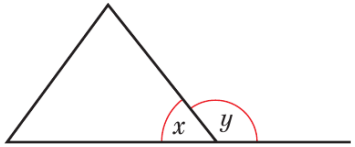
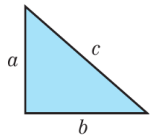
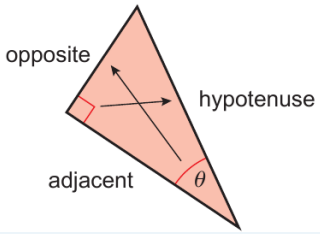
# Topic: KS4 Higher Unit 5 Angles and trigonometry

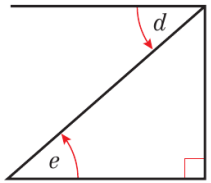
**MathsWatch clips: 9, 54, 150, 174**

# 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** |
|---|---|---|---|
| Angles<br>Triangles<br>Quadrilaterals<br>Interior<br>Exterior<br>Polygons<br>Pythagoras<br>Theorem<br>Trigonometry<br>Elevation<br>Depression<br>Sine, Cosine and Tangent | I know that:<br><br>The angle marked $x$ is called the **interior angle**. The angle marked $y$ is called the **exterior angle**.<br>  <br><br>$x + y = 180°$ (angles on a straight line add up to 180°)<br><br>The sum of the interior angles of a polygon with $n$ sides = $(n - 2) \times 180°$.<br><br>The sum of the exterior angles of a polygon is always 360°.<br><br>Pythagoras' theorem states that in a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.<br>$c^2 = a^2 + b^2$.<br>  <br><br><br>In a right-angled triangle, the side opposite the angle $\theta$ is called the **opposite**. The side next to the angle $\theta$ is called the **adjacent**.<br>  <br><br><br>The **sine** of angle $\theta$ is the ratio of the opposite side to the hypotenuse, $\sin\theta = \frac{\text{opp}}{\text{hyp}}$<br><br>The **cosine** of angle $\theta$ is the ratio of the adjacent side to the hypotenuse, $\cos\theta = \frac{\text{adj}}{\text{hyp}}$<br><br>The **tangent** of angle $\theta$ is the ratio of the opposite side to the adjacent side, $\tan\theta = \frac{\text{opp}}{\text{adj}}$ | I know how to:<br>• Derive and use the sum of angles in a triangle and in a quadrilateral.<br>• Derive and use the fact that the exterior angle of a triangle is equal to the sum of the two opposite interior angles.<br>• Calculate the sum of the interior angles of a polygon.<br>• Calculate the length of the hypotenuse in a right-angled triangle.<br>• Solve problems using Pythagoras' theorem.<br>• Calculate the length of a shorter side in a right-angled triangle.<br>• Find angles of elevation and angles of depression.<br>• Use trigonometric ratios to solve problems.<br>• Know the exact values of the sine, cosine and tangent of some angles.<br>know when to:<br>• Use the interior angles of polygons to solve problems.<br>• Use the angles of polygons to solve problems. | This topic builds on prior knowledge:<br>• Rearrange simple formulae and equations, as preparation for rearranging trig formulae.<br>• Recall basic angle facts.<br>• Recall the properties of special types of triangles and quadrilaterals.<br><br>This topic will be used in future learning:<br>• Using angle facts with similar and congruent shapes. Use angles in triangle and quadrilaterals when solving circle theorem problems. |

The **angle of elevation** ($e$) is the angle measured upwards from the horizontal. The **angle of depression** ($d$) is the angle measured downwards from the horizontal.




The sine, cosine and tangent of some angles may be written exactly

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

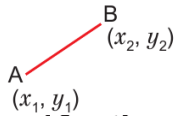
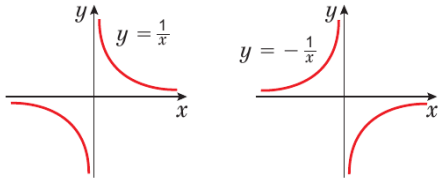
- Use trigonometric ratios to find lengths in a right-angled triangle.
- Use trigonometric ratios to solve problems.
- Use trigonometric ratios to calculate an angle in a right-angled triangle.

# Topic: KS4 Higher Unit 6 Graphs

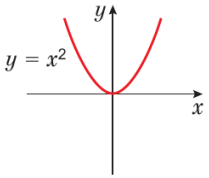
**MathsWatch clips: 96, 97, 133, 143, 159**

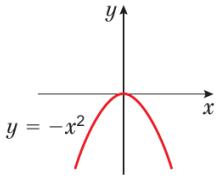
# Duration: 12 Lessons

# Composite: Unit Test

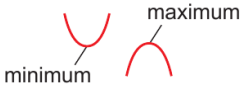
| Key vocabulary: | Powerful knowledge components crucial to commit to long term memory. Declarative knowledge. | Core knowledge components. Procedural and conditional knowledge. | Links to previous and future topics |
|---|---|---|---|
| Linear<br>Gradient<br>Intercept<br>Distance-time graphs<br>Speed<br>Accelerations<br>Velocity<br>Proportion<br>Midpoint<br>Line segment<br>Parallel<br>Perpendicular<br>Quadratic<br>Cubic | I know that:<br>A **linear equation** generates a straight-line (linear) graph.<br><br>**Parallel lines** have the same gradient.<br><br>A **distance–time graph** represents a journey.<br>○ Straight lines mean constant speed<br>○ horizontal lines mean no movement<br>○ the gradient is the speed, since average speed = $\frac{\text{total distance}}{\text{total time}}$<br>○ Average speed = $\frac{\text{total distance}}{\text{total time}}$<br><br>On a **velocity-time graph**<br>○ straight lines mean constant acceleration<br>○ horizontal lines mean no change in velocity (i.e. travelling at a constant velocity)<br>○ the gradient is the acceleration, since acceleration = $\frac{\text{change in velocity}}{\text{time}}$<br>○ the area under a velocity–time graph is the distance travelled.<br><br>When two quantities are in **direct proportion**<br>○ the graph is a straight line through the origin<br>○ when one variable is multiplied by $n$, so is the other.<br><br>The coordinates of the **midpoint** of a line segment are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$<br>  <br>**Reciprocal functions** are in the form $\frac{k}{x}$ where $k$ is a number.<br>  | I know how to:<br>• Find the gradient and y-intercept from a linear equation.<br>• Sketch graphs using the gradient and intercepts.<br>• Find the equation of a line, given its gradient and one point on the line.<br>• Calculate average speed from a distance–time graph.<br>• Find the coordinates of the midpoint of a line segment.<br>• Find the equations of lines parallel or perpendicular to a given line.<br>• Draw quadratic graphs, graphs of cubic and reciprocal functions, and graph of a circle.<br>• Solve equations using graphs.<br>• Identify the line of symmetry of a quadratic graph.<br>know when to:<br>• Interpret linear and non-linear real-life graphs.<br>• Draw and interpret real-life linear graphs.<br>• Find acceleration and distance from velocity–time graphs. | This topic builds on prior knowledge:<br>• Identify coordinates of given points in the first quadrant or all four quadrants.<br>• Write the equation for a straight line graph.<br>• Use and draw conversion graphs.<br>• Use function machines and inverse operations.<br>• Use compound units, such a speed.<br>This topic will be used in future learning:<br>• Trigonometry graphs.<br>Graphs on direct and inverse proportion. |

A **quadratic equation** contains a term in $x^2$ but no higher power of $x$.
The graph of a quadratic equation is a curved shape called a **parabola**.

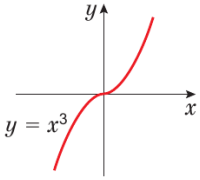


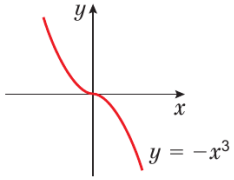




A quadratic graph has either a **minimum point** or a **maximum point** where the graph turns.




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.



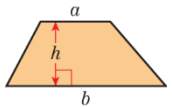
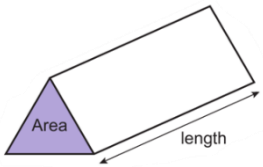
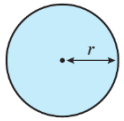
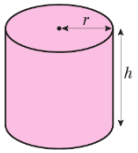
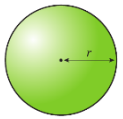
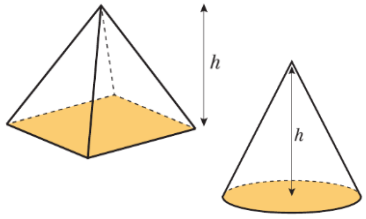
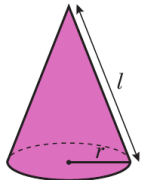



# Topic: KS4 Higher Unit 7 Area and Volume

**MathsWatch clips: 44, 117, 118, 132, 149, 167, 169, 170**

# Duration: 11 Lessons

# Composite: Unit Test

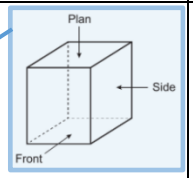
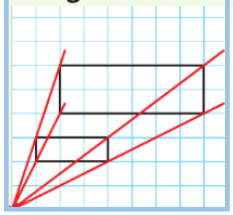
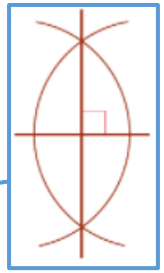
| Key vocabulary: | Powerful knowledge components crucial to commit to long term memory. Declarative knowledge. | Core knowledge components. Procedural and conditional knowledge. | Links to previous and future topics |
|---|---|---|---|
| Compound<br>Trapezium<br>Volume<br>Surface area<br>Prisma<br>Circumference<br>Semicircle<br>Sectors<br>Cylinder<br>Sphere<br>Pyramids<br>Cones | I know that:<br>Area of a trapezium = $\frac{1}{2}(a+b)h$<br>  <br><br>The **surface area** of a 3D solid is the total area of all its faces.<br>A **prism** is a 3D solid that has the same cross-section all through its length.<br>Volume of a prism<br>= area of cross-section × length.<br>  <br><br>The **circumference** of a circle is its perimeter. For any circle<br>circumference = π × diameter<br>$C = \pi d$ or $C = 2\pi r$<br>The formula for the area, $A$, of a circle with radius $r$ is $A = \pi r^2$<br>  <br><br>The volume of a cylinder of radius $r$ and height $h$ is $V = \pi r^2 h$<br>The surface area of a cylinder of radius $r$ and height $h$ is $2\pi r^2 + 2\pi rh$<br>  <br><br>For a sphere of radius $r$<br>surface area = $4\pi r^2$<br>volume = $\frac{4}{3}\pi r^3$<br>  <br><br>  <br><br>Volume of pyramid = $\frac{1}{3}$ area of base × vertical height<br>Volume of cone = $\frac{1}{3}$ area of base × vertical height = $\frac{1}{3}\pi r^2 h$<br>Curved surface area of a cone = $\pi rl$, where $r$ is the radius and $l$ is the slant height.<br>  <br><br>Total surface area of a cone = $\pi rl + \pi r^2$ . | I know how to:<br>• Find the perimeter and area of compound shapes.<br>• Calculate the maximum and minimum possible values of a measurement.<br>• Calculate volumes and surface areas of prisms.<br>• Calculate the area and circumference of a circle.<br>• Calculate area and circumference in terms of π.<br>• Calculate the perimeter and area of semicircles and quarter circles.<br>• Calculate arc lengths, angles and areas of sectors of circles.<br>• Calculate volume and surface area of pyramids and cones.<br>know when to:<br>• Convert between metric units of length, area and volume.<br>• Solve problems involving volumes, surface areas, pyramids and cones. | This topic builds on prior knowledge:<br>• Know the names and properties of 3D shapes.<br>• Know the concept of perimeter and area by measuring lengths of sides.<br>• Identify planes of symmetry of 3D solids.<br>• Recall Pythagoras' theorem.<br>This topic will be used in future learning:<br>• Calculate length, area and volume in similar shapes.<br>Calculate area following an enlargement on a coordinate grid. |

# Topic: KS4 Higher Unit 8 Transformations and constructions

**MathsWatch clips: 48, 49, 50, 148, 182**

# Duration: 11 Lessons

# Composite: Unit Test

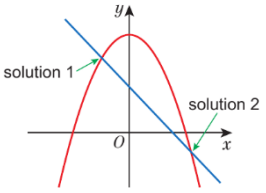
| **Key vocabulary:** | **Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.** | **Core knowledge components. Procedural and conditional knowledge.** | **Links to previous and future topics** |
|---|---|---|---|
| Plans<br>Elevations<br>Rotation<br>Reflection<br>Enlargement<br>Negative<br>Scale factors<br>Bearing<br>Bisector<br>Perpendicular<br>Compasses<br>Locus and Loci | I know that:<br>  <br>The **plan** is the view from above an object. The **front elevation** is the view of the front of the object. The **side elevation** is the view of the side of the object.<br>**Reflections**, **rotations**, **translations** and **enlargements** are all types of transformation.<br>To describe a **rotation** you need to give the direction of turn (clockwise or anticlockwise), the angle of turn and the **centre of rotation**.<br>To describe an enlargement you need to give the **centre of enlargement** and the scale factor. To find the centre of enlargement, join corresponding points of the object and the image<br>Draw lines through each vertex on the image and the equivalent vertex on the original. All the lines should meet at the **centre of enlargement**.<br>  <br>A negative scale factor takes the image to the opposite side of the centre of enlargement.<br>You can describe a translation using a **column vector**. The column vector for a translation 2 squares right and 3 squares down is $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.<br>The top number in the column vector gives the movement parallel to the $x$-axis and the bottom number gives the movement parallel to the $y$-axis.<br>In reflections, rotations and translations, the object and the image are **congruent**, as the lengths of the sides and the angles do not change.<br>  <br>A **bearing** is an angle in degrees, clockwise from north. A bearing is always written using three digits.<br>A **perpendicular bisector** cuts a line in half at right angles.<br>An **angle bisector** cuts an angle exactly in half. | I know how to:<br>• Draw plans and elevations of 3D solids.<br>• Reflect 2D shapes.<br>• Rotate a 2D shape about a centre of rotation.<br>• Describe reflections and rotations.<br>• Enlarge shapes by fractional and negative scale factors about a centre of enlargement.<br>• Translate shapes using vectors.<br>• Draw and use scales on maps and scale drawings.<br>• Construct triangles using a ruler and compasses.<br>• Construct the perpendicular bisector of a line.<br>• Construct the shortest distance from a point to a line.<br>• Bisect and construct angles.<br>• Draw a locus.<br>I know when to:<br>• Carry out and describe combinations of transformations.<br>• Solve problems involving bearings and loci. | This topic builds on prior knowledge:<br>• Recognise 2D shapes.<br>• Plot coordinates in four quadrants and linear equations parallel to the coordinate axes.<br>• Convert metric measures.<br>This topic will be used in future learning:<br>• Recognise and enlarge shapes and calculate scale factors with similarity.<br>Recognise and draw transformations of trigonometry graphs. |

# Topic: KS4 Higher Unit 9 Equations and Inequalities

**MathsWatch clips:**

# 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** |
|---|---|---|---|
| Quadratic<br><br>Functions<br><br>Expression<br><br>Simultaneous<br><br>Straight line<br><br>Unknowns<br><br>Inequalities<br><br>Notation | I know that:<br>The **roots** of a quadratic function are its solutions when it is equal to zero.<br><br>You can use the quadratic formula to find the solutions to the **quadratic equation** $ax^2 + bx + c = 0$<br>$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$<br><br>Expressions such as $(x + 2)^2$, $(x - 1)^2$ and $(x + \frac{1}{2})^2$ are called **perfect squares**.<br><br>$x^2 + bx + c$ can be written in the form $\left(x + \frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2 + c$<br>This is called **completing the square**.<br><br>$ax^2 + bx + c$ can be written as $a\left(x + \frac{b}{a}x\right)^2 + c$<br>before completing the square for the expression inside the brackets.<br><br>When there are two unknowns, you need two equations to find their values. These are called **simultaneous equations**.<br><br>A pair of quadratic and linear simultaneous equations can have two possible solutions.<br><br>To find the coordinates where two graphs intersect, solve their equations simultaneously.<br><br>  <br><br><br>You can show **inequalities** on a number line. An empty circle ○ shows that the value is not included. A filled circle ● shows that the value is included. An arrow ○——→ shows that the solution continues towards infinity.<br><br>You can write the solution to an inequality using **set notation**.<br>$\{x : x > 2\}$<br>the set of $x$ such that | I know how to:<br>• Find the roots of quadratics.<br>• Rearrange and solve quadratic equations.<br>• Use the quadratic formula to solve a quadratic equation.<br>• Complete the square for a quadratic expression.<br>• Solve quadratic equations by completing the square.<br>• Solve simultaneous equations, including for real-life situations.<br>• Solve linear simultaneous equations where both equations are multiplied.<br>• Solve simultaneous equations with one quadratic equation.<br>• Solve inequalities and show the solution on a number line and using set notation.<br>I know when to:<br>• Use simultaneous equations to find the equation of a straight line.<br>• Use real-life situations to construct quadratic and linear equations and solve them. | This topic builds on prior knowledge:<br>• Understand the ≥ and ≤ symbols.<br>• Substitute into, solve and rearrange linear equations.<br>• Factorise simple quadratic expressions.<br>• Recognise the equation of a circle.<br>This topic will be used in future learning:<br>• Rearrange formulae relating to trigonometry, Pythagoras and compound measures, such as speed, density and pressure. Represent inequalities graphically. |