Topic: KS4 Foundation Unit 12 Right-angled Triangles

MathsWatch clips: 9, 54, 150, 174

Duration: 11 Lessons

Composite: Unit Test

Key vocabulary:

Pythagoras

Theorem

Coordinate

Trigonometry

Sine, Cosine and Tangent

Line Segment

Formulae

Surd

Elevation

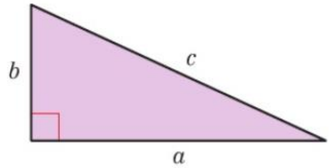
Depression

Hypotenuse

Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.

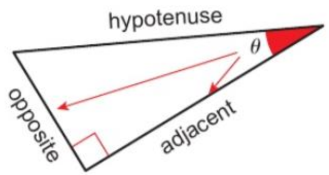
I know that:

- Pythagoras' theorem shows the relationship between the lengths of the three sides of a right-angled triangle.



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

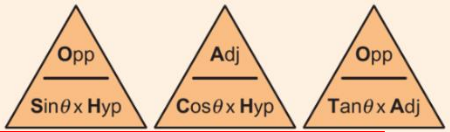
- A triangle with sides a, b and c, where c is the longest side, is right-angled only *if* $c^2 = a^2 + b^2$.
- In a right-angled triangle, the side opposite the angle θ is called the **opposite**. The side next to the angle θ is called the **adjacent**.



Know the exact values of the sine, cosine and tangent of some angles.

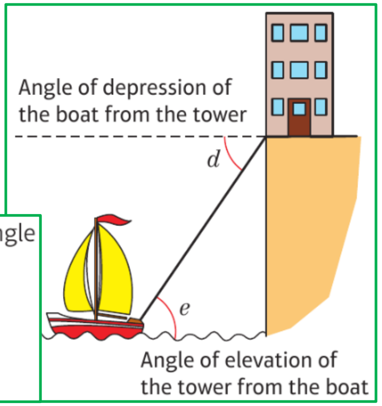
	30°	45°	60°	90°
sin	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	

The three trigonometric ratios can be remembered using the phrase **SOH CAH TOA**



You can use $\sin^{-1}$, $\cos^{-1}$ or $\tan^{-1}$ to find the size of an angle.

The **angle of elevation** is the angle measured upwards from the horizontal. The **angle of depression** is the angle measured downwards from the horizontal.



Core knowledge components. Procedural and conditional knowledge.

I know how to:

- Use Pythagoras' theorem to calculate the length of the hypotenuse and shorter sides in a right-angled triangle.
- Calculate the length of a line segment AB.
- Use the sine ratio to calculate the length of a side.
- Use the sine ratio to calculate an angle.
- Use the cosine ratio to calculate the length of a side.
- Use the cosine ratio to calculate an angle.
- Use the tangent ratio to calculate the length of a side.
- Use the tangent ratio to calculate an angle.
- Use the exact values of the sine, cosine and tangent of some angles.

I know when to:

- Solve problems using Pythagoras' theorem.
- Use trigonometric ratios to solve problems.
- Solve problems using an angle of elevation or depression.

Links to previous and future topics

This topic builds on prior knowledge:

- Rearrange simple formulae and equations, as preparation for rearranging trigonometric formulae.
- Recall basic angle facts.
- Understand when to leave an answer in surd form.

This topic will be used in future learning:

- Use angles in triangles to solve more complex bearing problems.
- Recall and apply Pythagoras' Theorem on a coordinate grid.

Topic: KS4 Foundation Unit 14 Multiplicative Reasoning **Mathswatch Clips: 88, 89, 108, 109, 110, 142, 164, 199**		**Duration: 9 Lessons**	**Composite: Unit Test**
Key vocabulary:	**Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.**	**Core knowledge components. Procedural and conditional knowledge.**	**Links to previous and future topics**
Percentage Express Growth and Decay Compound Measures Average speed Density Pressure Acceleration Inverse Proportions Compound Interest Simple Interest	I know that: • The original amount is always 100%. If the amount is *increased* the new amount will be *more* than 100%. If the amount is *decreased* the new amount will be *less* than 100%. • You can calculate a **percentage change** using the formula $\text{percentage change} = \frac{\text{actual change}}{\text{original amount}} \times 100$ • Percentage increase and decrease, profit and loss can be calculated using the formula for percentage change. • Banks and building societies pay **compound interest**. At the end of the first year, interest is paid on the money in the account. The interest is added to the amount in the account. At the end of the second year, interest is paid on the original amount in the account *and* on the interest earned in the first year, and so on. • To calculate $\text{density} = \frac{\text{mass}}{\text{volume}}$ or $D = \frac{M}{V}$  $\text{pressure} = \frac{\text{force}}{\text{area}}$ or $P = \frac{F}{A}$  $\text{speed} = \frac{\text{distance}}{\text{time}}$ or $S = \frac{D}{T}$  • $\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$ • You can use the **kinematics formulae** for calculations with moving objects. • $v = u + at$ • $s = ut + \frac{1}{2}at^2$ • $v^2 = u^2 + 2as$ where a is a constant acceleration, u is the initial velocity, v is the final velocity, t is the time taken and s is the displacement from the position when $t = 0$. • $y \propto x$ means 'y is proportional to x'. When $y \propto x$, then $y = kx$, where k is the constant of proportionality. • $X \propto \frac{1}{Y}$ means X and Y are in inverse proportion. This means that $XY = k$ (constant).	I know how to: • Calculate a percentage profit or loss. • Express a given number as a percentage of another in more complex situations. • Find the original amount given the final amount after a percentage increase or decrease • Find an amount after repeated percentage change. • Solve problems involving compound measures. • Calculate average speed, distance and time. • Use formulae to calculate speed and acceleration. I know when to: • Solve growth and decay problems. • Convert between metric speed measures. • Use ratio and proportion in measures and conversions. • Use inverse proportions.	This topic builds on prior knowledge: • Interpret scales on a range of measuring instruments. • Convert between metric measures. • Understand ratio notation, and be able to write a ratio in its simplest form. This topic will be used in future learning: • Multiplicative reasoning skills are often incorporated within questions relating to other topics such as graphs and compound measures.

<table>
<tr><td colspan="2">Topic: KS4 Foundation Unit 16 Quadratic Equations and Graphs
Mathswatch Clips: 98, 99, 157, 158, 160, 161</td><td>Duration: 9 Lessons</td><td>Composite: Unit Test</td></tr>
<tr><td>Key vocabulary:</td><td>Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.</td><td>Core knowledge components. Procedural and conditional knowledge.</td><td>Links to previous and future topics</td></tr>
<tr><td>Quadratic Function

Roots

Turning Point

Intercepts

Simplify

Binominal Expression

Factorise

Equation</td><td>I know that:
To expand or multiply double brackets, multiply each term in one bracket by each term in the other bracket.
To square a single bracket, multiply it by itself, then expand and simplify. $(x + 1)^2 = (x + 1)(x + 1)$
A quadratic expression always has a squared term (with a power of 2). It cannot have a power higher than 2. It may also have a term with a power of 1 that is the same letter as the squared term. It may also have a constant (number) term. $ax^2 + bx + c$ has a squared term, ax^2, a term with power 1, bx, and a constant term, c
A quadratic function has symmetrical ∪-shaped curve called a parabola. A quadratic function with a $-x^2$ term has a symmetrical ∩-shaped curve.
The curve always has a minimum or maximum turning point.
To solve the equation $ax^2 + bx + c = 0$ using a graph, read the x-coordinates where the graph crosses the x-axis. These are called roots.
To solve the equation $ax^2 + bx + c =$ 'a number' using a graph, read the x-coordinates where the graph crosses the line $y =$ 'a number'.
To factorise a quadratic equation, $ax^2 + bx + c = 0$, you need to find two numbers whose product is c and whose sum is b.
The difference of two squares is a quadratic expression with two squared terms, and one term is subtracted from the other. For example $x^2 - 25$
Solutions to quadratic equations can be found algebraically by factorising as well as from a graph.</td><td>I know how to:
Multiply double brackets.
Recognise quadratic expressions.
Square single brackets.
Plot graphs of quadratic functions.
Recognise a quadratic function.
Use quadratic graphs to solve problems.
Solve quadratic equations ax2 + bx + c = 0 using a graph.
Solve quadratic equations ax2 + bx + c = k
I know when to:
Factorising quadratic expressions
Solving quadratic equations algebraically</td><td>This topic builds on prior knowledge:
Square negative numbers.
Substitute into formulae.
Plot points on a coordinate grid.
Expand single brackets and collect 'like' terms.
This topic will be used in future learning:
The skills practice in this unit, such as substituting into a formulae, as also used for when substituting into formulae for volume of sphere and cones.
Graphs of cubic and reciprocal functions.</td></tr>
</table>

Topic: KS4 Foundation Unit 17 Perimeter, Area and Volume Part 2

MathsWatch clip numbers: 44, 117, 118, 132, 149, 167, 169, 170

Duration: 11 Lessons

Composite: Unit Test

Key vocabulary:

Circumference

Radius

Diameter

Pi

Semicircle

Surface Area

Cylinder

Pyramid

Cone

Sphere

Composite Solids

Volume

Area

Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.

I know that:

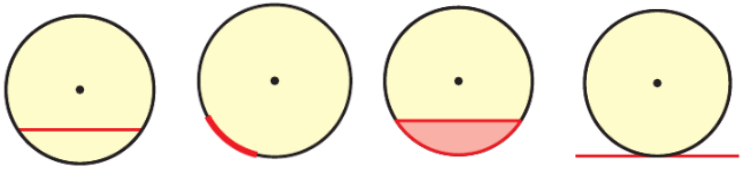
The **circumference** is the **perimeter** of a circle.

The Greek letter π (pronounced pi) is the ratio of the circumference of a circle to the diameter. Its decimal value never ends, but starts as 3.141 592 653 589 7…

The formula for the circumference of a circle is $C = \pi d$.

If you know the radius you can use $C = 2\pi r$.

The formula for the area A of a circle with radius r is $A = \pi r^2$.



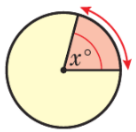
A **chord** An **arc** A **segment** A **tangent**

For a sector of a circle with an angle of $x°$ and radius r:

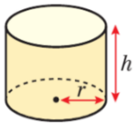
Arc length $= \frac{x}{360} \times 2\pi r$

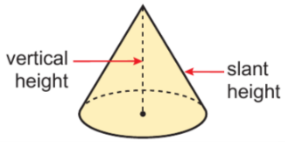
Perimeter of sector = arc length + $2r$

Area of sector $= \frac{x}{360} \times \pi r^2$

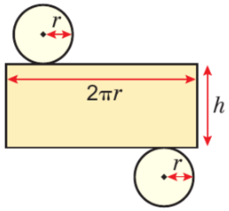


The formula for the volume of a **cylinder** is $V = \pi r^2 h$.





Total surface area of a cylinder $= 2\pi rh + 2\pi r^2$



- Total surface area of a cone $= \pi rl + \pi r^2$
- The volume of a **sphere** $= \frac{4}{3}\pi r^3$
- The surface area of a sphere $= 4\pi r^2$

- The volume of a pyramid $= \frac{1}{3} \times$ area of base $\times$ vertical height
- The volume of a cone $= \frac{1}{3} \times$ area of base $\times$ vertical height
- The area of the curved surface of a cone $= \pi \times$ base radius $\times$ slant height $= \pi rl$

Core knowledge components. Procedural and conditional knowledge.

I know how to:

- Calculate the circumference and radius of a circle.
- Solve problems involving the circumference of a circle.
- Find the area and radius of a circle.
- Solve problems involving the area of a circle.
- Give answers in terms of π.
- Work out areas of semicircles, quarter circle and perimeters.
- Solve problems involving sectors of circles.
- Work out the volume and surface area of cylinders, pyramids, cones and sphere.
- Work out the volume and surface area of composite solids.

I know when to:

- Use maths language for circles and perimeters.

Links to previous and future topics

This topic builds on prior knowledge:

- Define centre, radius and diameter for a circle.
- Know the formula for calculating the area of a rectangle.
- Substitute into formulae and solve for the unknown.

This topic will be used in future learning:

- Knowing that all circles are similar to each other.
- Area of congruent shapes does not change.

Topic: KS4 Foundation Unit 18 Fractions, indices and standard form

MathsWatch clips numbers are in brackets: 73, 75, 83

Duration: 7 Lessons

Composite: Unit Test

Key vocabulary:

Improper fractions

Indices

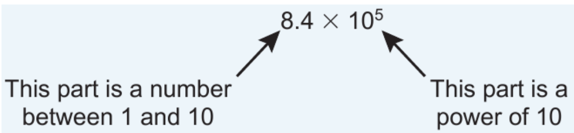
Reciprocal

Standard form

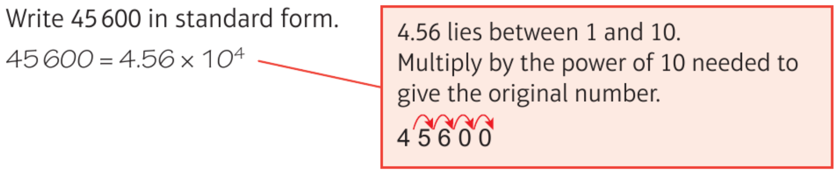
Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.

I know that:

1. To multiply or divide mixed numbers, change the mixed numbers to **improper fractions** first. **(73)**
2. To raise the power of a number to another power, multiply the **indices**.
   Any number (or term) raised to the power of 0 is equal to 1.
   Any number (or term) raised to the power of -1 is the **reciprocal** of the number. For example, $3^{-1} = ⅓$.
   3^{-2} is the same as $(3^{-1})^{2}$.
   To find a negative power, find the reciprocal and then raise the value to the positive power. **(83)**
3. **Standard form** is a way of writing very large and very small numbers. A number in standard form looks like this. **(83)**



   Example of writing large numbers in standard form:



4. To write a small number in standard form **(83)**: Place the decimal point after the first non-zero digit. How many places has this moved the digit? This is the negative power of 10.

Core knowledge components. Procedural and conditional knowledge.

I know how to:

- Multiply and divide mixed numbers and fractions.
- Use the laws of indices.
- Write large numbers in standard form.
- Convert large numbers from standard form into ordinary numbers.
- Write small numbers in standard form.
- Convert numbers from standard form with negative powers of ordinary numbers.
- Multiply and divide numbers in standard form.
- Add and subtract numbers in standard form.

I know when to:

- Use inverse operation to solve problems with fractions, indices and standard form.
- Apply the calculations for Fractions, indices and standard form to solve problems.

Links to previous and future topics

This topic builds on prior knowledge:

- Convert between improper fractions and mixed numbers.
- Write powers of 10 in index form and recognise and recall powers of 10, e.g. $10^2 = 100$.
- Recall the index laws for multiplying and dividing positive integer powers.

This topic will be used in future learning:

Fractions and reciprocals are used with graphs and finding perpendicular lines.

Example of writing a small number in standard form:

Write 0.003 52 in standard form.

$0.003\,52 = 3.52 \times 10^{-3}$ — 3.52 lies between 1 and 10. Multiply by the power of 10 needed to give the original number. 0 . 0 0 3 5 2

5. To multiply and divide numbers in standard form, use the laws of indices to simplify the power of 10 **(75, 83)**. Example:

Giving your answer in standard form, work out

a $12 \times 10^3 \times 3 \times 10^2$

$12 \times 10^3 \times 3 \times 10^2 = 12 \times 3 \times 10^3 \times 10^2$ (Rewrite the multiplication, grouping the numbers together and the powers of 10 together.)

$= 36 \times 10^5$ (Multiply the numbers together. Use the laws of indices to combine the powers of 10.)

$= 3.6 \times 10^6$ (If the number part is not between 1 and 10, rewrite the number in standard form.)

b $\frac{9 \times 10^4}{3 \times 10^2}$

$\frac{9 \times 10^4}{3 \times 10^2} = \frac{9}{3} \times \frac{10^4}{10^2}$ (Write the calculation as two fractions, grouping the numbers together and the powers of 10 together.)

$= 3 \times 10^2$ (Divide the numbers and use the laws of indices for the powers of 10. Check that the answer is in standard form.)

To add and subtract in standard form, write both numbers as ordinary numbers, add or subtract, and then convert back to standard form **(83)**. Example:

Work out the value of

a $3.2 \times 10^7 + 1.9 \times 10^8$

$3.2 \times 10^7 = 32\,000\,000$ (Write both numbers as ordinary numbers.)

$1.9 \times 10^8 = 190\,000\,000$

$32\,000\,000 + 190\,000\,000 = 222\,000\,000$ (Add the two numbers together.)

$222\,000\,000 = 2.22 \times 10^8$ (Convert this number into standard form.)

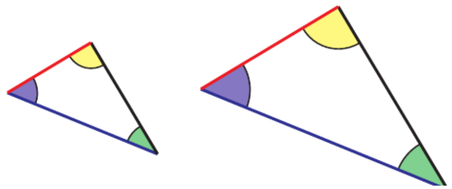
b $1.9 \times 10^{-4} - 3.4 \times 10^{-6}$

$1.9 \times 10^{-4} = 0.000\,19$ (Write both numbers as decimals.)

$3.4 \times 10^{-6} = 0.000\,003\,4$

$0.000\,19 - 0.000\,003\,4 = 0.000\,186\,6$ (Subract the two numbers.)

$0.000\,186\,6 = 1.866 \times 10^{-4}$ (Convert this number into standard form.)

Topic: KS4 Foundation Unit 19 Congruence, similarity, and vectors MathsWatch clips numbers are in brackets:		Duration: 11 Lessons	Composite: Unit Test
Key vocabulary:	**Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.**	**Core knowledge components. Procedural and conditional knowledge.**	**Links to previous and future topics**
Congruence Similarity Vector Enlargement Corresponding Resultant	I know that: When one shape is an enlargement of another, the shapes are **similar**. In the diagram, corresponding sides and corresponding angles are shown in the same colour.  For similar shapes, corresponding sides are in the same ratio and corresponding angles are equal. When a shape is enlarged, the perimeter of the shape is enlarged by the same scale factor. Triangles are congruent if they have equivalent: SSS, SAS, ASA or RHS. When two shapes are congruent, one can be rotated or reflected to fit exactly on the other. To add column vectors, add the top numbers and add the bottom numbers. $\begin{pmatrix} 2 \\ 5 \end{pmatrix} + \begin{pmatrix} 1 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ 8 \end{pmatrix}$ ($2 + 1$, $5 + 3$) and $\begin{pmatrix} -1 \\ 7 \end{pmatrix} + \begin{pmatrix} 5 \\ -2 \end{pmatrix} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ ($-1 + 5$, $7 + -2$)	I know how to: • Use similarity to solve angle problems. • Find the scale factor of an enlargement. • Calculate perimeters of similar shapes. • Add and subtract vectors. • Find the resultant of two vectors. • Find multiples of a vector. I know when to: • Use congruence to work out unknown angles. • Use congruence to work out unknown sides.	This topic builds on prior knowledge: • Convert between improper fractions and mixed numbers. • Write powers of 10 in index form and recognise and recall powers of 10, e.g.$10^2 = 100$. • Recall the index laws for multiplying and dividing positive integer powers. This topic will be used in future learning: Fractions and reciprocals are used with graphs and finding perpendicular lines.

<table>
<tr>
<td></td>
<td>Two translations can be combined into a single translation by adding the vectors.

To find the resultant of two vectors, add them together.
$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC}$.

A single letter may be used to represent a vector. The letter is shown in bold type. $-\mathbf{a}$ is the negative of a and points in the opposite direction. You can't write in bold, so you should underline a letter that represents a vector.
$\mathbf{a} - \mathbf{b}$ is the same as $\mathbf{a} + (-\mathbf{b})$.

You can multiply a vector by a number. For example,
if $\mathbf{a} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ then $2\mathbf{a} = \begin{pmatrix} 8 \\ 6 \end{pmatrix}$ and $-3\mathbf{a} = \begin{pmatrix} -12 \\ -9 \end{pmatrix}$.</td>
<td></td>
<td></td>
</tr>
</table>

<table>
<tr><td colspan="2">Topic: KS4 Foundation Unit 20 More Algebra
MathsWatch clips numbers: 136, 140, 161, 162, 193</td><td>Duration: 10 Lessons</td><td>Composite: Unit Test</td></tr>
<tr><td>Key vocabulary:</td><td>Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.</td><td>Core knowledge components. Procedural and conditional knowledge.</td><td>Links to previous and future topics</td></tr>
<tr><td>Interpret

Cubic

Function

Non-linear

Simultaneous

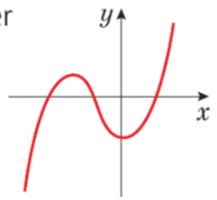
Formulae

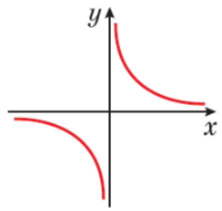
Expression

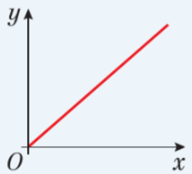
Equation

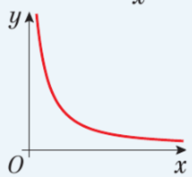
Identities

Prove</td>
<td>I know that:

A 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. When a cubic function is equal to zero, it can have one, two or three solutions – the x-values where the graph crosses the x-axis


For the reciprocal function $y = \frac{1}{x}$, the x- and y-axes are asymptotes to the curve. An asymptote is a line that the graph gets closer and closer to, but never actually touches.


When x and y are in direct proportion, $y = kx$


When x and y are inversely proportional, $y = \frac{k}{x}$


Simultaneous equations are equations that are both true for a pair of variables
To find the solution to simultaneous equations:
1 draw the lines on a coordinate grid
2 find the point where the lines cross (the point of intersection).

An equation has an equals sign. You can solve it to find the value of the letter.
An identity is similar, but is true for all values of x and uses the symbol '≡'.</td>
<td>I know how to:
• Draw and interpret graphs of cubic functions.
• Draw and interpret graphs of y = 1/x.
• Draw and interpret non-linear graphs to solve problems.
• Solve simultaneous equations by drawing a graph.
• Solve simultaneous equations algebraically.
• Revisit solving equations + algebra revision
• Identify expressions, equations, formulae and identities.
• Prove results using algebra.

I know when to:
• Write and solve simultaneous equations.
• Change the subject of a formula.</td>
<td>This topic builds on prior knowledge:
• Draw linear graphs.
• Plot coordinates and sketch simple functions with a table of values.
• Substitute into and solve equations.
• Have experience of using formulae.
• Recall and use the priority of operations and use of inequality symbols.
This topic will be used in future learning:
Incorporating this topic into challenging GCSE problem solving questions.</td></tr>
</table>