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 you need to know on 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
...or BODMAS. Use the correct order of operations; take care when using a calculator.
- Brackets
- Indices (or powers)
- Division and Multiplication
- Addition and Subtraction

Types of number
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
Highest Common Factor (HCF)
✚ Factors of 6 are 1, 2, 3, 6
Factors of 9 are 1, 3, 9
HCF of 6 and 9 is 3
Lowest Common Multiple (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
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
Special indices for any value a
$a^0 = 1$
$a^{-n} = \frac{1}{a^n}$

Calculating with fractions
Adding or subtracting fractions: use a common denominator...
Multiplying fractions: multiply numerators and denominators...
Dividing fractions: "flip" the second fraction, then multiply...

Fractions, decimals
Fraction is numerator ÷ denominator
Use place values to change decimals to fractions. Simplify where possible.
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
Look for the biggest square number factor of the number.
✚ $\sqrt{20} = \sqrt{4} \times \sqrt{5} = 2\sqrt{5}$

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

Standard units
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
Truncate the number, then use a "decider digit" to round up or down.
Decimal places: use the decimal point.
Significant figures: use the first non-zero digit.

Error intervals
Find the range of numbers that will round to a given value.
Note use of ≤ and <, and that the last significant figure of each is 5.

Algebraic notation
$ab = a \times b$
$3y = y + y + y$
$a^2 = a \times a$
$a^3 = a \times a \times a$
$a^2b = a \times a \times b$
$\frac{a}{b} = a \div b$

Equations and identities
An equation is true for some particular value of x
...but an identity is true for every value of x.

Laws of indices
For any value a
$a^m \times a^n = a^{m+n}$
$\frac{a^m}{a^n} = a^{m-n}$
$(a^m)^n = a^{mn}$

Standard graphs


y = mx + c
Equation of straight line $y = mx + c$ as m is the gradient, c is the y intercept.
✚ Find the equation of the line that joins (0, 3) and (2, 11).
Find its gradient...
...and its y intercept...
Parallel lines: gradients are equal.

Expanding brackets
Reverse of expanding is factorising: putting an expression into brackets.

Quadratics
Solve a quadratic by factorising.
Put into brackets (taking care with any negative numbers)...

Difference of two squares
$a^2 - b^2 = (a + b)(a - b)$

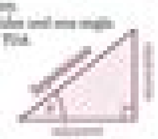
Simultaneous equations
Multiply to match a term in x or y...
Add or subtract to cancel...
Finally, substitute and solve...

Rearrange a formula
The subject of a formula is the term on its own. Use rules that "balance" the formula to change its subject.
Next, subtract 3y from both sides...
...then divide both sides by 2

Right-angled triangles
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



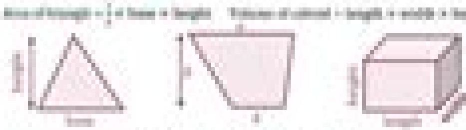
$\sin\theta = \frac{opp}{hyp}$ $\cos\theta = \frac{adj}{hyp}$ $\tan\theta = \frac{opp}{adj}$

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)...

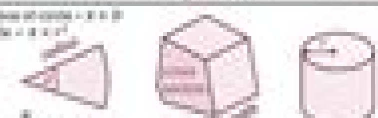
θ	$\sin\theta$	$\cos\theta$	$\tan\theta$
0	0	1	0
30	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$
45	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	1
60	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$
90	1	0	

Area and volumes
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 = $\pi \times r^2$



Volume of cylinder = πr^2 × height
Volume of prism = area of cross section × length

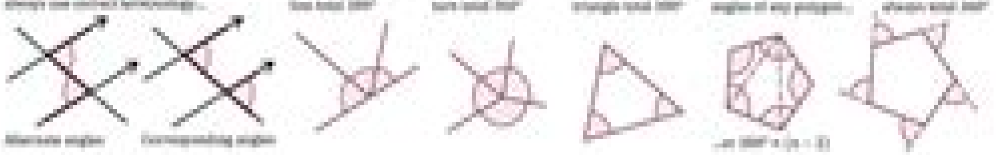
Transformations
Reflection
- Line of reflection

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
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°



Sequences
Triangular numbers
Square numbers ($n^2 = n \times n$)
Cube numbers ($n^3 = n \times n \times n$)
nth term of an arithmetic (linear) sequence is $an + d$
Geometric sequence: multiply each term by a constant ratio.
Fibonacci sequence: make the next term by adding the previous two...

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

Probability rules
Multiply for independent events
Add for mutually exclusive events
Apply these rules to tree diagrams

Parts of a circle


Dividing using ratio
Use a ratio for unequal sharing

Ratio and fractions
Link between ratio and fractions

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

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

Averages
Mode: most frequently occurring
Median: put the data in numerical order, then choose the middle one
Mean = $\frac{\text{total of items of data}}{\text{number of items of data}}$

Correlation
Positive correlation
Negative correlation

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