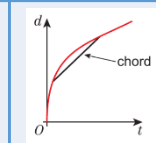
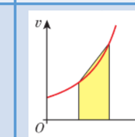
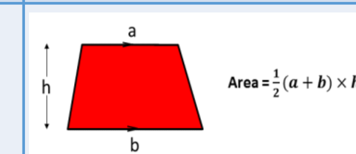
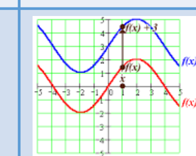
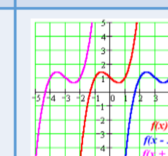
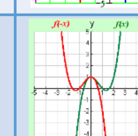
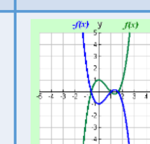
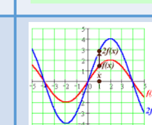
output (range)

$f(2) = 3(2) + 1 = 7$

$f(-4) = 3(-4) + 1 = 11$



Key Concepts — Higher – Unit 19 – Proportion and Graphs

Exponential Function	Expressions in the form a^x or a^{-x} where $a>1$.	
Tangent to a Curve	A straight line that touches the graph at a point. The gradient at a point on a curve is the gradient of the tangent at that point.	
Chord	A straight line that connects two points on a curve. The gradient of the chord gives the average rate of change and can be used to find the average rate of change between two points.	
Area under a velocity-time graph	The area under a velocity graph represents the displacement of the object.	
Area of a trapezium	Used to estimate the area under a curve.	
Y = f (x) + a	The graph of y=f(x) is transformed by a translation of a units parallel to the y-axis, or by a translation $\begin{pmatrix}0\\a\end{pmatrix}$	
Y = f (x + a)	The graph of y=f(x) is transformed by a translation of a units parallel to the x-axis, or by a translation $\begin{pmatrix}-a\\0\end{pmatrix}$	
Y = f (-x)	The graph of y=f(x) is transformed by a reflection in the y-axis.	
Y = -f (x)	The graph of y=f(x) is transformed by a reflection in the x-axis.	
Y = a f (x)	The graph of y=f(x) is transformed by a stretch of scale factor a parallel to the y-axis.	
Y = f (ax)	The graph of y=f(x) is transformed by a stretch of scale factor $\frac{1}{a}$ parallel to the x-axis.