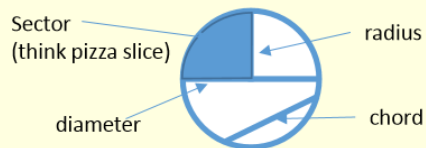


Video 61

Key Facts

Circumference = perimeter of a circle (units)
Area = space inside a 2D shape (units²)
Volume = the space inside a 3D shape (units³)



Circumference = video 60

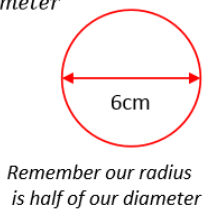
Area = Video 40

Circumference and Area of Circles

$Circumference = \pi \times diameter$

$Area = \pi \times radius^2$

" πr^2 sounds like area to me, if you need the circumference you just use πd "



Arc length = video 58

Semicircles and Sectors

Perimeter

Perimeter = arc length + radius + radius

Arc length = $\frac{\theta}{360} \times \pi \times diameter$

Arc length is a fraction of the circumference



Area

Video 46

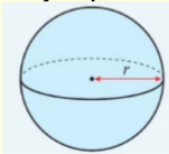
$Area = \frac{\theta}{360} \times \pi \times radius^2$

Perimeter of semi-circle = video 62

Volume and surface area of spheres

Volume of Sphere = $\frac{4}{3} \pi r^3$

Surface Area of a Sphere = $4\pi r^2$



SA = video 313

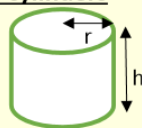
Volume = video 361

Perimeter, Area and Volume 2

Volume and SA of cylinders

Volume = $\pi r^2 h$

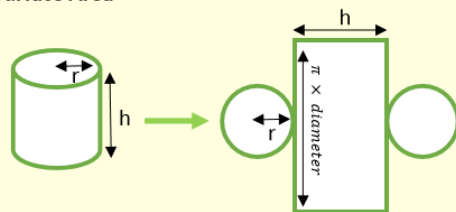
$V = \pi \times radius^2 \times height$



(this is just the area of one of the circles multiplied by how long your cylinder is)

Volume = video 357

Surface Area



SA = 2 circle areas + rectangle area

$SA = 2\pi r^2 + \pi dh$

SA = video 315

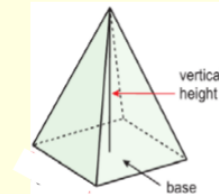
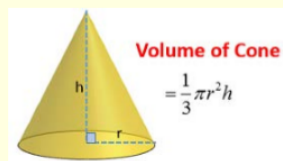
Volume of pyramids and cones



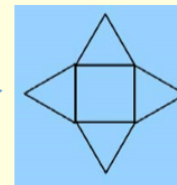
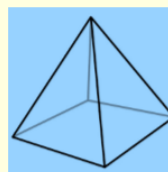
Volume of a Pyramid/Cone = $\frac{1}{3} \times area\ of\ base \times vertical\ height$

Volume of cone = video 359

Volume of pyramid = video 360



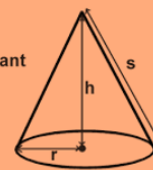
Surface Area of a Pyramid = total area of all faces



Area of all 4 triangles + area of the base

Surface Area of a Cone = $\pi \times radius \times slant\ height$
 $= \pi r l$

r = radius
 h = height
 s = length of slant



SA of Cone = video 314

Unit 17 Foundation



Multiplying and dividing fractions

To multiply fractions, just multiply the **numerators** and multiply the **denominators** (then simplify if you can!)

$$\frac{2}{3} \times \frac{3}{5} = \frac{2 \times 3}{3 \times 5} = \frac{6}{15} (= \frac{2}{5})$$

[Multiplying fractions](#)

To divide by a fraction, multiply by the **reciprocal** (flip the numerator and denominator)

[Dividing fractions](#)

$$\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3} = \frac{2 \times 5}{3 \times 3} = \frac{10}{9}$$

Reciprocals

When two numbers are reciprocal, it means they **multiply to make 1** (they're a bit like "opposites").

So 2 and $\frac{1}{2}$ are reciprocal because $2 \times \frac{1}{2} = 1$

Reciprocal fractions are the **reverse** of each other, as shown:

$$\frac{2}{3} \times \frac{3}{2} = \frac{2 \times 3}{3 \times 2} = \frac{6}{6} = 1$$

The numerator will always match the denominator, and we know that anything divided by itself is 1!

Combining indices

When multiplying indices with the same base value, **add the powers**:

$$2^2 \times 2^3 = \underline{2} \times \underline{2} \times \underline{2} \times \underline{2} \times \underline{2}, \text{ so}$$

$$2^2 \times 2^3 = 2^{(2+3)} = 2^5$$

[Video 174: Laws of indices \(including power of 0\)](#)

When dividing indices with the same base value, **subtract the powers**:

$$3^6 \div 3^2 = \frac{3 \times 3 \times 3 \times 3 \times 3 \times 3}{3 \times 3}$$

$$3^6 \div 3^2 = 3^{(6-2)} = 3^4$$

Negative indices

Raising something to a negative power is the same as raising the **reciprocal** (see left) to the positive power.

[Video 175: Negative indices](#)

$$3^{-2} = \left(\frac{1}{3}\right)^2 = \frac{1}{3} \times \frac{1}{3} = \frac{1}{9} = \frac{1}{3^2}$$

It's no coincidence!

$$\text{Negative power} = \frac{1}{\text{positive power}}$$



Power of 0

Unit 18 Foundation

Anything to the power of 0 is equal to 1, no matter what it is! We can show this by dividing two identical indices:

$$3^2 \div 3^2 = 3^{(2-2)}$$

$$3^2 \div 3^2 = 3^0$$

Since dividing a value by itself always gives the answer 1, we also know that:

$$3^2 \div 3^2 = 1, \text{ therefore } 3^0 = 1$$

This works for all numbers AND letters!

Standard form

Standard form is a way of writing very large or very small numbers using powers of 10 (multiplying/dividing by 10 until the decimal point is in the right place). The base number must always be between 1 and 10.

[Video 300: Standard form](#)

e.g. 50000000000000000000
can be written as
 $5 \times 1000000000000000000$,
which can then be written as
 5×10^{18}

Clearly, the last way is quicker!

$$0.000000000004 = 4 \div 100000000000$$

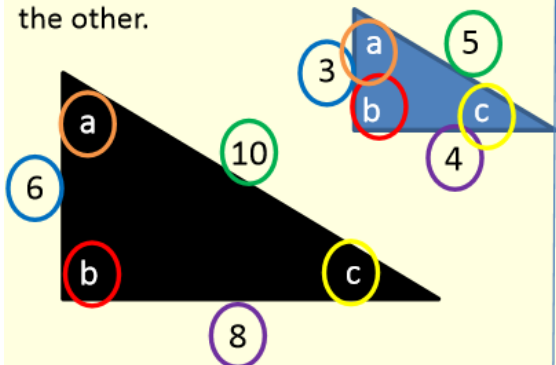
$$= 4 \times 10^{-11}$$

NOTE:

When we divide, we use negative powers!

SIMILARITY

When shapes look the same but are different sizes, they are mathematically **similar**. This means their **corresponding** ("matching") **angles are equal**, and their **corresponding sides are in the same ratio**. One shape is an **enlargement** of the other.



[Congruence & Similarity definitions](#)
[How to find missing sides](#)

VECTORS

Unit 19 Foundation

Column vectors describe horizontal and vertical "movement", a bit like how co-ordinates describe position. They look similar, but they're arranged in a column (hence the name), as shown below:

[Column vectors](#)

$\begin{pmatrix} x \\ y \end{pmatrix}$ horizontal movement
vertical movement

To get from A to B, you go 3 right, 2 up:

$$\vec{AB} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

Reverse: $\vec{BA} = \begin{pmatrix} -3 \\ -2 \end{pmatrix}$



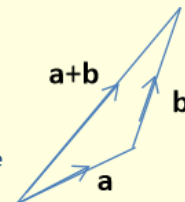
Vectors are labelled with a lower case letter, either **bold** or underlined.

You can combine vectors by adding their x and y values to give a **resultant** vector:

$$\mathbf{a} = \begin{pmatrix} 3 \\ 2 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad \mathbf{a+b} = \begin{pmatrix} 3+4 \\ 2+1 \end{pmatrix} = \begin{pmatrix} 7 \\ 3 \end{pmatrix}$$

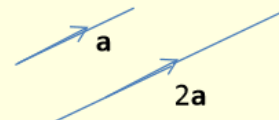
It would look like this:

We do this to move between points that don't have a vector between them – you can only go the way you know!

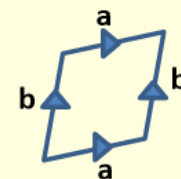


Vectors can also be multiplied:

$$2\mathbf{a} = \begin{pmatrix} 3 \times 2 \\ 2 \times 2 \end{pmatrix} = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$$



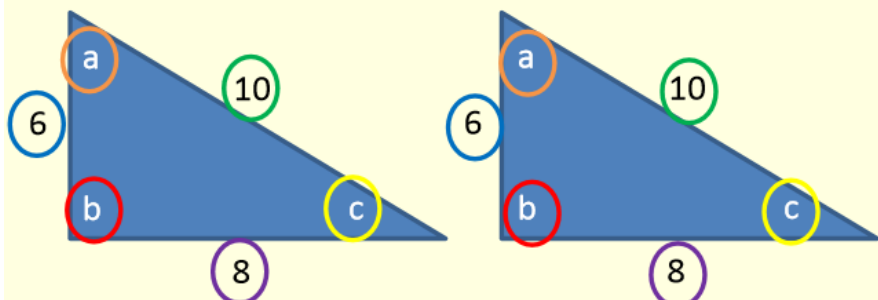
Parallel vectors can be represented using the same letter:



[Algebraic vectors](#)

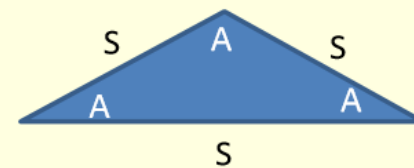
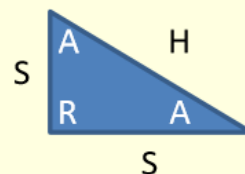
CONGRUENCE

When shapes are identical, they are **congruent**. All **corresponding lengths and angles are equal** – you could fit one perfectly on top of the other.



You can prove two triangles are congruent by showing that any of these combinations are matching ([video here](#)):

- SSS (all three sides)
- SAS (two sides and the angle between them)
- ASA (two angles and the side which connects them)
- AAS (two angles and the side after the second angle)
- RHS (right angle, hypotenuse and one other side)*



*only applies to right-angled triangles

Unit 20 Foundation More Algebra

Quadratic functions contain a term in x^2 but no higher power of x .

[Video 266 - https://tinyurl.com/y8san5jm](https://tinyurl.com/y8san5jm)

Cubic functions contain a term in x^3 but no higher power of x .

[Video 344 - https://tinyurl.com/yamclpto](https://tinyurl.com/yamclpto)

Cubic functions can contain terms in x^2 , x , and number terms.

When a cubic function is equal to zero it may have one, two, or three solutions. The solution to a cubic function equalling zero is there the graph crosses the x -axis. The solutions are commonly called **roots**.

[Video 264 - https://tinyurl.com/y7u3d79a](https://tinyurl.com/y7u3d79a)

The **reciprocal** function ($y = \frac{1}{x}$) of a cubic function has the x - and y -axes as **asymptotes** to the graph.

[Video 346 - https://tinyurl.com/yd8x2uz8](https://tinyurl.com/yd8x2uz8)

An **asymptote** is a line that the graph gets closer and closer to, but never actually touches.

Key Points:



<https://tinyurl.com/ybfxnjsj>

When a graph has x and y in **direct proportion**, $y = kx$

[Video 254 - https://tinyurl.com/htma465](https://tinyurl.com/htma465)

When a graph has x and y **inversely proportional** to each other, $y = -$

[Video 255 - https://tinyurl.com/yb2ur2yq](https://tinyurl.com/yb2ur2yq)

The graph of two quantities that are inversely proportional is a reciprocal graph.

Simultaneous equations are equations that are both true for a pair of variables (letters).

[Video 296 - https://tinyurl.com/y9dbmoe](https://tinyurl.com/y9dbmoe)

Simultaneous equations can be solved graphically by plotting both equations on the same coordinate grid. The point at which the lines cross (the point of **intersection**) has the coordinates that are the solution.

Knowledge Check:



<https://tinyurl.com/y9nl3tka>

Simultaneous equations can also be solved by the elimination method. To do this, the coefficients of either the x or y terms must be equal (or equal with the opposite sign).

[Video 295 - https://tinyurl.com/yadevfgk](https://tinyurl.com/yadevfgk)
Subtract (or add) the two equations to eliminate one of the terms. The remaining term can now be evaluated.

The **subject** of a formula is the letter on its own side of the equals sign.

[Video 7 - https://tinyurl.com/yc6vax5f](https://tinyurl.com/yc6vax5f)

You can change the subject of a formula using **inverse operations** (subtract to move an added term to the other side, etc).

[Video 8 - https://tinyurl.com/yahmeoy](https://tinyurl.com/yahmeoy)

An **even number** is a multiple of 2. $2m$ and $2n$ are general terms for even numbers where m and n are integers.

An **equation** has an equals sign ($=$). You can solve it to find one value of the letter (unknown/variable).

An **identity** has an equivalent (triple bar) sign (\equiv). The left hand side equals the right hand side for all values of the letter (unknown/variable).