

Part 66 Module 1 — Maths Formula Cheat Sheet

Module 1.1 — Arithmetic

Order of operations & signs

- **BIDMAS / BODMAS:** Brackets → Indices → Division/Multiplication → Addition/Subtraction.
- Two like signs give +; two unlike signs give −. $(-a) \times (-b) = +ab$.
- $\approx$ means approximately equal; $=$ means exactly equal.

Fractions

- Add/subtract: put over a common denominator first.
- Multiply: $a/b \times c/d = ac/bd$. Divide: multiply by the reciprocal — $a/b \div c/d = a/b \times d/c$.
- Reciprocal of a fraction = flip it ($a/b \rightarrow b/a$).
- Always cancel to lowest terms at the end.

Fractions ↔ decimals ↔ percentages

- Fraction → decimal: divide numerator by denominator.
- Decimal → fraction: write over a power of ten, then cancel.
- Percentage → fraction: over 100 and cancel. Percentage → decimal: $\div 100$.

Factors & multiples

- **HCF** = largest number that divides both exactly.
- **LCM** = smallest number both divide into exactly.
- Prime = only factors are 1 and itself; composite has others.

Ratio & proportion

- Sharing: add the parts → one part = total $\div$ sum of parts → scale each.
- Simplify a ratio by dividing every part by their common factor.
- Direct proportion: cross-multiply to find the unknown.

Percentages

- Percentage of an amount: $(\% \div 100) \times \text{amount}$.
- Increase: add it on. Decrease: take it away.
- As a percentage: $(\text{part} \div \text{whole}) \times 100$.

Averages

- **Mean** = sum of values $\div$ number of values.
- **Median** = middle value in order. **Mode** = most frequent.
- **Range** = largest – smallest.

Powers, indices & roots

- Multiply same base: add indices ($a^m \times a^n = a^{m+n}$). Divide: subtract.
- Power of a power: multiply indices ($(a^m)^n = a^{mn}$). $a^0 = 1$.
- Negative index: $a^{-n} = 1 \div a^n$. Fractional: $a^{m/n} = \sqrt[n]{a^m}$.
- Squaring = $n \times n$; cubing = $n \times n \times n$. A root reverses this.

Scientific / standard form

- Write as a number 1 to $<10 \times$ a power of ten (e.g. 4.7×10^3).
- Multiplying: multiply the fronts, add the powers, renormalise the front to 1–9.99.

Units & conversions

- Multiply by the conversion factor — check which way it goes.
- Metric prefixes step in $\times 1000$ (...milli → unit → kilo → mega...).
- Area $\times (10^n)^2$; volume $\times (10^n)^3$. $1 \text{ m}^2 = 10\,000 \text{ cm}^2$; $1 \text{ m}^3 = 1\,000\,000 \text{ cm}^3$.

Areas, perimeters & volumes

- Rectangle = $l \times w$. Triangle = $\frac{1}{2} \times \text{base} \times \text{height}$.
- Circle: area = πr^2 ; circumference = $2 \pi r (= \pi d)$.
- Cuboid = $l \times w \times h$. Cube = side^3 . Cylinder = $\pi r^2 \times h$.
- Sphere: volume = $\frac{4}{3} \pi r^3$; surface area = $4 \pi r^2$.

Denominated numbers

- Time: 60 min = 1 hour — carry/borrow at 60.
- Length: 12 inches = 1 foot — carry/borrow at 12.
- Angles: 60 minutes = 1 degree — carry/borrow at 60.

Module 1.2 — Algebra

Expressions

- Collect like terms (same letter and power).
- Evaluate: substitute the numbers for the letters, then use BIDMAS.
- Expand a bracket: multiply the outside term by each inside term.
- Two brackets (FOIL): $(a+b)(c+d) = ac + ad + bc + bd$.

Algebraic fractions

- Same denominator: combine numerators, then simplify.
- Different denominators: rewrite over a common denominator first.
- Simplify by factorising, then cancelling common factors.

Linear equations & transposition

- Expand brackets, gather the unknown on one side, then divide.
- Do the same operation to both sides to keep the balance.
- Rearranging: undo each operation in reverse; square to clear a $\sqrt{}$, multiply up to clear a denominator.

Index laws

- $x^m \times x^n = x^{m+n}$; $x^m \div x^n = x^{m-n}$; $(x^m)^n = x^{mn}$.
- $x^{-n} = 1/x^n$; $x^{1/n} = \sqrt[n]{x}$; $x^0 = 1$.

Simultaneous equations

- Eliminate one unknown by adding/subtracting the two equations...
- ...or substitute one equation into the other, then solve.

Quadratics (second-degree)

- Factorise into two brackets, then set each = 0.
- Pure x^2 : isolate x^2 , take the square root of both sides (remember $\pm$).
- **Formula:** $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
- Discriminant = $b^2 - 4ac$ (positive → 2 roots, 0 → 1, negative → none real).

Logarithms

- A log asks: base to what power gives this? $\log_a x = y \Leftrightarrow a^y = x$.
- $\log(ab) = \log a + \log b$; $\log(a/b) = \log a - \log b$; $\log(a^n) = n \log a$.
- $\ln = \log$ base e ; $\ln(e) = 1$; $\ln(1) = 0$.

Part 66 Module 1 — Maths Formula Cheat Sheet

Number systems

- Binary → decimal: add place values (1,2,4,8,16...) where there is a 1.
- Decimal → binary: divide by 2 repeatedly, read remainders bottom-up.
- Hex digits A-F = 10-15; each place a power of 16. Octal uses powers of 8.

Rounding & significant figures

- Look at the next digit: 5 or more rounds up, otherwise down.
- Count significant figures from the first non-zero digit.

Module 1.3 — Geometry & trigonometry

Angles & polygons

- Angles on a straight line = 180° ; around a point = 360° .
- Angles in a triangle = 180° .
- Polygon interior angle sum = $(n - 2) \times 180^\circ$.
- Exterior angles sum = 360° ; each one (regular) = $360^\circ \div n$.

Shape properties

- Equilateral = 3 equal sides & angles; isosceles = 2 equal; scalene = none.
- Lines of symmetry = lines a shape reflects onto itself.

Pythagoras' theorem

- $a^2 + b^2 = c^2$, where c is the hypotenuse (longest side).
- Missing leg: $a = \sqrt{c^2 - b^2}$.
- Right-angled if $a^2 + b^2 = c^2$ holds.

Trigonometry ratios

- **SOH-CAH-TOA:** $\sin = O/H$, $\cos = A/H$, $\tan = O/A$.
- Find an angle: apply the inverse — $\sin^{-1}$, $\cos^{-1}$ or $\tan^{-1}$.

Standard trig values

- $\sin$: $0^\circ=0$, $30^\circ=0.5$, $45^\circ=\sqrt{2}/2$, $60^\circ=\sqrt{3}/2$, $90^\circ=1$.
- $\cos$: the reverse ($0^\circ=1$... $90^\circ=0$).
- $\tan$: $0^\circ=0$, $30^\circ=1/\sqrt{3}$, $45^\circ=1$, $60^\circ=\sqrt{3}$, $90^\circ=\text{undefined}$.

Radians

- π radians = 180° .
- Degrees → radians: $\times \pi/180$. Radians → degrees: $\times 180/\pi$.

Coordinate geometry

- Straight line: $y = mx + c$ (m = gradient, c = y-intercept).
- Gradient = change in y ÷ change in x.
- Midpoint = (average of x's, average of y's).
- Distance = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

Polar coordinates

- From (x, y): $r = \sqrt{x^2 + y^2}$.
- Angle $\theta = \tan^{-1}(y / x)$.