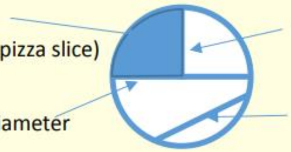
Year 11 – Maths Foundation / Unit 17 – HT1

Video 61

Key Facts

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

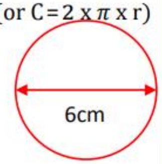


Circumference video   Area video

Circumference and Area of Circles

Circumference $= \pi \times diameter$ (or C = 2 x π x r)

Area $= \pi \times radius^2$



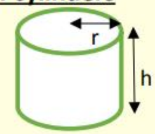
"πr^2 sounds like area to me, if you need the circumference you just use πd"

Remember our radius is half of our diameter

Perimeter, Area and Volume 2

Volume and SA of cylinders

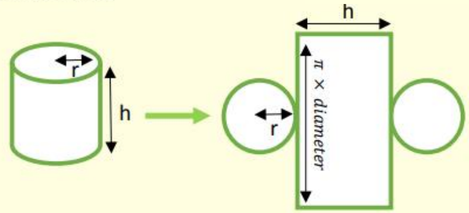
Volume = $\pi r^2 h$
V = $\pi \times radius^2 \times height$



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

Volume video

Surface Area



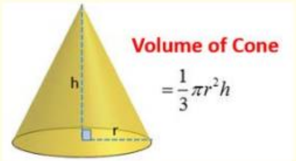
SA = 2 circle areas + rectangle area
SA = $2\pi r^2 + \pi dh$

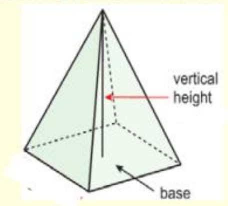
SA Video

Volume of pyramids and cones

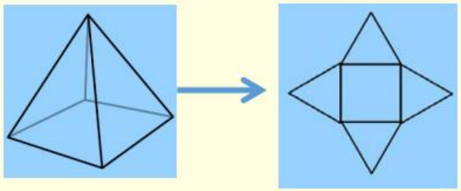
Volume of a Pyramid/Cone $= \frac{1}{3} \times area\ of\ base \times vertical\ height$

Volume of cone   Volume of pyramid



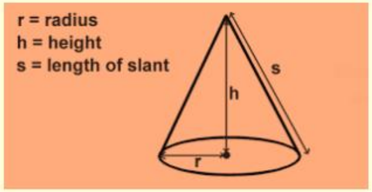


Surface Area of a Pyramid = total area of all faces



Area of all 4 triangle + area of the base

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



SA of Cone

Arc length video

Semicircles and Sectors

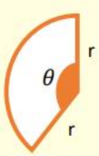
Perimeter of semi-circle video

Perimeter

Perimeter = arc length + radius + radius

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

Arc length is a fraction of the circumference



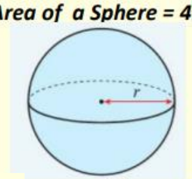
Area   Video 46

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

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   Volume Video

Multiplying and dividing fractions

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

$$\frac{2}{3} \times \frac{3}{5} = \frac{2\times3}{3\times5} = \frac{6}{15} \quad (= \frac{2}{5})$$

Multiplying fractions

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

Dividing fractions

$$\frac{2}{3} \div \frac{3}{5} = \frac{2}{3} \times \frac{5}{3} = \frac{2\times5}{3\times3} = \frac{10}{9}$$

Combining indices

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

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

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

Laws of indices inc power base of 0

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

$$3^6 \div 3^2 = \frac{3\times3\times3\times3\times3\times3}{3\times3}$$

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

Power of 0

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:

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

This works for all numbers AND letters!

Reciprocals

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

So 2 and ½ are reciprocal because
2 x ½ = 1

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

$$\frac{2}{3} \times \frac{3}{2} = \frac{2\times3}{3\times2} = \frac{6}{6} = 1$$

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

Negative indices

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

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!

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

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.

Standard form

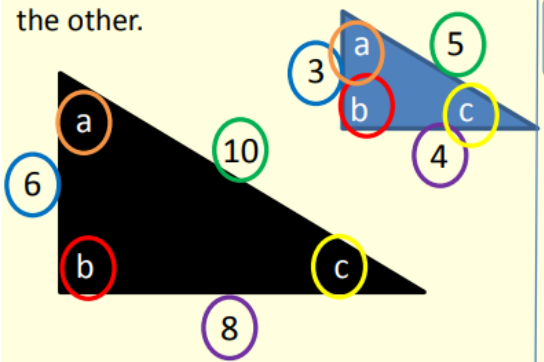
e.g. 5000000000000000000
can be written as
5 x 1000000000000000000,
which can then be written as
$\mathbf{5 \times 10^{18}}$
Clearly, the last way is quicker!

$$0.00000000004 = 4 \div 100000000000$$
$$= 4 \times 10^{-11}$$

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 and similarity definitions]
[How to find missing sides]

VECTORS

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:

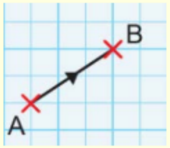
[Column vectors]

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

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

$\overrightarrow{AB} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ (**a**)

Reverse: $\overrightarrow{BA} = \begin{pmatrix} -3 \\ -2 \end{pmatrix}$ (-**a**)



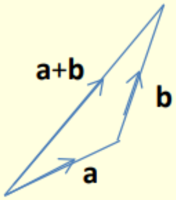
Vectors are labelled with a lower case letter, either **bold** or underlined.

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

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

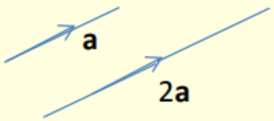
It would look like this:

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

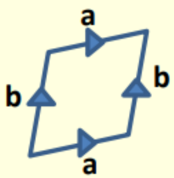


Vectors can also be multiplied:

$2\mathbf{a} = \begin{pmatrix} 3\times2 \\ 2\times2 \end{pmatrix} = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$



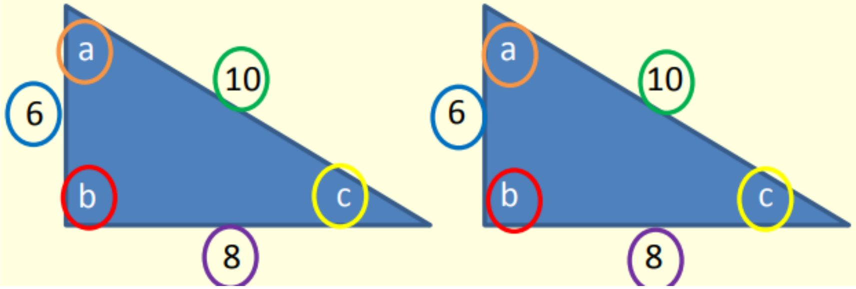
Parallel vectors can be represented using the same letter:



[Algebraic vectors]

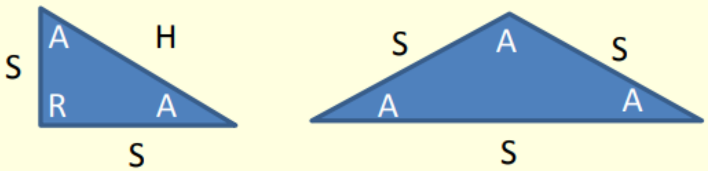
CONGRUENCE

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

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

[Video 266]

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

[Video 344]

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]

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

[Video 346]

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

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

[Video 254]

When a graph has x and y **inversely proportional** to each other, $y = \frac{}{}$

[Video 255]

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]

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.

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]

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]

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

[Video 8]

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 (≡). The left hand side equals the right hand side for all values of the letter (unknown/variable).

Key Points:

https://tinyurl.com/ybfxnjsj

Knowledge Check:

https://tinyurl.com/y9nl3tka