Year 11 Curriculum Overview Mathematics 2023-24

Year 11	**Term 1**					
Unit Title	Gradients and lines	Non-linear graphs	Using graphs	Expanding and factorising	Changing the subject	Functions
Approximate Number of Lessons	3	3	3	3	3	3
Curriculum Content **Higher content in bold**	• Equations of lines parallel to the axis • Plot and draw straight lines • Interpret $y = mx + c$ • Find the equation of a line from a graph, given one point and gradient, or two points • Determine whether a point is on a line • Solve linear simultaneous equations • **Recognise and find equations of perpendicular lines**	• Plot and read from quadratic, cubic and **reciprocal graphs** • Recognise graph shapes • Identify and interpret roots and intercepts • **Understand and use exponential graphs** • **Find and use the equation of a circle** • **Find the equation of the tangent to any curve**	• Reflect shapes • Construct and interpret conversion and other real-life straight-line graphs • Interpret and construct distance/time, speed/time and piece-wise graphs • Recognise and interpret graphs that illustrate direct and inverse proportion • Find approximate solutions to equations using graphs • **Estimate the area under a curve**	• Expand and factorise with a single bracket • Expand binomials • **Factorise quadratics expressions, including where $a \neq 1$** • Solve equations equal to zero • Solve quadratic equations by factorisation • **Complete the square of an expression** • **Use the quadratic formula to solve an equation**	• Solve linear equations and inequalities • Form and solve equations and inequalities in the context of shape • Change the subject of a formula, **including where the subject appears more than once** • **Solve equations by iteration**	• Use function machines • Substitute into expressions and formulae • Use function notation • **Work with composite and inverse functions** • Graphs of quadratic functions • **Solve quadratic inequalities** • **Understand and use trigonometric functions**
	Identification and focused teaching on weaker topic areas from weekly past paper practice, accounting for approximately 4 lessons a fortnight.					
Links to prior learning	• Plotting coordinates and using graphs • Parallel and perpendicular lines • Substitution	• Coordinates • Table of values • Reciprocal • Intercepts • Names for parts of a circle	• Transformations • Straight line graphs • Problems involving direct and inverse proportion • Area of rectangles, triangles and trapeziums	• Expanding and factorising expressions • Identify factors • Sum and product • Coefficients • Substitution	• Solve simple linear equations • Recognise inequality signs • Recall a range of formulae • Use of ANS button on calculator	• Function machines • Substitution into expressions • Inputs and outputs • Quadratic functions • Trigonometric functions
Cultural Capital Opportunities	Looking forward to Key Stage 5 Maths					

Assessment Focus	/	/	Paper 1.1.1 (non-calc)	Paper 1.1.2 (non-calc)	Paper 1.2.1 (calc)	Paper 1.2.2 (calc)	Paper 1.3.1 (calc)	Paper 1.3.2 (calc)	Paper 2.1.1 (non-calc)	Paper 2.1.2 (non-calc)	Catch up

Knowledge Organiser	KS4 GCSE Mathematics **Foundation Tier** KS4 GCSE Mathematics **Higher Tier**

From Christmas to May/June, lessons are more tailored to the needs of the respective groups, as well as focusing on revision for the January Mock and addressing gaps identified by past paper practice.

KS4 GCSE Mathematics Foundation Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

Here is pretty much all the Foundation Tier content we could fit onto an A3 sheet of paper, including all the formulae you are required to know for GCSE. An ➔ points to an illustrative example. The codes refer to the DfE subject content. Pin this to a wall, keep it on your desk, carry it in your bag, make notes on it (sorry, don't take it into the examination)...

BIDMAS N3

...or BODMAS. Use the correct order of operations; take care when using a calculator.

- **B**rackets
- **I**ndices (or p**O**wers)
- **D**ivision and **M**ultiplication
- **A**ddition and **S**ubtraction

Types of number N4

Integer: a "whole" number

Factors; the divisors of an integer

➔ **Factors of 12 are 1, 2, 3 ,4, 6, 12**

Multiples; a "times table" for an integer (will continue indefinitely)

➔ **Multiples of 12 are 12, 24, 36 ...**

Prime number: an integer which has exactly two factors (1 and the number itself). Note: 1 is not a prime number.

HCF, LCM N4

Highest **C**ommon **F**actor (HCF)

➔ **Factors of 6 are 1, 2, 3, 6**
Factors of 9 are 1, 3, 9
HCF of 6 and 9 is 3

Lowest **C**ommon **M**ultiple (LCM)

➔ **Multiples of 6 are 6, 12, 18, 24, ...**
Multiples of 9 are 9, 18, 27, 36, ...
LCM of 6 and 9 is 18

Prime factors N4

Write a number as a product of its prime factors; use indices for repeated factors:

➔ $720 = 5 \times 3^2 \times 2^4$

Powers and roots N6, N7

Special indices: for any value a:

$a^0 = 1$

$a^{-n} = \frac{1}{a^n}$

➔ $3^{-4} = \frac{1}{3^4} = \frac{1}{81}$

Calculating with fractions N8

Adding or subtracting fractions; use a common denominator...

➔ $\frac{4}{5} - \frac{1}{3} = \frac{12}{15} - \frac{5}{15} = \frac{7}{15}$

Multiplying fractions; multiply numerators and denominators...

➔ $\frac{4}{7} \times \frac{2}{3} = \frac{8}{21}$

Dividing fractions; "flip" the second fraction, then multiply...

➔ $\frac{2}{7} \div \frac{5}{6} = \frac{2}{7} \times \frac{6}{5} = \frac{12}{35}$

Fractions, decimals N10

Fraction is numerator ÷ denominator

➔ $\frac{5}{8} = 5 \div 8 = 0.625$

Use place values to change decimals to fractions. Simplify where possible.

➔ $0.45 = \frac{45}{100} = \frac{9}{20}$

Learn the most frequently used ones:

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{3}{4}$
0.5	0.25	0.1	0.2	0.75

Surds N8

Look for the biggest square number factor of the number:

➔ $\sqrt{80} = \sqrt{16 \times 5} = 4\sqrt{5}$

Standard form N9

Standard form numbers are of the form $a \times 10^n$ where $1 \le a < 10$ and n is an integer.

Standard units N13

1 tonne = 1000 kilograms
1 kilogram = 1000 grams

1 kilometre = 1000 metres
1 metre = 100 centimetres
= 1000 millimetres
1 centimetre = 10 millimetres

1 day = 24 hours
1 hour = 60 minutes = 3600 seconds
1 minute = 60 seconds

Rounding N15

Truncate the number, then use a "decider digit" to round up or down.

Decimal places: use the decimal point

➔ **162.3681 to 2dp;**
162.36 | 81 = **162.37 to 2dp**

Significant figures: use the first non-zero digit.

➔ **162.3681 to 2sf;**
16 | 2.3681 = **160 to 2sf**

➔ **0.007 039 to 3sf;**
0.007 03 | 9 = **0.007 04 to 3sf**

Error intervals N15

Find the range of numbers that will round to a given value:

➔ $x = 5.83$ **(2 decimal places)**
$5.825 \le x < 5.835$

➔ $y = 46$ **(2 significant figures)**
$45.5 \le y < 46.5$

Note use of ≤ and <, and that the last significant figure of each is 5

Algebraic notation A1

$ab = a \times b$

$3y = y + y + y$

$a^2 = a \times a$

$a^3 = a \times a \times a$

$a^2b = a \times a \times b$

$\frac{a}{b} = a \div b$

Equations and identities A3

An equation is true for some particular value of x

➔ $2x + 1 = 7$ **is true if** $x = 3$

...but an identity is true for every value of x

➔ $(x + a)^2 \equiv x^2 + 2ax + a^2$

(note the use of the symbol ≡)

Laws of indices A4

For any value a:

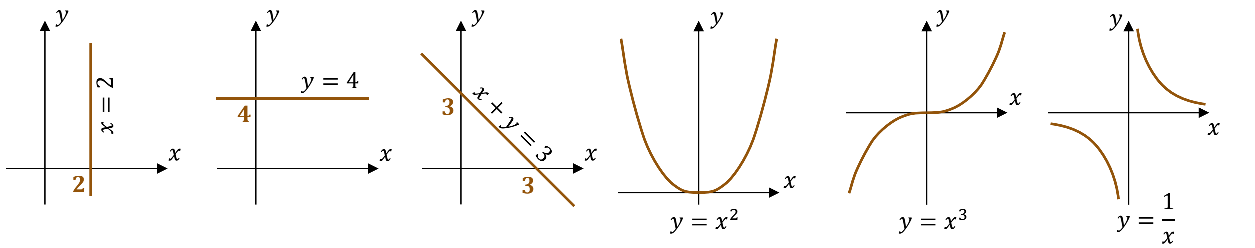
$a^x \times a^y = a^{x+y}$

$\frac{a^x}{a^y} = a^{x-y}$

$(a^x)^y = a^{xy}$

➔ $\left(\frac{2pq^4}{p^3q}\right)^3 = \frac{8p^3q^{12}}{p^9q^3} = \frac{8q^9}{p^6}$ or $8q^9p^{-6}$

Standard graphs A12



y = mx + c A9

Equation of straight line $y = mx + c$
m is the gradient; c is the y intercept:

➔ **Find the equation of the line that joins (0 , 3) to (2 , 11)**

Find its gradient...

$\frac{11 - 3}{2 - 0} = \frac{8}{2} = 4$

...and its y intercept...

Passes through (0 , 3), so c = 3

Equation is $y = 4x + 3$

Parallel lines: gradients are equal;

➔ $y = 2x + 3$ **and** $y = 2x - 5$ **both have gradient 2 so are parallel.**

Expanding brackets A4

$p(q + r) = pq + pr$

➔ $5(x - 2y) = 5x - 10y$

$(x + a)(x + b) = x^2 + ax + bx + ab$

➔ $(2x - 3)(x + 5)$
$= 2x^2 - 3x + 10x - 15$
$= 2x^2 + 7x - 15$

Reverse of expanding is factorising - putting an expression into brackets.

Quadratics A18

Solve a quadratic by factorising.

➔ **Solve** $x^2 - 8x + 15 = 0$

Put into brackets (taking care with any negative numbers)...

$(x - 3)(x - 5) = 0$

...then either $x - 3 = 0$ or $x - 5 = 0$ so that $x = 3$ **or** $x = 5$.

Difference of two squares A4

$a^2 - b^2 = (a + b)(a - b)$

➔ $x^2 - 25 = (x + 5)(x - 5)$

Simultaneous equations A19

➔ **Solve** $\begin{cases} 2x + 3y = 11 \\ 3x - 5y = 7 \end{cases}$

Multiply to match a term in x or y

$\begin{cases} 10x + 15y = 55 \\ 9x - 15y = 21 \end{cases}$

Add or subtract to cancel...

$19x = 76$, **so** $x = 4$

Finally, substitute and solve...

$2 \times 4 + 3y = 11$, **so** $y = 1$

Rearrange a formula A5

The subject of a formula is the term on its own. Use rules that "balance" the formula to change its subject

➔ **Make x the subject of**
$2x + 3y = z$

Here, subtract $3y$ from both sides...

$2x = z - 3y$

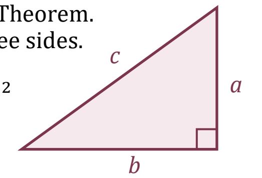
...then divide both sides by 2

$x = \frac{z - 3y}{2}$

Right angled triangles G20, G22

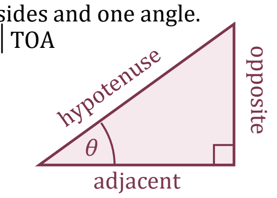
Pythagoras Theorem.
Links all three sides.
No angles.

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



The longest side of any right angled triangle is the hypotenuse; check that your answer is consistent with this.

Trigonometry.
Links two sides and one angle.
SOH | CAH | TOA



$\sin\theta = \frac{\text{opp}}{\text{hyp}}$ $\cos\theta = \frac{\text{adj}}{\text{hyp}}$ $\tan\theta = \frac{\text{opp}}{\text{adj}}$

Use "2ndF" or "SHIFT" key to find a missing angle

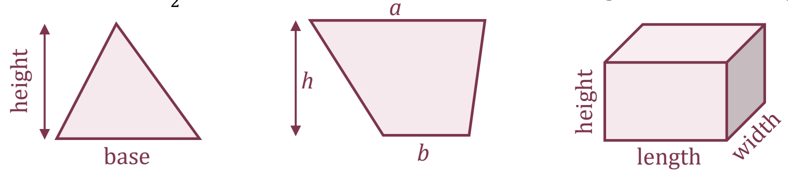
Special values of sin, cos, tan
Learn (or be able to find without a calculator)...

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

Areas and volumes G16, G17, G18, G23

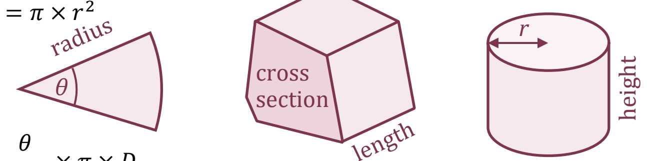
Area of triangle = $\frac{1}{2}$ × base × height

Volume of cuboid = length × width × height



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

Circumference of circle = $\pi \times D$
Area of circle = $\pi \times r^2$



Arc length = $\frac{\theta}{360°} \times \pi \times D$

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

Volume of cylinder = πr^2 × height

Volume of prism = area of cross section × length

Transformations G7, G8

Reflection
- Line of reflection

Translation
- Vector

Rotation
- Centre of rotation
- Angle of rotation
- Clockwise or anticlockwise

Enlargement
- Centre of enlargement
- Scale factor (if SF < 1 the shape will get smaller).

Angle facts G3

Equal angles in parallel lines: always use correct terminology...

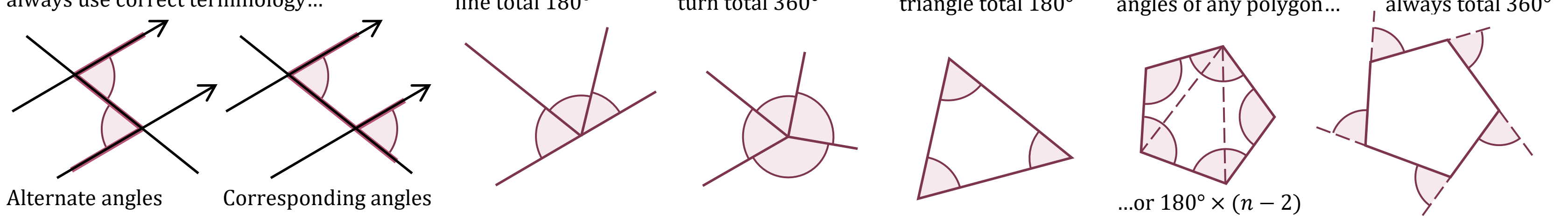
Angles on a straight line total 180°

Angles in a full turn total 360°

Interior angles in a triangle total 180°

Use this for the interior angles of any polygon...

Exterior angles always total 360°



Alternate angles

Corresponding angles

...or 180° × (n − 2)

Sequences A24, A25

Triangular numbers:

1st	2nd	3rd	4th	5th
1	3	6	10	15

Square numbers ($n^2 = n \times n$):

1^2	2^2	3^2	4^2	5^2
1	4	9	16	25

Cube numbers ($n^3 = n \times n \times n$):

1^3	2^3	3^3	4^3	5^3
1	8	27	64	125

nth term of an arithmetic (linear) sequence is $an + d$

➔ ***n*th term of 5, 8, 11, 14, ... is 3n+2 (always increases by 3 first term is 3 × 1 + 2 = 5)**

Geometric sequence; multiply each term by a constant ratio

➔ **3, 6, 12, 24, ... (ratio is 2)**

Fibonacci sequence; make the next term by adding the previous two ...

➔ **2, 4, 6, 10, 16, 26, 42, ...**

Probability P8, P9

$p = \frac{n(\text{equally likely favourable outcomes})}{n(\text{equally likely possible outcomes})}$

$p = 0$	impossible
$0 < p < 0.5$	unlikely
$p = 0.5$	evens
$0.5 < p < 1$	likely
$p = 1$	certain

Probability rules P8, P9

Multiply for independent events

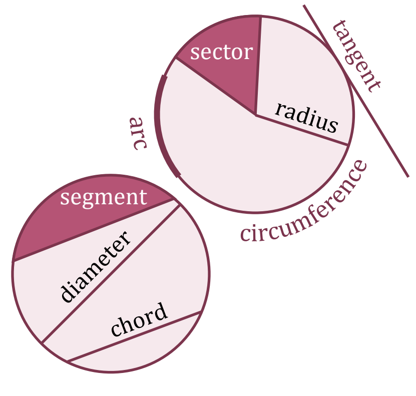
➔ **P(6 on dice and H on coin)**
$\frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$

Add for mutually exclusive events

➔ **P(5 or 6 on dice)**
$\frac{1}{6} + \frac{1}{6} = \frac{2}{6}$

Apply these rules to tree diagrams.

Parts of a circle G9



Division using ratio R5

Use a ratio for unequal sharing

➔ **Divide £480 in the ratio 7 : 5**
7 + 5 = 12, then £480 ÷ 12 = £40
7 × £40 = £280, 5 × £40 = £200
(check: £280 + £200 = £480 ✓)

Ratio and fractions R8

Link between ratios and fractions

➔ **Boys to girls in ratio 2 : 3**
$\frac{2}{5}$ **are boys,** $\frac{3}{5}$ **are girls.**

Percentages R9

y percent of $x = \frac{y}{100} \times x$

➔ **Increase £58 by 26%.**
$\frac{26}{100} \times £58 = £15.08$
£58 + £15.08 = £73.08

y as a percentage of $x = \frac{y}{x} \times 100\%$

➔ **The population of a town increases from 3500 to 4620**
Find the percentage increase.
$\frac{1120}{3500} \times 100\% = 32\%$

Note: fraction $= \frac{\text{increase}}{\text{original}}$

Learn the most frequently used ones:

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{1}{100}$
50%	25%	10%	20%	1%

Speed, distance, time R11

$\text{Speed} = \frac{\text{distance}}{\text{time}}$

➔ **A car travels 90 miles in 1 hour, 30 minutes. Find its average speed.**
90 miles ÷ 1.5 hours = 60 mph

Averages S4

Mode: most frequently occurring

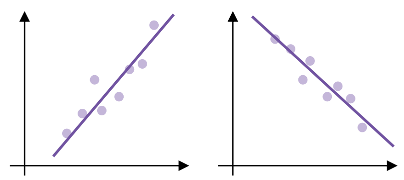
Median: put the data in numerical order, then choose the middle one

$\text{Mean} = \frac{\text{total of items of data}}{\text{number of items of data}}$

Correlation S6

Positive correlation

Negative correlation



KS4 GCSE Mathematics Higher Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

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Listing strategies (N5)

Product rule for counting:
➔ **$4 \times 3 \times 2 \times 1 = 24$ ways to arrange the letters P, I, X and L**

Powers and roots (N6, N7)

Special indices: for any value a:

$$a^0 = 1$$
$$a^{-n} = \frac{1}{a^n}$$
$$a^{\left(\frac{p}{q}\right)} = \sqrt[q]{a^p}$$

➔ $3^{-4} = \frac{1}{3^4} = \frac{1}{81}$

➔ $8^{\left(\frac{2}{3}\right)} = \sqrt[3]{8^2} = 4$

Surds (N8)

Look for the biggest square number factor of the number:
➔ $\sqrt{80} = \sqrt{16 \times 5} = 4\sqrt{5}$

Rationalise the denominator (N8)

Multiply the numerator and denominator by an expression that makes the denominator an integer:

➔ $\frac{4}{\sqrt{7}} = \frac{4 \times \sqrt{7}}{\sqrt{7} \times \sqrt{7}} = \frac{4\sqrt{7}}{7}$

➔ $\frac{2}{4+\sqrt{5}}$

$= \frac{2}{4+\sqrt{5}} \times \frac{4-\sqrt{5}}{4-\sqrt{5}} = \frac{2(4-\sqrt{5})}{11}$

Standard form (N9)

Standard form numbers are of the form $a \times 10^n$, where $1 \leq a < 10$ and n is an integer.

Recurring decimals (N10)

Make a recurring decimal a fraction:
➔ $n = 0.2\dot{3}\dot{6}$
(two digits are in the recurring pattern, so multiply by 100)
$100n = 23.\dot{6}$
(this is the same as $23.6\dot{3}\dot{6}$)
$99n = 23.6\dot{3}\dot{6} - 0.2\dot{3}\dot{6} = 23.4$
$n = \frac{23.4}{99} = \frac{234}{990} = \frac{13}{55}$

Error intervals (N15)

Find the range of numbers that will round to a given value:
➔ $x = 5.83$ (2 decimal places)
$5.825 \leq x < 5.835$
➔ $y = 46$ (2 significant figures)
$45.5 \leq y < 46.5$
Note use of ≤ and <, and that the last significant figure of each is 5

Equations and identities (A3)

An equation is true for some particular value of x
➔ **$2x + 1 = 7$ is true if $x = 3$**
...but an identity is true for every value of x
➔ $(x+a)^2 \equiv x^2 + 2ax + a^2$
(note the use of the symbol ≡)

Laws of indices (A4)

For any value a:
$$a^x \times a^y = a^{x+y}$$
$$\frac{a^x}{a^y} = a^{x-y}$$
$$(a^x)^y = a^{xy}$$

➔ $\left(\frac{2pq^4}{p^3q}\right)^3 = \frac{8p^3q^{12}}{p^9q^3} = \frac{8q^9}{p^6}$ or $8q^9p^{-6}$

Difference of two squares (A4)

$$a^2 - b^2 = (a+b)(a-b)$$
➔ $x^2 - 25 = (x+5)(x-5)$

Rearranging a formula (A5)

The subject of a formula is the term on its own. Rearrange to
➔ **Make x the subject of**
$2x + ay = y - bx$
$2x + bx = y - ay$
$x(2+b) = y - ay$
$x = \frac{y - ay}{2+b}$

Functions (A7)

Combining functions:
$\mathrm{fg}(x) = \mathrm{f}(\mathrm{g}(x))$
➔ **If $\mathrm{f}(x) = x + 3$ and $\mathrm{g}(x) = x^2$**
$\mathrm{fg}(x) = x^2 + 3$
$\mathrm{gf}(x) = (x+3)^2$

The inverse of f is f^{-1}
➔ **If $\mathrm{f}(x) = 2x + 5$ then**
$\mathrm{f}^{-1}(x) = \frac{x-5}{2}$

$y = mx + c$ (A9)

Equation of straight line $y = mx + c$
m is the gradient; c is the y intercept:
➔ **Find the equation of the line that joins $(0, 3)$ to $(2, 11)$**
Find its gradient...
$\frac{11-3}{2-0} = \frac{8}{2} = 4$
...and its y intercept...
Passes through $(0, 3)$, so c = 3
Equation is $y = 4x + 3$

Parallel lines: gradients are equal; perpendicular lines: gradients are "negative reciprocals".
➔ **$y = 2x + 3$ and $y = 2x - 5$ are parallel to each other; $y = 2x + 3$ and $y = -\frac{1}{2}x + 3$ are perpendicular**

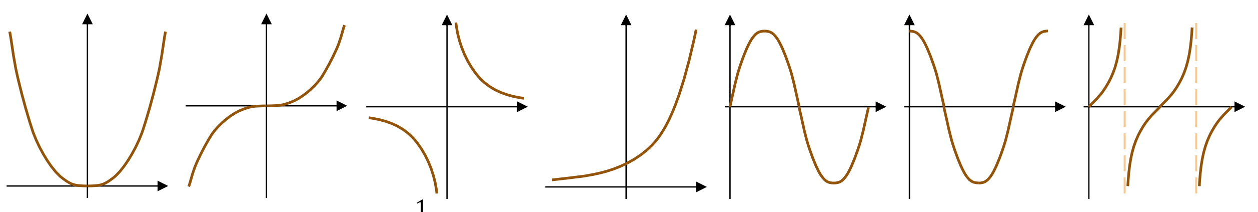
Transformations of curves (A13)

Starting with the curve $y = \mathrm{f}(x)$:
Translate $\binom{0}{a}$ for $y = \mathrm{f}(x) + a$
Translate $\binom{-a}{0}$ for $y = \mathrm{f}(x + a)$
Reflect in x axis for $y = -\mathrm{f}(x)$
Reflect y axis for $y = \mathrm{f}(-x)$

Velocity - time graph (A15)

Gradient = acceleration (you may need to draw a tangent to the curve at a point to find the gradient);
Area under curve = distance travelled.

Standard graphs (A12)



$y = x^2$ $y = x^3$ $y = \frac{1}{x}$ $y = a^x$ $y = \sin(x°)$ $y = \cos(x°)$ $y = \tan(x°)$

Quadratics (A11, A18)

If a quadratic equation cannot be factorised, use the formula
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
➔ **Solve $2x^2 + 3x - 7 = 0$**
$x = \frac{-3-\sqrt{9-(-56)}}{2\times2} = -2.73$
or $x = \frac{-3+\sqrt{9-(-56)}}{2\times2} = 1.23$

Complete the square to find the turning point of a quadratic graph.
➔ $y = x^2 - 6x + 2$
$y = (x-3)^2 - 9 + 2$
$y = (x-3)^2 - 7$
Turning point is at $(3, -7)$

Equation of a circle (A16)

$x^2 + y^2 = r^2$ is a circle with centre (0 ,0) and radius r.
➔ **$x^2 + y^2 = 25$ has centre $(0, 0)$ and radius 5**

Simultaneous equations (A19)

One linear, one quadratic;
➔ **Solve** $\begin{cases} x + 3y = 10 \\ x^2 + y^2 = 20 \end{cases}$
Rearrange the linear, and substitute into the quadratic
$x = 10 - 3y$
so $(10 - 3y)^2 + y^2 = 20$
Expand and solve the quadratic
$100 - 60y + 9y^2 + y^2 = 20$
$10y^2 - 60y + 80 = 0$
$y = 2$ or $y = 4$
Finally, substitute into the linear and solve, pairing values...
$x + 3 \times 2 = 10$ so $(x, y) = (4, 2)$
$x + 3 \times 4 = 10$ so $(x, y) = (-2, 4)$

Sequences (A24, A25)

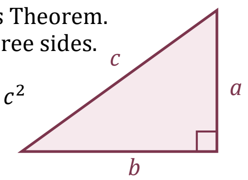
nth term of an arithmetic (linear) sequence is $bn + c$
➔ **nth term of 5, 8, 11, 14, ... is $3n$+2 (always increases by 3 first term is $3 \times 1 + 2 = 5$)**
nth term of a quadratic sequence is $an^2 + bn + c$
➔ **First three terms of $n^2 + 3n - 1$ are 3, 9, 17, ...**
Geometric sequence; multiply each term by a constant ratio
➔ **3, 6, 12, 24, ... (ratio is 2)**
Fibonacci sequence; make the next term by adding the previous two ...
➔ **2, 4, 6, 10, 16, 26, 42, ...**

Iteration (A20)

You will be given the formula to use:
➔ **Solve $x^3 + 6x + 4 = 0$ by using the iteration $x_{n+1} = \sqrt[3]{6x_n - 4}$**
Start with $x_1 = -2.8$
$x_2 = \sqrt[3]{6 \times (-2.8) - 4} = -2.750\ldots$
$x_3 = \sqrt[3]{6 \times (-2.750\ldots) - 4} = \cdots$
Repeat until you know the solution, or you do as many as the question says.

Right angled triangles (G20)

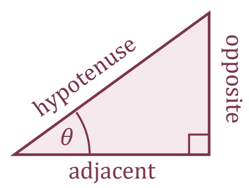
Pythagoras Theorem.
Links all three sides.
No angles.
$a^2 + b^2 = c^2$



Trigonometry.
Links two sides and one angle.
SOH | CAH | TOA

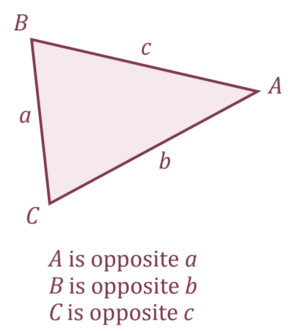
$\sin\theta = \frac{\text{opp}}{\text{hyp}}$ $\cos\theta = \frac{\text{adj}}{\text{hyp}}$ $\tan\theta = \frac{\text{opp}}{\text{adj}}$

Use "2ndF" or "SHIFT" key to find a missing angle



The longest side of any right angled triangle is the hypotenuse; check that your answer is consistent with this.

Advanced trigonometry (G21, G22)



A is opposite a
B is opposite b
C is opposite c

Sine Rule
Use if you are given an angle-side pair

Missing side: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Missing angle: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Cosine Rule
Use if you can't use the sine rule

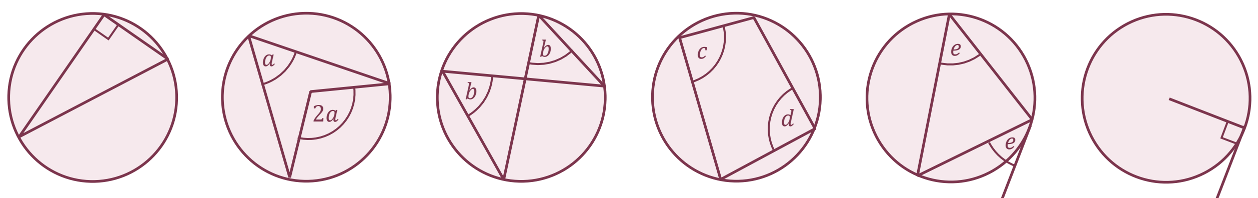
Missing side: $a^2 = b^2 + c^2 - 2bc\cos A$

Missing angle: $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Special values of sin, cos, tan
Learn (or be able to find without a calculator)...

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

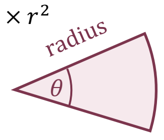
Circle theorems (G10)



Angle in a semicircle is 90° · Angle at the centre is double the angle at the circumference · Angles in the same segment are equal · Opposite angles in a cyclic quadrilateral total 180° · Alternate segment theorem · Tangent and radius are perpendicular

Areas and volumes (G16, G17, G18, G23)

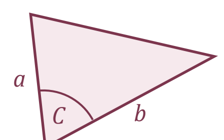
Circumference of circle = $\pi \times D$
Area of circle = $\pi \times r^2$

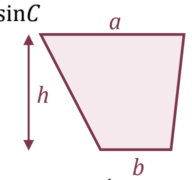


Arc length = $\frac{\theta}{360°} \times \pi \times D$

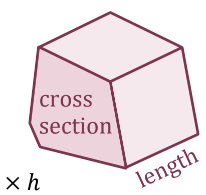
Area of sector = $\frac{\theta}{360°} \times \pi \times r^2$

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

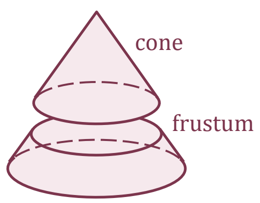




Area of trapezium = $\frac{1}{2}(a + b) \times h$



Volume of prism = area of cross section × length



Volume of cone = $\frac{1}{3}\pi r^2 h$
Volume of frustum is difference between the volumes of two cones

Transformations (G7, G8)

Reflection
• Line of reflection
Translation
• Vector

Rotation
• Centre of rotation
• Angle of rotation
• Clockwise or anticlockwise

Enlargement
• Centre of enlargement
• Scale factor (if −1 < SF < 1 the shape will get smaller).

Similar shapes (G19)

Ratios in similar shapes and solids:

• Length/perimeter	$1:n$	$a:b$
• Area	$1:n^2$	$a^2:b^2$
• Volume	$1:n^3$	$a^3:b^3$

Percentages: multipliers (R9, R16)

Percentage increase or decrease; use a multiplier (powers for repetition)
➔ **Initially there were 20 000 fish in a lake. The number decreases by 15% each year. Estimate the number of fish after 6 years.**
$20\,000 \times 0.85^6 = 7500$ (2sf)

Formula for compound interest
$$\text{Total accrued} = P\left(1 + \frac{r}{100}\right)^n$$
➔ **I invest £600 at 3% compound interest. What is my account worth after 5 years?**
$£600 \times \left(1 + \frac{3}{100}\right)^5 = £695.56$

Direct & inverse proportion (R10)

y is directly proportional to x:
$y = kx$ for a constant k
➔ **b is directly proportional to a^2**
$a = 6$ when $b = 90$ Find b if $a = 8$
$b = ka^2$ $a = 6$ and $b = 90$ for k
$90 = k \times 6^2$ so $k = 2.5, b = 2.5a^2$
$b = 2.5 \times 8^2 = 160$
y is inversely proportional to x
$yx = k$ or $y = \frac{k}{x}$ for a constant k

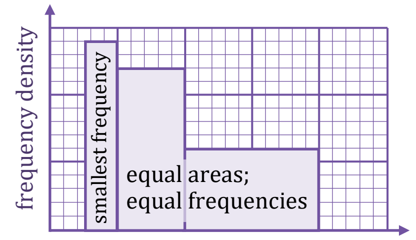
Probability rules (P8, P9)

Multiply for independent events
➔ **P(6 on dice and H on coin)**
$\frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$
Add for mutually exclusive events
➔ **P(5 or 6 on dice)**
$\frac{1}{6} + \frac{1}{6} = \frac{2}{6}$
Apply these rules to tree diagrams.

In general...
P(A or B) = P(A) + P(B) − P(A and B)
P(A and B) = P(A given B) × P(B)

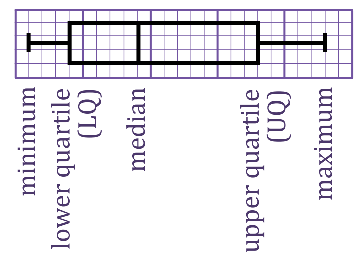
Histograms (S3)

Frequency = frequency density multiplied by class width. This means that bars with the same frequency have the same area.



Box plots (S4)

Interquartile range (IQR) = UQ − LQ



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