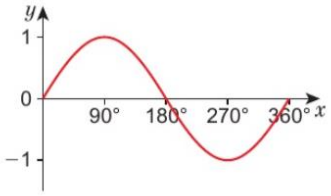
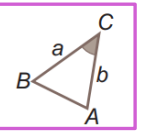
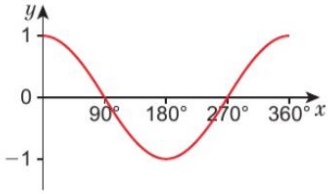
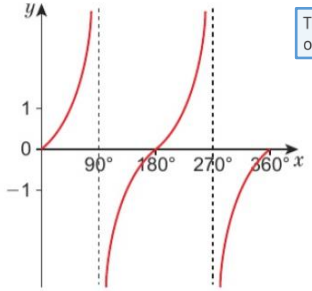
Topic: KS4 Higher Unit 12 Similarity and Congruence **MathsWatch clips:**		**Duration: 9 Lessons**	**Composite: Unit Test**
Key vocabulary:	**Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.**	**Core knowledge components. Procedural and conditional knowledge.**	**Links to previous and future topics**
Congruent Prove Corresponding Scale factors Similar shapes Linear	I know that: ◉ Congruent triangles have exactly the same size and shape. Their angles are the same and corresponding sides are the same length. ◉ Two triangles are congruent when one of these conditions of congruence is true. SSS (all three sides equal) SAS (two sides and the included angle are equal) AAS (two angles and a corresponding side are equal) RHS (right angle, hypotenuse and one other side are equal) ◉ You can use congruence to solve problems and prove that shapes are the same. ◉ To prove something, you write a series of logical statements that show the statement is true. Each statement must be supported by a mathematical reason. ◉ Shapes are similar when one shape is an enlargement of the other. Corresponding angles are equal and corresponding sides are all in the same ratio. ◉ When a shape is enlarged by linear scale factor k, the area of the shape is enlarged by scale factor k^2. ◉ When a shape is enlarged by linear scale factor k, the volume is enlarged by scale factor k^3. ◉ When the linear scale factor is k: Lengths are multiplied by k Area is multiplied by k^2 Volume is multiplied by k^3	I know how to: • Show that two triangles are congruent. • Know the conditions of congruence. • Prove shapes are congruent. • Solve problems involving congruence. • Use the ratio of corresponding sides to work out scale factors. • Find missing lengths on similar shapes. know when to: • Use similar triangles to work out lengths in real life. • Use the link between linear scale factor and area scale factor to solve problems. • Use the link between scale factors for length, area and volume to solve problems.	This topic builds on prior knowledge: • Recognise and enlarge shapes and calculate scale factors. • Know how to calculate area and volume in various metric measures. • Measure lines and angles, and use compasses, ruler and protractor to construct standard constructions. This topic will be used in future learning: • Solve similarity and congruence questions that include trigonometry, Pythagoras and transformations.

Topic: KS4 Higher Unit 13 More Trigonometry

MathsWatch clips: 124, 196, 201, 202, 203, 206, 217, 218

Duration: 13 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**
Upper and lower bounds Trigonometry Sine, cosine and tangent function Segment of a circle Bearings Pythagoras	I know that: ◉ The **sine** graph repeats every 360° in both directions.  Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ Cosine Rule $a^2 = b^2 + c^2 - 2bc\cos A$ Area of a Triangle = $\frac{1}{2}ab\sin C$  ◉ The **cosine** graph repeats every 360° in both directions.  **Transforming trigonometric graphs** The graph of $y = -f(x)$ is the reflection of the graph of $y = f(x)$ in the x-axis. The graph of $y = f(-x)$ is the reflection of the graph of $y = f(x)$ in the y-axis. ◉ The **tangent** graph repeats every 180° in both directions.  The graph of $y = -f(-x)$ is a reflection of the graph of $y = f(x)$ in the x-axis and then the y-axis, or vice versa. These two reflections are equivalent to a rotation of 180° about the origin. The graph of $y = f(x) + a$ is the translation of the graph of $y = f(x)$ by $\begin{pmatrix}0\\a\end{pmatrix}$. The graph of $y = f(x + a)$ is the translation of the graph of $y = f(x)$ by $\begin{pmatrix}-a\\0\end{pmatrix}$. The graph of $y = af(x)$ is a vertical stretch of the graph of $y = f(x)$, with scale factor a, parallel to the y-axis. ◉ $\tan x$ is not defined for angles of the form $(90 \pm 180n°)$ The graph of $y = f(ax)$ is a horizontal stretch of the graph of $y = f(x)$, with scale factor $\frac{1}{a}$, parallel to the x-axis.	I know how to: • Use upper and lower bounds in calculations. • Find the sine of any angle. • Use the graph of the sine function to solve equations. • Find the cosine of any angle. • Use the graph of the cosine function to solve equations. • Find the tangent of any angle. • Use the graph of the tangent function to solve equations. • Find the area of a triangle and a segment of a circle. know when to: • Use the sine and cosine rules to solve 2D problems. • Solve bearings problems using trigonometry. • Use Pythagoras' theorem in 3D. • Use trigonometry in 3D. • Changes in a function affect trigonometric graphs.	This topic builds on prior knowledge: • Use axes and coordinates to specify points in all four quadrants. • Recall and apply Pythagoras' Theorem and trigonometric ratios. • Substitute into formulae. This topic will be used in future learning: • Recall transformations of trigonometric functions when translating, reflecting and stretching graphs of functions.

Topic: KS4 Higher Unit 14 Further Statistics **MathsWatch clips:**		**Duration: 13 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**
Simple random sample Stratified sample Median Quartiles Interquartile range Stem-and-leaf diagram Box plots Frequency density Histograms	I know that: ◉ A **population** is the set of items that you are interested in. ◉ A **census** is a survey of the whole population. ◉ A **sample** is a smaller number of items from the population. A sample of at least 10% is considered to be a good-sized sample. ◉ In order to reduce **bias**, the sample must represent the whole population. ◉ In a **random sample** each item has the same chance of being chosen. ◉ A population may divide into groups such as age range or gender. These groups are called **strata** (singular **stratum**). ◉ In a **stratified sample**, the number of people taken from each group is proportional to the group size. ◉ To estimate the size of the population N of an animal species: Capture and mark a sample size n. Recapture another sample of size M. Count the number marked (m). $\frac{n}{N}=\frac{m}{M}$ So, $N=\frac{n\times M}{m}$ This is the capture–recapture method. ◉ A **cumulative frequency diagram** has data values on the x-axis and cumulative frequency on the y-axis. ◉ The **median** and **quartiles** can be estimated from the cumulative frequency diagram. For a set of n data values ○ the estimate for the **median** is the $\frac{n}{2}$ th value ○ the estimate for the **lower quartile** (LQ) is the $\frac{n}{4}$ th value ○ the estimate for the **upper quartile** (UQ) is the $\frac{3n}{4}$ th value. ○ the **interquartile range** (IQR) = UQ – LQ ◉ In a histogram the area of the bar represents the frequency. The height of each bar is the frequency density. $\text{Frequency density}=\frac{\text{frequency}}{\text{class width}}$	I know how to: • Take a simple random sample. • Take a stratified sample. • Draw and interpret cumulative frequency tables and diagrams. • Work out the median, quartiles and interquartile range from a cumulative frequency diagram. • Find the quartiles and the interquartile range from stem-and-leaf diagrams. • Draw and interpret box plots. • Use frequency density. • Draw histograms. know when to: • Interpret histograms. • Compare two sets of data.	This topic builds on prior knowledge: • Understand the different types of data: discrete/continuous. • Have experience of inequality notation. • Multiply a fraction by a number. • Understand the data handling cycle. This topic will be used in future learning: • Use graph skills when learning to translate, reflect and stretch graphs of a function.

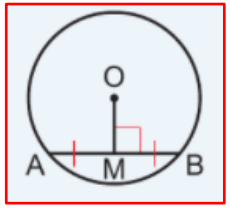
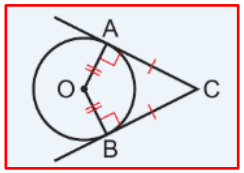
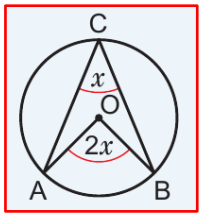
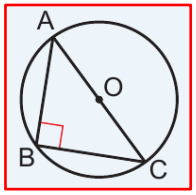
Topic: KS4 Higher Unit 15 Equations and Graphs **MathsWatch clips:**		**Duration: 9 Lessons**	**Composite: Unit Test**
Key vocabulary:	**Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.**	**Core knowledge components. Procedural and conditional knowledge.**	**Links to previous and future topics**
Simultaneous Equations Graphically Inequalities Functions Quadratic Iterative process Roots Cubic	I know that: ◎ The points that satisfy an inequality can be represented on a graph by shading the area to one side of the line. A dotted line is used to indicate $<$ or $>$ A solid line is used to indicate $\geqslant$ or $\leqslant$ ◎ The graph of a quadratic function is a smooth curve called a parabola. The lowest or highest point of the parabola, where the graph turns, is called the turning point. The turning point is either a minimum or maximum point. The x-values where the graph intersects the x-axis are the solutions, or roots, of the equation $y = 0$. ◎ To find the coordinate of the turning point, write the equation in completed square form: $y = a(x + b)^2 + c$. ◎ When a quadratic is written in completed square form $y = a(x + b)^2 + c$ the coordinate of the turning point is $(-b, c)$ ◎ To sketch a quadratic function Calculate the solutions to the equation $y = 0$ (points of intersection with the x-axis). Calculate the point at which the graph crosses the y-axis. Find the coordinates of the turning point and whether it is a maximum or a minimum. ◎ The quadratic equation $ax^2 + bx + c = 0$ is said to have no real roots if its graph does not cross the x-axis. If its graph just touches the x-axis, the equation has one repeated root. ◎ To solve a quadratic inequality, solve as a quadratic equation then sketch the graph. Use the graph to find the values that satisfy the inequality. ◎ To expand three pairs of brackets, first expand two of the brackets. ◎ A cubic function is one whose 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 the point $y = d$. The graph's roots can be found by finding the values of x for which $y = 0$. ◎ When the graph of a cubic function y crosses the x-axis three times, the equation $y = 0$ has three solutions. When it crosses once and touches once it has three solutions but one is repeated. When it crosses once it can have one distinct, repeated solution or only one real solution.	I know how to: • Solve simultaneous equations graphically. • Represent inequalities on graphs. • Interpret graphs of inequalities. • Recognise and draw quadratic functions. • Find approximate solutions to quadratic equations graphically. • Solve quadratic equations using an iterative process. • Find the roots of cubic equations. know when to: • Sketch graphs of cubic functions. • Solve cubic equations using an iterative process.	This topic builds on prior knowledge: • Solve quadratics and linear equations. • Solve simultaneous equations algebraically. This topic will be used in future learning: • Using graph skills when dealing with transformation, reflection and stretch of function graphs. Using graph skill with solving problems with inverse proportion graphs.

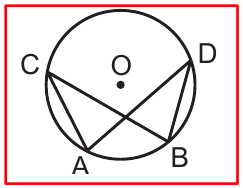
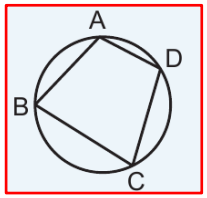
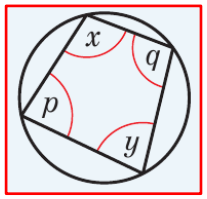
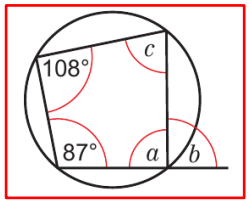
Topic: KS4 Higher Unit 16 Circle Theorems

MathsWatch clip numbers are in brackets: 119, 183, 184

Duration: 7 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**
Theorems Chord Perpendicular Bisects Tangent Subtended Semicircle Sector Segment Cyclic quadrilateral	I know that: 1. A **chord** is a straight line connecting two points on the circumference of the circle. The line AB is a chord **(119)**.  The **perpendicular** from the centre of the circle to a chord (the line OM), **bisects** the chord. The line drawn from the centre of a circle to the midpoint of a chord is at right angles to the chord. So, the line AM = MB. **(183, 184)** 2. A **tangent** is a straight line that touches a circle at one point only. The angle between a tangent and the radius is 90°.  Tangents to a circle drawn from a point outside the circle are equal in length. So, AC = BC. **(183, 184)** 3. The angle at the centre of a circle is twice the angle at the circumference when both are **subtended** by the same arc. **(183, 184)**  **Subtend** means that the arms of the angle start and finish at the ends of the arc. So, angles ACB and AOB are both subtended by arc AB. The angle in a **semicircle** is a right angle.  	I know how to: • Solve problems involving angles, triangles, and circles. • Solve problems involving chords and radii. • Prove and use facts about angles subtended at the centre and the circumference of circles. • Prove and use facts about the angle in a semicircle being a right angle. • Find missing angles using these theorems and give reasons for answers. • Prove and use facts about cyclic quadrilaterals. • Prove the alternate segment theorem. • Find the equation of the tangent to a circle at a given point. I know when to: • Solve angle problems using circle theorems. • Use facts about chords and their distance from the centre of a circle.	This topic builds on prior knowledge: • Have practical experience of drawing circles with compasses. • Recall the words, centre, radius, diameter, circumference, arc, **sector, semicircle,** and **segment** • Recall the relationship between the gradient of two perpendicular lines. • Recall the basic facts and properties of circles and triangles This topic will be used in future learning: • Being able to solve circle theorem problems

	4. Angles subtended from the same arc are equal. Another form of the same theorem is that the angles in the same **segment** are equal. So, angle ACB = ADB. **(183, 184)**  A **cyclic quadrilateral** is a quadrilateral with all four vertices on the circumference of a circle. **(183, 184)**  Opposite angles of a cyclic quadrilateral add up to 180°. So, x + y = 180° and p + q = 180°.  An exterior angle of a cyclic quadrilateral is equal to the opposite interior angles. So, b = 108°.  5. Reasons must always be given. Always!	• Use facts about tangents at a point and from a point.	that include trigonometry and Pythagoras. • Being able to sole circle theorem problem that also include challenging algebraic problems.

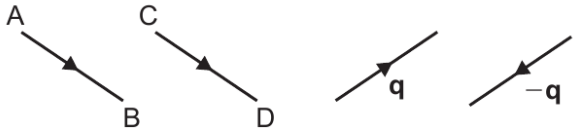
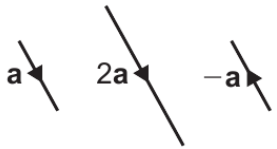
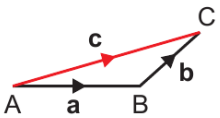
pTopic: KS4 Higher Unit 17 More algebra

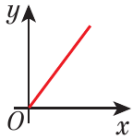
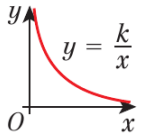
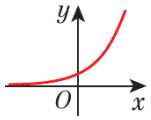
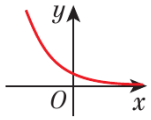
MathsWatch clip numbers:

Duration: 12 Lessons

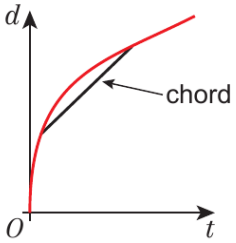
Composite: Unit Test

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**
Formula Subject Algebraic fractions Numerator Denominator Surds Rationalise Function notation Inverse functions	I know that: To add or subtract algebraic fractions, write each fraction as an equivalent fraction with a common denominator. To rationalise the fraction $\frac{1}{a \pm \sqrt{b}}$, multiply by $\frac{a \mp \sqrt{b}}{a \mp \sqrt{b}}$ fg is the composition of the function f with the function g. To work out fg(x), first work out g(x) and then substitute your answer into f(x). The inverse function reverses the effect of the original function. $f^{-1}(x)$ is the inverse of f(x). To prove a statement is not true you can find a **counter-example** – an example that does not fit the statement. For an algebraic proof, use n to represent any integer. Even number: $2n$ Odd number: $2n + 1$ or $2n - 1$ Consecutive numbers: $n, n + 1, n + 2, \ldots$ Consecutive even numbers: $2n, 2n + 2, 2n + 4, \ldots$ Consecutive odd numbers: $2n + 1, 2n + 3, 2n + 5, \ldots$	I know how to: • Change the subject of a formula where the power of the subject appears twice and where all the variables are in the denominators. • Add, subtract, multiply and divide algebraic fractions. • Simplify algebraic fractions. • Multiply and divide more complex algebraic fractions. • Simplify expressions involving surds. • Expand expressions involving surds. • Solve equations that involve algebraic fractions. • Find composite functions. • Find inverse functions. • Prove a result using algebra. I know when to: • Rationalise the denominator of a fraction. • Use function notation.	This topic builds on prior knowledge: • Simplify surds. • Use negative numbers with all four operations. • Manipulate algebraic expressions. • Recall and use the quadratic formula. This topic will be used in future learning: • Recognising and sketching function. • Using function notation with graphs of functions.

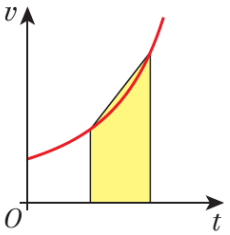
Topic: KS4 Higher Unit 18 Vectors and geometric proof **MathsWatch clip numbers:**		**Duration: 11 Lessons**	**Composite: Unit Test**
Key vocabulary:	**Powerful knowledge components crucial to commit to long term memory. Declarative knowledge.**	**Core knowledge components. Procedural and conditional knowledge.**	**Links to previous and future topics**
Vector Notation Prove Parallel Collinear Geometric	I know that: The magnitude of the vector $\begin{pmatrix} x \\ y \end{pmatrix}$ is its length, i.e. $\sqrt{x^2 + y^2}$. If $\overrightarrow{AB} = \overrightarrow{CD}$ then the line segments AB and CD are equal in length and are parallel. $\overrightarrow{AB} = -\overrightarrow{BA}$  2**a** is twice as long as **a** and in the same direction. −**a** is the same length as **a** but in the opposite direction.  **Triangle law for vector addition**: Let $\overrightarrow{AB}$ = **a**, $\overrightarrow{BC}$ = **b** and $\overrightarrow{AC}$ = **c**. **a** + **b** = **b** + **a**. Then **a** + **b** = **c** forms a triangle.  **Parallelogram law for vector addition**: In parallelogram PQRS where $\overrightarrow{PQ}$ is **a** and $\overrightarrow{PS}$ is **b**, the diagonal $\overrightarrow{PR}$ of the parallelogram is **a** + **b**. When **c** = **a** + **b** the vector **c** is called the **resultant vector** of the two vectors **a** and **b**. With the origin O, the vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are called the **position vectors** of the points A and B. In general, a point with coordinates (p, q) has position vector $\begin{pmatrix} p \\ q \end{pmatrix}$.	I know how to: • Work out the magnitude of a vector. • Calculate using vectors and represent the solutions graphically. • Calculate the resultant of two vectors. • Solve problems using vectors. • Use the resultant of two vectors to solve vector problems. • Express points as position vectors. I know when to: • Prove lines are parallel. • Prove points are collinear. • Solve geometric problems in two dimensions using vector methods. • Apply vector methods for simple geometric proofs.	This topic builds on prior knowledge: • Use vectors to describe translations. • Recall and use Pythagoras' Theorem. • Recall the properties of triangles and quadrilaterals. • Express the relationship between two quantities as a ratio. This topic will be used in future learning: • Use the skill of proof with circle theorem and algebraic proof questions in examinations

Topic: KS4 Higher Unit 19 Proportion and graphs **MathsWatch clip numbers:**		**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**
Direct proportion Inverse proportion Square and cubic proportionality Exponential functions Estimate	I know that: When a graph of two quantities is a straight line through the origin, one quantity is directly proportional to the other.  Where k is the constant of proportionality: ○ if y is proportional to the square of x then $y \propto x^2$ and $y = kx^2$ ○ if y is proportional to the cube of x then $y \propto x^3$ and $y = kx^3$ ○ if y is proportional to the square root of x then $y \propto \sqrt{x}$ and $y = k\sqrt{x}$ When y is **inversely proportional** to x, $y \propto \frac{1}{x}$ and $y = \frac{k}{x}$  The graph of an exponential function has one of these shapes.  $y = a^x$ where $a > 1$ or $y = b^{-x}$ where $0 < b < 1$ **exponential growth**  $y = a^{-x}$ where $a > 1$ or $y = b^x$ where $0 < b < 1$ **exponential decay**	I know how to: • Write and use equations to solve problems involving direct proportion. • Write and use equations to solve problems involving direct proportion. • Solve problems involving square and cubic proportionality. • Write and use equations to solve problems involving inverse proportion. • Use and recognise graphs showing inverse proportion. • Recognise and sketch graphs of exponential functions. I know when to: • Estimate the area under a non-linear graph. • Calculate the gradient of a tangent at a point.	This topic builds on prior knowledge: • Draw linear and quadratic graphs. • Calculate the gradient of a linear function between two points. • Recall transformations of trigonometric functions. • Write statements of direct proportion and forming an equation to find values. This topic will be used in future learning: • Use proportion and graph skills within more complex exam style questions.

The straight line that connects two points on a curve is called a **chord**. 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.



The area under a velocity–time graph shows the displacement, or distance from the starting point. To estimate the area under a part of a curved graph, draw a chord between the two points you are interested in, and straight lines down to the horizontal axis to create a trapezium. The area of the trapezium is an estimate for the area under this part of the graph.



The graph of $y = f(x)$ is transformed into the graph of:

$y = f(x) + a$ by a translation of a units parallel to the y-axis

or a translation by $\begin{pmatrix} 0 \\ a \end{pmatrix}$

$y = f(x + a)$ by a translation of $-a$ units parallel to the x-axis

or a translation by $\begin{pmatrix} -a \\ 0 \end{pmatrix}$

$y = f(-x)$ by a reflection in the y-axis

$y = -f(x)$ by a reflection in the x-axis

$y = af(x)$ by a stretch of scale factor a parallel to the y-axis

$y = f(ax)$ by a stretch of scale factor $\frac{1}{a}$ parallel to the x-axis