

Edexcel IGCSE Mathematics A (4MA1)

1 Topic 1: Numbers and the Number System

This syllabus combines Foundation and Higher Tier content.

1.1 1.1 Integers

Students should be taught to:

- Understand and use integers (positive, negative and zero)
 - Understand place value
 - Use directed numbers in practical situations (e.g. temperatures)
 - Order integers
 - Use the four rules of addition, subtraction, multiplication and division
 - Use brackets and the hierarchy of operations
 - Use the terms “odd”, “even”, “prime numbers”, “factors” and “multiples”
 - Identify prime factors, common factors and common multiples
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1.2 1.2 Fractions

Students should be taught to:

- Understand and use equivalent fractions, simplifying a fraction by cancelling common factors:

$$\frac{8}{60} = \frac{2}{15}$$

- Understand and use mixed numbers and vulgar fractions
- Identify common denominators
- Order fractions and calculate a given fraction of a quantity
- Express a number as a fraction of another number

- Use common denominators to add and subtract fractions and mixed numbers:

$$\frac{2}{3} + \frac{5}{7}, \quad 1\frac{2}{5} - \frac{3}{4}$$

- Convert a fraction to a decimal or a percentage:

$$\frac{3}{5} = 0.6 = 60\%, \quad \frac{4}{9} = 0.\bar{4} = 44.\bar{4}\%$$

- Understand and use unit fractions as multiplicative inverses:

$$\frac{13}{5} \div 3 = \frac{13}{5} \times \frac{1}{3}$$

- Multiply and divide fractions and mixed numbers:

$$\frac{2}{3} \times \frac{5}{7}, \quad 1\frac{2}{3} \div 2\frac{1}{5}$$

1.3 1.3 Decimals

Students should be taught to:

- Use decimal notation
- Understand place value
- Order decimals
- Convert decimals to fractions and percentages (terminating decimals only)
- Recognise that a terminating decimal is a fraction:

$$0.65 = \frac{65}{100} = \frac{13}{20}$$

- Convert recurring decimals into fractions (Higher Tier):

$$0.\bar{3} = \frac{1}{3}, \quad 0.\overline{322} = \frac{290}{900} = \frac{29}{90}$$

1.4 1.4 Powers and Roots

Students should be taught to:

- Identify square and cube numbers
- Calculate squares, square roots, cubes and cube roots
- Use index notation and index laws for multiplication and division of positive and negative integer powers, including zero:

$$a^0 = 1, \quad a^m \times a^n = a^{m+n}, \quad \frac{a^m}{a^n} = a^{m-n}$$

- Express integers as a product of powers of prime factors:

$$720 = 2^4 \times 3^2 \times 5$$

- Find HCF and LCM using prime factor form
- Understand the meaning of surds (Higher Tier)
- Manipulate surds, including rationalising a denominator (Higher Tier):

$$\sqrt{8} + \sqrt{32} = 2\sqrt{2} + 4\sqrt{2} = 6\sqrt{2}$$

$$\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$$

- Use index laws to simplify and evaluate expressions involving integer, fractional and negative powers:

$$25^{1/2} = 5, \quad 8^{-1/3} = \frac{1}{2}$$

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1.5 1.5 Set Language and Notation

Students should be taught to:

- Understand the definition of a set
- Use the set notation:

$$\cup, \cap, \in, \notin, \subset, \emptyset, E$$

- Understand the universal set and the empty set
- Understand and use the complement of a set:

$$A' \text{ or } \overline{A}$$

- Use Venn diagrams to represent sets
- Understand and use sets defined in algebraic terms (Higher Tier)
- Use notation $n(A)$ for the number of elements in set A (Higher Tier)
- Use sets in practical contexts (Higher Tier)

1.6 1.6 Percentages

Students should be taught to:

- Understand that “percentage” means “number of parts per 100”
- Express a number as a percentage of another

- Express percentages as fractions and decimals
- Understand percentages as operators:

$$15\% \text{ of } 120 = \frac{15}{100} \times 120 = 18$$

- Solve percentage problems including increase and decrease
 - Use reverse percentages: e.g. An item costs £17.50 after a 30% reduction. What was the original price?
 - Use compound interest and depreciation (Higher Tier)
 - Use repeated percentage change (Higher Tier)
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1.7 1.7 Ratio and Proportion

Students should be taught to:

- Use ratio notation and reduce to simplest form
 - Convert between ratios and fractions
 - Divide a quantity in a given ratio
 - Use proportion to find unknown quantities
 - Solve problems involving direct and inverse proportion (Higher Tier)
 - Interpret and solve word problems involving ratio and proportion, including maps and scale diagrams
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1.8 1.8 Degree of Accuracy

Students should be taught to:

- Round numbers to powers of 10, significant figures, and decimal places
 - Identify upper and lower bounds for rounded numbers
 - Use estimation to evaluate approximations: Round values to 1 significant figure
 - Solve problems involving bounds (Higher Tier)
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1.9 1.9 Standard Form

Students should be taught to:

- Understand and use standard form:

$$a \times 10^n \quad \text{where } 1 \leq a < 10, n \in \mathbb{Z}$$

- Convert numbers to and from standard form
 - Perform calculations with numbers in standard form
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1.10 1.10 Applying Number

Students should be taught to:

- Apply number skills in real-life contexts: personal, domestic, community
 - Use standard units of mass, length, area, volume and capacity (metric only)
 - Perform time calculations and currency conversions
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1.11 1.11 Electronic Calculators

Students should be taught to:

- Use a scientific calculator effectively for a range of calculations

2 Topic 2: Equations, Formulae and Identities

This topic combines Foundation and Higher Tier content.

2.1 2.1 Use of Symbols

Students should be taught to:

- Understand that symbols may represent numbers or variables in expressions, equations, or formulae
- Understand that algebraic expressions follow the generalised rules of arithmetic
- Use index notation for positive, negative, and zero integer powers:

$$a^3 = a \times a \times a, \quad a^0 = 1, \quad a^{-1} = \frac{1}{a}$$

- Use index laws:

$$x^m \times x^n = x^{m+n}, \quad \frac{x^m}{x^n} = x^{m-n}, \quad (x^m)^n = x^{mn}$$

2.2 2.2 Algebraic Manipulation

Students should be taught to:

- Evaluate expressions by substituting values into variables
- Collect like terms
- Multiply a single term over a bracket:

$$3(x + 5) = 3x + 15$$

- Factorise simple expressions by taking out common factors:

$$28xy + 12y = 4y(7x + 3)$$

- Expand the product of two linear expressions:

$$(x + 4)(x - 2) = x^2 + 2x - 8$$

- Understand and factorise quadratic expressions of the form:

$$x^2 + bx + c$$

- (Higher Tier) Expand the product of three linear expressions:

$$(x + 2)(x - 1)(x + 3)$$

- (Higher Tier) Factorise complex quadratics (e.g. $6x^2 - 5x - 6$)
- (Higher Tier) Manipulate algebraic fractions and simplify:

$$\frac{3}{x - 2} + \frac{1}{x + 1}$$

- (Higher Tier) Complete the square:

$$x^2 + 6x - 1 = (x + 3)^2 - 10$$

- (Higher Tier) Use algebra to construct and support proofs
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2.3 2.3 Expressions and Formulae

Students should be taught to:

- Understand that letters may represent unknowns or variables
- Use correct algebraic notation

- Substitute values into expressions and formulae including negative, fractional, and decimal values
- Use and construct formulae from contexts (e.g. area, physics)
- Derive a formula from a description or diagram
- Change the subject of a formula (where the subject appears once):

$$A = \pi r^2 \Rightarrow r = \sqrt{\frac{A}{\pi}}, \quad v = u + at \Rightarrow t = \frac{v - u}{a}$$

- (Higher Tier) Rearrange more complex formulae, including those where the subject appears more than once or appears as a power

2.4 2.4 Linear Equations

Students should be taught to:

- Solve linear equations with the unknown on one or both sides:

$$5x + 8 = 12, \quad 7(x - 3) = 5x - 8$$

- Solve linear equations with fractional coefficients:

$$\frac{4x + 5}{2} = 3$$

- Set up and solve simple linear equations from word problems: E.g. Angles in a triangle add to 180°:

$$a + (a + 10) + (a + 20) = 180$$

2.5 2.5 Proportion

- (Higher Tier) Set up equations from proportional relationships:

$$y \propto x^2 \Rightarrow y = kx^2$$

2.6 2.6 Simultaneous Equations

Students should be taught to:

- Solve a pair of simultaneous linear equations algebraically (elimination or substitution)

$$2x + 3y = 17, \quad 3x - 5y = 35$$

- (Higher Tier) Solve simultaneous equations involving one linear and one quadratic equation:

$$y = 2x - 11, \quad x^2 + y^2 = 25$$

- (Higher Tier) Interpret simultaneous equations graphically as points of intersection
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2.7 2.7 Quadratic Equations

Students should be taught to:

- Solve quadratic equations by factorising:

$$x^2 + x - 30 = 0 \Rightarrow (x + 6)(x - 5) = 0$$

- (Higher Tier) Solve quadratics using the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- (Higher Tier) Solve quadratics by completing the square
 - (Higher Tier) Form and solve quadratics from contexts
 - (Higher Tier) Solve a quadratic and linear system of equations
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2.8 2.8 Inequalities

Students should be taught to:

- Use inequality symbols: $>$, $<$, \geq , \leq
- Represent linear inequalities on a number line:

$$1 < x \leq 5$$

- Solve inequalities such as:

$$3x - 2 < 10 \Rightarrow x < 4, \quad 7 - x \leq 5 \Rightarrow x \geq 2$$

- Solve compound inequalities:

$$3 < x + 2 \leq 5 \Rightarrow 1 < x \leq 3$$

- Represent linear inequalities in two variables on Cartesian graphs: Shade regions defined by:

$$x \geq 0, \quad y \geq 1, \quad x + y \leq 5$$

- (Higher Tier) Solve and represent quadratic inequalities on number lines:

$$x^2 - 4 < 0 \Rightarrow -2 < x < 2$$

- (Higher Tier) Identify regions defined by multiple inequalities on graphs

3 Topic 3: Sequences, Functions and Graphs

This topic combines Foundation and Higher Tier content.

3.1 3.1 Sequences

Students should be taught to:

- Generate terms of a sequence using:
 - Term-to-term rules
 - Position-to-term rules
- Identify and continue integer sequences including:
 - Odd and even numbers
 - Squares, multiples and powers
- Use linear expressions to describe the n th term of an arithmetic sequence:

$$2, 5, 8, 11, \dots \quad \text{has } n\text{th term} = 3n - 1$$

- Recognise and use:
 - Arithmetic sequences
 - Geometric sequences (Higher Tier)
 - Quadratic sequences (Higher Tier)
- Know and use:
 - First term a
 - Common difference d in arithmetic sequences

- Find the sum of the first n terms of an arithmetic series (Higher Tier):

$$S_n = \frac{n}{2} (2a + (n-1)d)$$

3.2 3.2 Function Notation (Higher Tier)

Students should be taught to:

- Understand the concept of a function as a mapping between two sets
- Use function notation:

$$f(x) = 3x + 1, \quad f : x \mapsto 3x + 1$$

- Understand domain and range
 - Identify values to exclude from the domain (e.g. for $f(x) = \frac{1}{x}$, $x \neq 0$)
 - Find composite functions $fg(x)$
 - Find inverse functions $f^{-1}(x)$
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3.3 3.3 Graphs

Students should be taught to:

- Interpret and draw information from a range of linear and non-linear graphs, including:
 - Distance-time graphs
 - Speed-time graphs
- Use Cartesian coordinates in all four quadrants
- Plot points (x, y) and locate them on the plane
- Determine coordinates of points from geometric descriptions
- Find the midpoint of a line segment:

$$\text{Midpoint of } (x_1, y_1) \text{ and } (x_2, y_2) = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

- Draw and interpret conversion graphs, including currency conversions
- Calculate the gradient of a straight line:

$$m = \frac{\text{change in } y}{\text{change in } x}$$

- Understand equations of straight lines in the form $y = mx + c$, where: $-m$ is the gradient $-c$ is the y-intercept
- Write the equation of a straight line from its graph
- Recognise and plot graphs of:
 - Linear functions $y = mx + c$
 - Vertical and horizontal lines $x = a, y = b$
 - Quadratic functions $y = ax^2 + bx + c$
 - Simple cubic and reciprocal functions (Higher Tier)
- Complete tables of values for functions
- Identify and draw:
 - Parallel lines (same gradient)
 - Perpendicular lines (negative reciprocal gradients)
- (Higher Tier) Plot and interpret:
 - Cubic functions: $y = x^3$
 - Reciprocal functions: $y = \frac{1}{x}$
- (Higher Tier) Find the intersection of two graphs (linear and non-linear):
Solve $f(x) = g(x)$ graphically or algebraically
- (Higher Tier) Apply transformations to graphs of functions:

$$y = f(x) + a, \quad y = f(x + a), \quad y = af(x), \quad y = f(ax)$$

3.4 3.4 Calculus (Higher Tier)

Students should be taught to:

- Understand the concept of a variable rate of change
- Differentiate simple functions:

$$\frac{d}{dx}x^n = nx^{n-1}$$

- Use differentiation to:
 - Find gradients of curves
 - Calculate instantaneous rates of change
 - Find and classify stationary points
- Identify maxima and minima from graphs
- Apply calculus to:
 - Simple kinematics (e.g. $s(t) \rightarrow v(t) \rightarrow a(t)$)
 - Practical problems involving rate of change

4 Topic 4: Geometry and Trigonometry

This topic combines Foundation and Higher Tier content.

4.1 4.1 Angles, Lines and Triangles

Students should be taught to:

- Distinguish between acute, obtuse, reflex and right angles
 - Use angle facts:
 - Angles on a straight line sum to 180°
 - Angles at a point sum to 360°
 - Vertically opposite angles are equal
 - Use properties of angles with parallel lines:
 - Alternate angles are equal
 - Corresponding angles are equal
 - Allied (co-interior) angles sum to 180°
 - Understand the exterior angle and angle sum properties of triangles:
 - The exterior angle equals the sum of the opposite interior angles
 - The angles in a triangle sum to 180°
 - Use properties of:
 - Equilateral, isosceles, and right-angled triangles
 - Congruent triangles
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4.2 4.2 Polygons

Students should be taught to:

- Name and recognise common polygons:
 - Triangle, quadrilateral, pentagon, hexagon, octagon, etc.
- Understand and use the angle sum of polygons:

$$\text{Sum of interior angles} = (n - 2) \times 180^\circ$$

- Calculate interior and exterior angles of regular polygons:

$$\text{Exterior angle} = \frac{360^\circ}{n}, \quad \text{Interior angle} = 180^\circ - \text{Exterior angle}$$

- Use properties of quadrilaterals:
 - Parallelogram, rectangle, rhombus, trapezium, kite, square
 - Understand congruence: same shape and size
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4.3 4.3 Symmetry

Students should be taught to:

- Identify lines of symmetry and order of rotational symmetry for 2D shapes
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4.4 4.4 Measures

Students should be taught to:

- Interpret scales and read measuring instruments
- Calculate time intervals using 12-hour and 24-hour clocks
- Estimate a range of measures
- Use three-figure bearings
- Measure angles to the nearest degree
- Use the formula:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

- Use compound measures (Higher Tier):
 - Density = mass/volume
 - Pressure = force/area
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4.5 4.5 Construction

Students should be taught to:

- Measure and draw lines to the nearest mm
 - Construct triangles and other 2D shapes using ruler, protractor, and compasses
 - Solve problems using scale drawings
 - Use straight edge and compasses to:
 - Construct the perpendicular bisector of a line
 - Construct the bisector of an angle
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4.6 4.6 Circle Properties

Students should be taught to:

- Know and use terms: centre, radius, chord, diameter, circumference, arc, sector, segment, tangent

- Understand circle theorems (Higher Tier):
 - Angle at centre = $2 \times$ angle at circumference
 - Angle in semicircle = 90°
 - Angles in same segment are equal
 - Opposite angles in cyclic quadrilateral sum to 180°
 - Alternate segment theorem
 - Two tangents from a point are equal in length
 - Tangent is perpendicular to radius at point of contact
 - A line from the centre that is perpendicular to a chord bisects the chord
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4.7 Geometrical Reasoning

Students should be taught to:

- Give reasons for angle values using appropriate geometric properties and theorems
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4.8 Trigonometry and Pythagoras' Theorem

Students should be taught to:

- Use Pythagoras' Theorem in 2D:

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

- Use trigonometric ratios in right-angled triangles:

$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}, \quad \cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}, \quad \tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

- (Higher Tier) Use sine, cosine and tangent for obtuse angles
- Solve problems involving angles of elevation and depression
- (Higher Tier) Use sine and cosine rules:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}, \quad a^2 = b^2 + c^2 - 2bc \cos A$$

- (Higher Tier) Use:

$$\text{Area of triangle} = \frac{1}{2}ab \sin C$$

- (Higher Tier) Use trigonometry and Pythagoras' Theorem in 3D

- (Higher Tier) Find the angle between a line and a plane
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4.9 4.9 Mensuration

Students should be taught to:

- Convert between metric units, including square and cubic units
- Calculate perimeters and areas of:
 - Rectangles, triangles, parallelograms, trapezia, circles, semicircles
- Calculate:

$$\text{Area of trapezium} = \frac{1}{2}(a + b)h$$

$$\text{Area of circle} = \pi r^2, \quad \text{Circumference} = 2\pi r$$

- Calculate volumes and surface areas of:
 - Cubes, cuboids, prisms, cylinders
- (Higher Tier) Calculate volume and surface area of:
 - Spheres, cones, pyramids

$$V = \frac{4}{3}\pi r^3, \quad V = \frac{1}{3}\pi r^2 h$$

- Convert between cm^3 , m^3 and litres
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4.10 4.10 Similarity

Students should be taught to:

- Recognise similar figures: same shape, different size
- Understand:
 - Corresponding angles are equal
 - Corresponding sides are in the same ratio
- Use scale factors for enlargement
- (Higher Tier) Use:
 - Area scale factor = (length scale factor)²
 - Volume scale factor = (length scale factor)³
- Solve problems using similarity

5 Topic 5: Vectors and Transformation Geometry

This topic combines Foundation and Higher Tier content.

5.1 5.1 Vectors (Higher Tier)

Students should be taught to:

- Understand that a vector has both **magnitude** and **direction**
- Use vector notation, including:
 - Column vectors: $\begin{bmatrix} x \\ y \end{bmatrix}$
 - Directed line segments: \vec{AB} or \overrightarrow{AB}
- Perform operations with vectors:
 - Add and subtract vectors
 - Multiply vectors by scalar quantities:

$$3 \begin{bmatrix} 2 \\ -1 \end{bmatrix} = \begin{bmatrix} 6 \\ -3 \end{bmatrix}$$

- Calculate the **magnitude** (modulus) of a vector:

$$\left| \begin{bmatrix} x \\ y \end{bmatrix} \right| = \sqrt{x^2 + y^2}$$

- Use vectors to represent geometric information and solve problems
 - Use vector methods for **geometrical proofs** (e.g. show points are collinear, midpoints, parallel vectors)
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5.2 5.2 Transformation Geometry

Students should be taught to:

- Understand and perform the four transformations:
 - **Translation:** described using a vector
 - **Reflection:** in a given line (e.g. $y = x$, $x = -1$)
 - **Rotation:** specified by centre, angle and direction
 - **Enlargement:** with centre and scale factor (including fractional and negative)

- Use column vectors to describe translations:

$$\begin{bmatrix} 3 \\ -2 \end{bmatrix}$$

- Construct mirror lines and reflect shapes across them
- Understand that translations, rotations, and reflections preserve:
 - **Length**
 - **Angle**
 - **Shape**
 - Therefore, images are **congruent** to the original
- Understand the properties of enlargements:
 - **Angles** are preserved
 - **Lengths** are multiplied by the scale factor
- Perform enlargements **with or without** a given centre
- Identify and describe transformations (including combinations)
- Use correct mathematical language when describing transformations

6 Topic 6: Statistics and Probability

This topic combines Foundation and Higher Tier content.

6.1 Graphical Representation of Data

Students should be taught to:

- Use and interpret various forms of data presentation:
 - **Pictograms**
 - **Bar charts**
 - **Pie charts**
 - **Line graphs**
 - **Two-way tables**
 - Construct and interpret:
 - **Frequency tables**
 - **Cumulative frequency tables and diagrams** (Higher Tier)
 - **Histograms** for continuous data with unequal class widths (Higher Tier)
 - Identify and describe patterns and trends in graphical data
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6.2 6.2 Statistical Measures

Students should be taught to:

- Understand the concept of an **average**
 - Calculate from a data list or frequency table:
 - **Mean**
 - **Median**
 - **Mode**
 - **Range**
 - (Higher Tier) Estimate the mean for **grouped data** using mid-interval values
 - Identify the **modal class** in grouped data
 - (Higher Tier) Use **cumulative frequency diagrams** to:
 - Estimate the median
 - Estimate the interquartile range (IQR)
 - (Higher Tier) Understand and use measures of spread:
 - **Range**
 - **Interquartile range (IQR)**
 - **Standard deviation** (not calculated manually)
 - Compare two distributions using:
 - Measures of **central tendency**
 - Measures of **spread**
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6.3 6.3 Probability

Students should be taught to:

- Understand and use the **language of probability**:
 - Event, outcome, sample space, likely, certain, impossible
- Use a **probability scale** from 0 to 1
- Know that:

$$P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$$

- List all outcomes for one or two events using:
 - Tables
 - Lists
 - Sample space diagrams
- Calculate probabilities of:
 - Single events

- **Mutually exclusive** events:

$$P(A \text{ or } B) = P(A) + P(B)$$

- **Complementary** events:

$$P(A') = 1 - P(A)$$

- Estimate probabilities using relative frequency from experimental data
- Use Venn diagrams to:
 - Represent sets and events
 - Calculate probabilities (e.g. union, intersection)
- (Higher Tier) Use **tree diagrams** to:
 - Calculate probabilities of successive independent or dependent events
- (Higher Tier) Understand and calculate **conditional probability**:
 - E.g. choosing two objects **without replacement**
- Calculate **expected frequency**:

$$\text{Expected frequency} = \text{Probability} \times \text{Number of trials}$$