

# Year 10 Maths Learning Outcomes

## Unit 1: Investigating Properties of Shapes

- Appreciate that the ratio of corresponding sides in similar triangles is constant.
- Choose an appropriate trigonometric ratio that can be used in a given situation.
- Understand that sine, cosine and tangent are functions of an angle.
- Establish the exact values of  $\sin\theta$  and  $\cos\theta$  for  $\theta = 0^\circ, 30^\circ, 45^\circ, 60^\circ$  and  $90^\circ$ .
- Establish the exact value of  $\tan\theta$  for  $\theta = 0^\circ, 30^\circ, 45^\circ$  and  $60^\circ$ .
- Use a calculator to find the sine, cosine and tangent of an angle.
- Know the trigonometric ratios,  $\sin\theta = \text{opp/hyp}$ ,  $\cos\theta = \text{adj/hyp}$ ,  $\tan\theta = \text{opp/adj}$ .
- Set up and solve a trigonometric equation to find a missing side in a right-angled triangle.
- Set up and solve a trigonometric equation when the unknown is in the denominator of a fraction.
- Set up and solve a trigonometric equation to find a missing angle in a right-angled triangle.
- Use trigonometry to solve problems involving bearings.
- Use trigonometry to solve problems involving an angle of depression or an angle of elevation.

### Extended Learning:

- Multistep trigonometry questions.
- 3D trigonometry problems.

## Unit 2: Calculating

- Estimate squares and cubes of numbers up to 100.
- Estimate powers of numbers up to 10.
- Estimate square roots of numbers up to 150 and cube roots of numbers up to 20.
- Know and use the fact that  $a^{-n} = 1/a^n$ .
- Know and use the fact that  $a^{1/n} = \sqrt[n]{a}$ .
- Calculate exactly with surds.
- Choose the required minimum and maximum values when solving a problem involving upper and lower bounds.
- Calculate the upper and lower bounds in a given situation.

### Extended Learning:

- Simplifying surds.
- Adding/Subtracting surds.
- Expanding brackets involving surds.
- Rationalise the denominator.

## Unit 3: Solving Equations and Inequalities 1

- State the (simple) inequality represented by a shaded region on a graph.
- Construct and shade a graph to show a linear inequality of the form  $y > ax + b$ ,  $y < ax + b$ ,  $y \geq ax + b$  or  $y \leq ax + b$ .
- Construct and shade a graph to show a linear inequality in two variables stated implicitly.
- Construct and shade a graph to represent a set of linear inequalities in two variables.
- Find the set of integer coordinates that are solutions to a set of inequalities in two variables.
- Use set notation to represent the solution set to an inequality.

### Extended Learning:

- Solve other pairs of simultaneous equations graphs (not both linear).

## Unit 4: Mathematical Movement 1

- Use the centre and scale factor to carry out an enlargement of a 2D shape with a fractional scale factor.
- Find the scale factor of an enlargement with fractional scale factor.
- Find the centre of an enlargement with fractional scale factor.
- Solve problems involving similarity.
- Perform a sequence of transformations on a 2D shape.
- Find and describe a single transformation given two congruent 2D shapes.

### Extended Learning:

- Combinations of transformations (Grade 5 or Grade 6 if negative enlargement is included).

## Unit 5: Algebraic Proficiency (Tinkering)

- Add and subtract algebraic fractions.
- Multiply and divide algebraic fractions.
- Simplify an algebraic fraction.
- Expand the product of three binomials.
- Expand the product of two binomials involving surds.
- Factorise an expression involving the difference of two squares.
- Factorise a quadratic expression of the form  $ax^2 + bx + c$  ( $a$  is prime).
- Factorise a quadratic expression of the form  $ax^2 + bx + c$  ( $a$  is composite).
- Identify when factorisation of the numerator and/or denominator is needed to simplify an algebraic fraction.
- Simplify an algebraic fraction that involves factorisation.
- Change the subject of a formula when more than two steps are required.
- Change the subject of a formula when the required subject appears twice.

### Extended Learning:

- Apply BIDMAS to a sum involving algebraic fractions.
- Solving equations involving algebraic fractions.

## Unit 6: Proportional Reasoning

- Interpret graphs and equations that describe direct proportion.
- Interpret graphs and equations that describe inverse proportion.
- Solve problems involving the combining of ratios.
- Solve complex problems combining understanding of fractions, percentages and/or ratio.
- Solve more complex problems involving density.
- Solve more complex problems involving pressure.
- Solve more complex problems involving speed.

### Extended Learning:

- Ensure that students have seen questions involving tables of values and roots up to and including cube roots.

## Unit 7: Pattern Sniffing & Solving Equations Inequalities II & III

### Pattern Sniffing

- Find the  $n$ th term of a sequence of the form  $ax^2 + b$ .
- Find the  $n$ th term of a sequence of the form  $ax^2 + bx + c$ .
- Recognise and describe a simple geometric progression (of the form  $rn$ ).
- Find the next three terms, or a given term, in a geometric progression.

### Solving Equations II

- State the (simple) inequality represented by a shaded region on a graph.
- Construct and shade a graph to show a linear inequality of the form  $y > ax + b$ ,  $y < ax + b$ ,  $y \geq ax + b$  or  $y \leq ax + b$ .
- Construct and shade a graph to show a linear inequality in two variables stated implicitly.
- Construct and shade a graph to represent a set of linear inequalities in two variables.
- Find the set of integer coordinates that are solutions to a set of inequalities in two variables.
- Use set notation to represent the solution set to an inequality.

### Solving Equations III

- Solve a quadratic equation of the form  $x^2 + bx + c = 0$  by factorising.
- Solve a quadratic equation by rearranging and factorising.
- Make connections between graphs and quadratic equations of the form  $ax^2 + bx + c = 0$ .
- Make connections between graphs and quadratic equations of the form  $ax^2 + bx + c = dx + e$ .
- Find approximate solutions to quadratic equations using a graph.
- Deduce roots of quadratic functions algebraically.
- Solve problems that involve solving a quadratic equation in context.

### Extended Learning:

- $N$ th term of quadratic patterns.
- Find the next 3 terms of a geometric progression.
- Find a given term in a simple geometric progression.

## Unit 8: Calculating Space

- Use Pythagoras' theorem to find lengths in a pyramid or cone.
- Find the surface area of spheres, cones and pyramids.
- Find the volume of spheres, cones and pyramids.
- Identify how to find the volume or surface area of a composite solid.
- Solve practical problems involving the surface area of solids.
- Solve practical problems involving the volume of solids.
- Understand the implications of enlargement on area.
- Understand the implications of enlargement on volume.
- Move freely between scale factors for length, area and volume.
- Solve practical problems involving length, area and volume in similar figures.

### Extended Learning:

- Volumes of compound shapes (including spheres/cones).
- Volume of frustums.

## Unit 9: Conjecturing

- Create a chain of logical steps to create a proof in a geometrical situation.
- Know that 'the angle in a semicircle is a right angle'.
- Know that 'the angle at the centre is double the angle at the circumference'.
- Know that 'angles in the same segment are equal'.
- Know that 'opposite angles in a cyclic quadrilateral sum to  $180^\circ$ '.
- Know that 'two tangents from an external point are equal in length'.
- Know that 'a radius is perpendicular to a tangent at that point'.
- Know that 'a radius that bisects a chord is perpendicular to that chord'.
- Know the alternate segment theorem.
- Use a combination of known and derived facts to solve a geometrical problem.
- Identify when a circle theorem can be used to help solve a geometrical problem.
- Justify solutions to geometrical problems.

### Extended Learning:

- Use circle theorems to prove geometrical situations.

## Unit 10: Algebraic proficiency (Visualising 1 & Visualising 2)

### Visualising 1

- Recognise, plot and interpret exponential graphs.
- Plot graphs of non-standard functions.
- Use graphs of non-standard functions to solve simple kinematic problems.
- Recognise that the gradient of a curve is not constant.
- Know that the gradient of a curve is the gradient of the tangent at that point.
- Calculate the gradient at a point on a curve.
- Interpret the gradient at a point on a curve as the instantaneous rate of change.
- Interpret the gradient of a chord as an average rate of change.
- Solve problems involving the gradients of graphs in context.

- Calculate an estimate for the area under a graph, including the area under a speed-time graph as distance.
- Solve problems involving the area under graphs in context.
- Identify and interpret roots, intercepts and turning points of quadratic functions graphically.

### Visualising 2

- Know that perpendicular lines have gradients with a product of -1.
- Identify perpendicular lines using algebraic methods.
- Identify the equation of a circle from its graph.
- Use the equation of a circle to draw its graph.
- Find the equation of a tangent to circle at a given point.
- Solve algebraic problems involving tangents to a circle.

### Extended Learning:

- Calculate gradients of curves for tangents at a point.

## Unit 11: Exploring Fractions, Decimals and Percentages

- Convert a fraction to a recurring decimal.
- Convert a recurring decimal of the form  $0.\dot{x}$ ,  $0.\dot{x}y$ ,  $0.\dot{x}yz$  to a fraction.
- Convert a recurring decimal of the form  $0.0\dot{x}$ ,  $0.0\dot{x}y$ , to a fraction.
- Recognise when a situation involves compound interest.
- Calculate the result of a repeated percentage change, including compound interest.
- Solve problems involving growth and decay.

### Extended Learning:

- Use exponential graphs to figure out decay problems.

## Unit 12: Understanding Risk and Analysing Statistics

### Understanding Risk

- Apply the product rule for counting.
- Understand set notation used with Venn diagrams:  $\cup$ ,  $\cap$ ,  $\emptyset$ ,  $\xi$
- Use a Venn diagram to calculate theoretical probabilities.
- Use a two-way table to sort information in a probability problem.
- Use a two-way table to calculate theoretical probabilities.
- Calculate conditional probabilities using different representations.

### Statistics

- Understand limitations of sampling and use a sample to infer properties of a population.
- Construct and use a cumulative frequency graph.
- Construct and compare box plots.
- Stratified sampling.

### Extended Learning for Unit 15: (Analysing Statistics)

## Unit 13: Mathematical Movement 2

- Know and use different notations for vectors, including diagrammatic representation.
- Add and subtract vectors.
- Multiply a vector by a scalar.
- Solve simple geometrical problems involving vectors.

### **Extended Learning for Unit 13: Mathematical Movement 2**

- Prove two vectors are parallel.
- Show that two vectors make a straight line.
- Simultaneous equations using vectors.