FORMULAS YOU MUST MEMORISE

Cambridge IGCSE Mathematics (0580)

Not on the 0580 list of formulas: learn these by heart. Ext = Extended tier only.

★ Not given in the exam: learn every formula on this page. The full sheet and the booklet have the rest. Ext Extended tier only.

Number

★ **Indices:** $a^m \times a^n = a^{m+n}$, $a^m \div a^n = a^{m-n}$, $(a^m)^n = a^{mn}$, $a^0 = 1$, $a^{-n} = \frac{1}{a^n}$
When: Simplify and evaluate powers without a calculator

★ **Fractional indices** Ext: $a^{\frac{1}{n}} = \sqrt[n]{a}$, $a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m$
When: Evaluate zero, negative and fractional indices

★ **Standard form:** $A \times 10^n$, $1 \le A < 10$, $n \in \mathbb{Z}$
When: Calculate in standard form with and without a calculator

★ **Sets:** $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
When: Venn diagrams with two and three sets

★ **Percentage change:** $\frac{\text{new} - \text{original}}{\text{original}} \times 100\%$
When: Percentage increases, decreases and changes

★ **Reverse percentage** Ext: $\text{original} = \frac{\text{new}}{1 \pm \frac{r}{100}}$
When: Finding the price before a rise or a discount

★ **Simple interest (rate r% a year, n years):** $I = \frac{Prn}{100}$
When: Simple interest; find the rate or the number of years

★ **Compound interest:** $A = P\left(1 + \frac{r}{100}\right)^n$
When: Savings, depreciation and population questions

★ **Growth and decay** Ext: $y = a \times k^n$: $k > 1$ growth, $0 < k < 1$ decay
When: Exponential growth and decay, such as depreciation

★ **Surds** Ext: $\sqrt{ab} = \sqrt{a}\sqrt{b}$, $\frac{a}{\sqrt{b}} = \frac{a\sqrt{b}}{b}$, $\frac{1}{c+\sqrt{b}} = \frac{c-\sqrt{b}}{c^2-b}$
When: Simplify surds; rationalise denominators

★ **Recurring decimal:** $x = 0.\dot{4}\dot{5}$, so $100x - x = 45$ and $x = \frac{45}{99} = \frac{5}{11}$ Ext
When: Convert recurring decimals into fractions using algebra

★ **Bounds: a value to the nearest u lies in** $\left[x - \frac{u}{2},\ x + \frac{u}{2}\right)$
When: Rounding and accuracy questions

★ **Bounds in calculations: for the largest $a - b$ or $a \div b$ use the upper bound of a with the lower bound of b** Ext
When: Greatest possible area or least possible speed

★ **Rates:** $\text{speed} = \frac{\text{distance}}{\text{time}}$, $\text{density} = \frac{\text{mass}}{\text{volume}}$, $\text{pressure} = \frac{\text{force}}{\text{area}}$
When: Average speed for journeys with several stages

Algebra & graphs

★ **Completing the square** Ext: $x^2 + bx + c = \left(x + \frac{b}{2}\right)^2 - \frac{b^2}{4} + c$
When: Completed-square form; turning points

★ **Difference of two squares** Ext: $a^2 - b^2 = (a+b)(a-b)$
When: Factorise quadratics such as $9x^2 - 16$

★ **Linear sequence, nth term:** $u_n = a + (n-1)d$
When: Finding a rule and a term of a sequence

★ **Exponential sequence** Ext: $u_n = ar^{n-1}$
When: nth term of exponential sequences such as 3, 6, 12, 24

★ **Proportion** Ext: $y \propto x^n \Rightarrow y = kx^n$; $y \propto \frac{1}{x^n} \Rightarrow y = \frac{k}{x^n}$
When: Direct and inverse proportion: find the constant

★ **Functions** Ext: $fg(x) = f(g(x))$; f^{-1}: swap x, y and rearrange
When: Composite and inverse functions; solve $fg(x) = 7$

★ **Inequalities: multiplying or dividing by a negative number reverses the sign**
When: Solve linear inequalities; list integer values

★ **Straight line:** $y = mx + c$, **gradient m, y-intercept c; vertical line $x = k$**
When: Equations of straight lines from graphs and descriptions

★ **Gradient from two points** Ext: $m = \frac{y_2 - y_1}{x_2 - x_1}$
When: Gradient from a graph or two points

★ **Midpoint; length** Ext: $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$, $\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$
When: Coordinate geometry

★ **Parallel lines:** $m_1 = m_2$
When: Line parallel to a given line through a given point

★ **Perpendicular lines** Ext: $m_1 \times m_2 = -1$
When: Perpendicular lines and perpendicular bisectors

★ **Differentiation** Ext: $y = ax^n \Rightarrow \frac{dy}{dx} = anx^{n-1}$
When: Gradients of curves and finding maximum and minimum points

★ **Turning points:** $\frac{dy}{dx} = 0$; **the gradient of the curve at $x = a$ is the value of** $\frac{dy}{dx}$ **at a** Ext
When: Find stationary points; maximum or minimum

Trigonometry & vectors

★ **Pythagoras:** $a^2 + b^2 = c^2$
When: Any right-angled triangle, in 2D or 3D

★ **SOHCAHTOA:** $\sin\theta = \frac{\text{opp}}{\text{hyp}}$, $\cos\theta = \frac{\text{adj}}{\text{hyp}}$, $\tan\theta = \frac{\text{opp}}{\text{adj}}$
When: Sides and angles in right-angled triangles, bearings, and elevation

★ **Bearings: measured clockwise from north, written with 3 figures**
When: Bearings with Pythagoras and trigonometry

★ **Exact values** Ext: $\sin 30° = \frac{1}{2}$, $\cos 60° = \frac{1}{2}$, $\tan 45° = 1$, $\sin 60° = \frac{\sqrt{3}}{2}$, $\sin 45° = \frac{\sqrt{2}}{2}$
When: Problems without a calculator using exact values

★ **Obtuse angles** Ext: $\sin(180° - x) = \sin x$, $\cos(180° - x) = -\cos x$
When: The sine rule when the angle may be obtuse

★ **Vectors: add and subtract column vectors component by component;** $k\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} kx \\ ky \end{pmatrix}$ Ext
When: Add, subtract and multiply vectors by scalars

★ **Magnitude; position vectors** Ext: $\left|\begin{pmatrix} x \\ y \end{pmatrix}\right| = \sqrt{x^2 + y^2}$, $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$
When: Vector questions on Papers 2 and 4

Geometry & mensuration

★ **Angles: on a straight line 180°; around a point 360°; in a triangle 180°**
When: Missing angles with a geometric reason for each step

★ **Polygons (n sides):** interior sum $= (n-2) \times 180°$, exterior angle (regular) $= \frac{360°}{n}$
When: Interior and exterior angles of polygons

★ **Circle theorems: angle in a semicircle = 90°; tangent ⊥ radius**
When: Angle in a semicircle and tangent–radius angles

★ **More circle theorems: angle at centre = 2 × angle at circumference; angles in the same segment are equal; opposite angles of a cyclic quadrilateral sum to 180°; alternate segment theorem; tangents from a point are equal; the perpendicular bisector of a chord passes through the centre** Ext
When: Angles at the centre, same segment, cyclic quadrilaterals

★ **Parallelogram; trapezium:** $A = bh$; $A = \frac{1}{2}(a+b)h$
When: Area and composite-shape questions

★ **Arc; sector (angle θ):** $\text{arc} = \frac{\theta}{360} \times 2\pi r$, $\text{sector} = \frac{\theta}{360} \times \pi r^2$
When: Sectors with the angle in degrees

★ **Similar shapes, scale factor k: lengths $\times k$**
When: Missing lengths in similar shapes

★ **Similar shapes: areas $\times k^2$, volumes $\times k^3$** Ext
When: Scaling areas and volumes of similar shapes and solids

Probability & statistics

★ **Probability:** $P(\text{not } A) = 1 - P(A)$; expected frequency $= n \times P(A)$
When: Single events and $P(\text{not } A) = 1 - P(A)$

★ **Relative frequency:** $\frac{\text{frequency of the outcome}}{\text{number of trials}}$
When: Estimate probabilities; expected frequencies

★ **Mutually exclusive:** $P(A \text{ or } B) = P(A) + P(B)$
When: Combined events from sample spaces and Venn diagrams

★ **Independent:** $P(A \text{ and } B) = P(A) \times P(B)$
When: Tree diagrams for combined events

★ **Conditional** Ext: $P(A \mid B) = \frac{P(A \cap B)}{P(B)}$
When: Probability of A given that B has happened

★ **Tree diagrams: multiply along branches, add the outcomes you want**
When: Tree diagrams with and without replacement

★ **Without replacement: the second-branch probabilities change (one fewer item)** Ext
When: Selections without replacement

★ **Mean from a frequency table:** $\bar{x} = \frac{\sum fx}{\sum f}$
When: Mean, median and mode from frequency tables

★ **Estimated mean, grouped data (class midpoints m)** Ext: $\bar{x} \approx \frac{\sum fm}{\sum f}$
When: Estimate the mean of grouped data with midpoints

★ **Median position (n values in order):** $\frac{n+1}{2}$th value
When: Mean, median, mode and range of discrete data

★ **Range: largest − smallest**
When: Compare two data sets with an average and a spread

★ **Interquartile range** Ext: $Q_3 - Q_1$
When: Compare the spread of two data sets

★ **Histogram** Ext: $\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$
When: Drawing and reading histograms

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