IGCSE MATHEMATICS 0580 · FORMULA SHEET · ~10 MIN READ

Maths Formula & Method Sheet

Every formula you must be able to write down from memory, drawn where a picture helps, plus the first move for the most common question types. One sheet for the night before.

Number | Algebra | Geometry | Mensuration | Trigonometry | Statistics | Probability

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No tag = **Core** (everyone) EXTENDED Extended only highlight = comes up again and again
HANDY worth memorising Test yourself at the end

IN 30 SECONDS

- **Learn these cold:** percentage change, indices, gradient, angle rules, area and volume, and SOH CAH TOA. Each one saves you thinking time on every paper.
- **Some formulas are printed on your paper** (such as the curved areas and volumes of a cone, sphere and pyramid, and for Extended the quadratic formula and the sine and cosine rules). You still need to **rearrange and use them correctly**.
- **Method marks:** write the formula, substitute, then calculate. Keep full calculator values and round only at the end (3 significant figures, angles to 1 decimal place).

1 Number

Percentages, ratio and speed

$$\text{percentage change} = \frac{\text{change}}{\text{original}} \times 100$$

always divide by the ORIGINAL value

$$\text{original} = \frac{\text{new amount}}{\text{multiplier}}$$

reverse percentage. After a 20% rise the multiplier is 1.2

$$\text{compound interest: final} = P\left(1 + \frac{r}{100}\right)^n$$

P = start amount, r = % rate, n = years

$$\text{simple interest} = \frac{P \times r \times n}{100}$$

the same amount is added every year

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

also density = $\frac{\text{mass}}{\text{volume}}$

- **Multipliers:** a 15% increase is × 1.15. A 15% decrease is × 0.85.
- **Ratio:** add the parts to get the total. Share 40 in the ratio 3 : 5 → 40 ÷ 8 = 5, so 15 and 25.
- **Average speed** = total distance ÷ total time. It is never the mean of two speeds.

Indices, surds and bounds

$$a^m \times a^n = a^{m+n}$$

add the powers when you multiply

$$a^m \div a^n = a^{m-n}$$

subtract the powers when you divide

$$(a^m)^n = a^{mn}$$

multiply the powers

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

a negative power means the reciprocal

$$a^{1/n} = \sqrt[n]{a}$$

a fractional power is a root. Also $a^0 = 1$

- **Standard form** is $a \times 10^n$ with $1 \le a < 10$. For example $45\,000 = 4.5 \times 10^4$ and $0.0006 = 6 \times 10^{-4}$.
- **Bounds:** go half a unit either side. A length of 8.4 cm (1 d.p.) has $8.35 \le$ length < 8.45.
- **Surds** EXT : $\sqrt{12} = 2\sqrt{3}$, and to rationalise $\frac{1}{\sqrt{3}}$ multiply top and bottom by $\sqrt{3}$ to get $\frac{\sqrt{3}}{3}$.

2 Algebra

Expanding, factorising and solving

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

and $(a - b)^2 = a^2 - 2ab + b^2$. Never $a^2 + b^2$

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

difference of two squares

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

for $ax^2 + bx + c = 0$ EXT

$$x^2 + bx = (x + \frac{b}{2})^2 - (\frac{b}{2})^2$$

completing the square EXT

- **The discriminant** $b^2 - 4ac$ tells you the roots EXT : positive means 2 real roots, zero means 1 repeated root, negative means no real roots.
- **Inequalities:** flip the sign when you multiply or divide by a negative number.

Sequences and straight lines

$$\text{nth term} = a + (n - 1)d$$

arithmetic sequence, first term a, common difference d

$$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

and the line is $y = mx + c$

$$\text{midpoint} = (\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$$

the mean of the coordinates

$$\text{length} = \sqrt{((x_2 - x_1)^2 + (y_2 - y_1)^2)}$$

Pythagoras between two points

- **Parallel lines** have the same gradient. **Perpendicular lines** have gradients that multiply to −1.

Variation and calculus EXTENDED

- **Direct proportion:** $y = kx$, or $y = kx^2$. **Inverse proportion:** $y = k/x$, or $y = k/x^2$. Find k from one pair of values first.

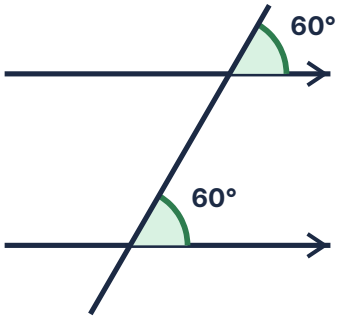
$$d/dx\,(ax^n) = nax^{n-1}$$

multiply by the power, then reduce the power by 1

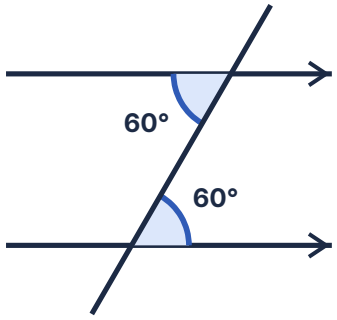
- **Turning points** are where $dy/dx = 0$. The gradient of a curve at a point is dy/dx there.
- **Functions:** $f(g(x))$ means do g first. For $f^{-1}(x)$, swap x and y and rearrange.

3 Geometry and mensuration

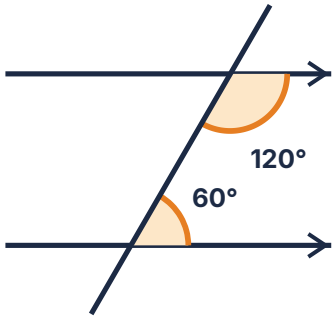
Angles and polygons



Corresponding (F)
angles are equal
same position



Alternate (Z)
angles are equal
inside, opposite sides



Co-interior (C)
angles add up to 180°
inside, same side

Parallel lines give three pairs of equal or supplementary angles. Name the rule in your answer.

- **Straight line** 180° · **around a point** 360° · **vertically opposite** angles are equal · **triangle** 180° · **quadrilateral** 360°.
- **Exterior angle of a triangle** = the sum of the two opposite interior angles.

$$\text{interior angles add up to } (n-2)\times 180^\circ$$

n = number of sides

$$\text{exterior angle of a regular polygon} = \frac{360^\circ}{n}$$

interior angle = 180° − exterior angle

- **Congruent triangles:** SSS, SAS, ASA or AAS, and RHS.

- **Similar shapes:** if the length scale factor is k, areas scale by k^2 and volumes by k^3.

Circle theorems

EXTENDED

- **Angle in a semicircle** = 90°. **Angle at the centre** = 2 × the angle at the circumference.
- **Angles in the same segment** are equal. **Opposite angles of a cyclic quadrilateral** add to 180°.
- **A tangent** is at 90° to the radius. Two tangents from one point are equal in length.
- **Alternate segment theorem:** the angle between a tangent and a chord = the angle in the alternate segment.

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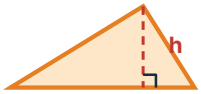
Area and perimeter

Rectangle



A = l × w
P = 2(l + w)

Triangle



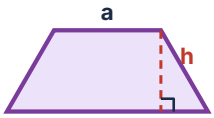
A = ½ × b × h
h is at right angles to b

Parallelogram



A = b × h
h is the vertical height

Trapezium



A = ½(a + b) × h
a and b are parallel

Circle



A = πr²
C = 2πr (or πd)

Sector



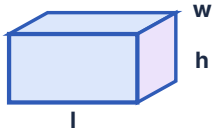
r
arc = θ/360 × 2πr
area = θ/360 × πr²

Area is always in squared units. Sector and arc use the fraction θ/360 of the whole circle.

- **Compound shapes:** split into rectangles, triangles and circles, or subtract a hole from a larger shape.

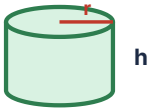
Volume and surface area

Prism and cuboid



V = area of end × length
cuboid: V = l × w × h

Cylinder



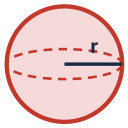
V = πr²h
curved area = 2πrh
+ 2 circles = 2πr²

Cone



V = ⅓πr²h
curved area = πrl
l is the slant height

Sphere



V = 4/3 × πr³
A = 4πr²

Pyramid



V = ⅓ × base area × h
h is the vertical height

Units to remember

1 m = 100 cm = 1000 mm
1 m² = 10 000 cm²
1 m³ = 1 000 000 cm³
1 cm³ = 1 ml
1000 cm³ = 1 litre
1 litre = 1000 ml

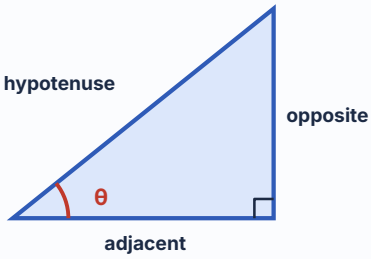
Volume is in cubed units. Prisms, cylinders and cuboids all use area of cross-section × length.

- **Total surface area:** cylinder = 2πrh + 2πr². Cone = πrl + πr². Add or leave out the circle(s) carefully.
- **Slant height of a cone:** $l^2 = r^2 + h^2$ by Pythagoras.
- **Same units first:** convert everything to cm (or m) before you calculate.

4 Trigonometry

Right-angled and non-right-angled triangles

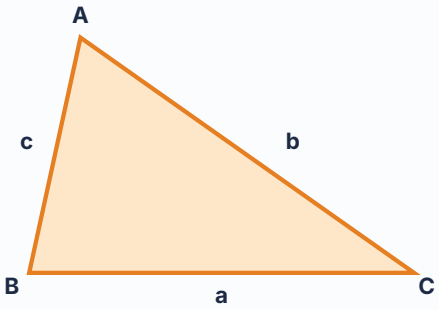
Right-angled triangles



sin θ = opp ÷ hyp
cos θ = adj ÷ hyp
tan θ = opp ÷ adj

SOH CAH TOA

Any triangle



sine rule: a/sin A = b/sin B = c/sin C
cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$
area = ½ ab sin C

sides a, b, c are opposite A, B, C

Label the hypotenuse first, then the opposite and adjacent sides relative to the angle you are using.

angle	0°	30°	45°	60°	90°
sin	0	1/2	√2/2	√3/2	1
cos	1	√3/2	√2/2	1/2	0
tan	0	1/√3	1	√3	undefined

- **Pythagoras:** $a^2 + b^2 = c^2$, where c is the hypotenuse. Subtract to find a shorter side.
- **Bearings** are measured clockwise from North, using three figures (for example 045° or 270°).
- **Angle of elevation** is measured up from the horizontal. **Angle of depression** is measured down from it.
- **Graphs:** sin x and cos x repeat every 360° and lie between −1 and 1. tan x repeats every 180°. EXT

5 Statistics and probability

Statistics

$$\text{mean} = \frac{\Sigma(f \times x)}{\Sigma f}$$

for grouped data use the midpoints, and the answer is an estimate

$$\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$$

in a histogram the area of a bar is the frequency EXT

$$\text{pie chart angle} = \frac{\text{frequency}}{\text{total}} \times 360°$$

and the angles add to 360°

- **Quartiles** EXT: Q1 is at position (n + 1) ÷ 4, the median at (n + 1) ÷ 2 and Q3 at 3(n + 1) ÷ 4. IQR = Q3 − Q1.
- **Cumulative frequency** EXT: plot at the upper class boundary and read at ¼n, ½n and ¾n.
- **Scatter graphs:** draw a straight line of best fit through the middle of the points. Do not predict outside the data.

Probability

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

outcomes must be equally likely

- **P(not A) = 1 − P(A).** Probabilities are between 0 and 1, never a ratio.
- **Independent events:** P(A and B) = P(A) × P(B). **Mutually exclusive:** P(A or B) = P(A) + P(B).
- **Expected frequency** = probability × number of trials.
- **Without replacement** EXT : the denominators drop by 1 on the second set of branches.

6 Quick methods

Question → first move

If you see	Do this first
show that	write every step. The last line must equal the value in the question
simplify fully	factorise top and bottom, then cancel
bounds	half the rounding unit either side
reverse percentage	divide by the multiplier
two sides and the angle between them	cosine rule
a side and the angle opposite it	sine rule
find an angle in a right-angled triangle	$\sin^{-1}$, $\cos^{-1}$ or $\tan^{-1}$
similar shapes, area or volume	square or cube the length scale factor
turning point EXT	differentiate and set dy/dx = 0
histogram EXT	the area of a bar is the frequency
cumulative frequency EXT	read at ¼n, ½n and ¾n
no calculator	write each step. Use exact values such as π and surds

EXAM TIP

Being given a formula is not enough. Practise rearranging, for example r from $V = 4/3\ \pi r^3$: $r = \sqrt[3]{(3V \div 4\pi)}$.

7 Test yourself

Test yourself — cover the answers first

QUICK CHECK

1. Write the formula for percentage change.
2. A price rises by 20% to $60. What was the original price?
3. Write $a^m \times a^n$ as a single power.
4. What is a^{-2} as a fraction?
5. Give the gradient formula for two points.
6. What is the sum of the interior angles of a hexagon?
7. Write the area of a trapezium.
8. Write the volume of a cone and a sphere.
9. Write sin, cos and tan as ratios.
10. EXT Write the cosine rule for side a.
11. EXT Write the quadratic formula.
12. EXT Differentiate $5x^3$.

Show answers

1. change ÷ original × 100
2. $50 (60 ÷ 1.2)
3. a^{m+n}
4. $1 \div a^2$
5. $(y_2 - y_1) \div (x_2 - x_1)$
6. 720°
7. $\frac{1}{2}(a + b) \times h$
8. $\frac{1}{3}\pi r^2 h$ and $4/3\ \pi r^3$
9. opp ÷ hyp, adj ÷ hyp, opp ÷ adj
10. $a^2 = b^2 + c^2 - 2bc \cos A$
11. $x = (-b \pm \sqrt{(b^2 - 4ac)}) \div 2a$
12. $15x^2$

Stuck on a question?

Send it to me on WhatsApp. I read every message.

Want regular help? Send this to your parent →

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