

Geometry and trigonometry

Edexcel IGCSE Maths (4MA1) · Knowledge organiser

KEY DEFINITIONS

Scale Drawings and Bearings

Bearings are 3-figure angles measured clockwise from North. Back-bearing = original $\pm 180^\circ$.

Pythagoras' Theorem

Pythagoras: in a right-angled triangle, $a^2 + b^2 = c^2$ (c = hypotenuse).

Sine and Cosine Rules

For triangles without a right angle: sine rule $a/\sin A = b/\sin B$, cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$, area = $\frac{1}{2}ab \sin C$.

Vectors

A vector has size and direction. Add column vectors component by component; parallel vectors are multiples of each other.

YOU SHOULD BE ABLE TO...

- Use the relationship between speed, distance and time to solve problems, including converting between units such as km/h and m/s.
- Calculate the perimeter and area of triangles, parallelograms and trapezia, and find missing lengths from a given area.
- Solve problems with angles of elevation and depression and with bearings by drawing right-angled triangles and using trigonometry.
- Use the area scale factor k^2 for similar shapes to find missing areas or lengths, such as the area of an enlarged photograph.
- Use the cosine rule to find a missing side, or an angle when all three sides are known, in triangles that are not right-angled.
- Write geometric proofs using angle facts, congruence and circle theorems, giving a clear reason for every step of the argument.

COMMON MISTAKES

- ✗ Similar shapes: length scale factor used for area or volume
- ✗ Circle theorems: reasons not in the recognised wording
- ✗ Confusing alternate and co-interior angles
- ✗ Using $360 \div n$ for the interior angle

KEY FORMULAS

B = given in the exam (formula booklet or list); learn the rest.

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

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

Sine rule **B** $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule **B** $a^2 = b^2 + c^2 - 2bc \cos A$

Area of a triangle **B** $\frac{1}{2}ab \sin C$

Exact values $\sin 30^\circ = \frac{1}{2}$, $\cos 60^\circ = \frac{1}{2}$, $\tan 45^\circ = 1$,
 $\sin 60^\circ = \frac{\sqrt{3}}{2}$, $\sin 45^\circ = \frac{\sqrt{2}}{2}$

Polygons (n sides) interior sum = $(n - 2) \times 180^\circ$,
exterior angle (regular) = $\frac{360^\circ}{n}$

Areas triangle $\frac{1}{2}bh$, parallelogram bh

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

Circle $C = 2\pi r = \pi d$, $A = \pi r^2$

Arc; sector arc = $\frac{\theta}{360} \times 2\pi r$, sector = $\frac{\theta}{360} \times \pi r^2$

Prism; cylinder **B** $V = \text{cross-section} \times \text{length}$; $V = \pi r^2 h$,
curved $A = 2\pi r h$

Cone (slant l) **B** $V = \frac{1}{3}\pi r^2 h$, curved $A = \pi r l$

Sphere **B** $V = \frac{4}{3}\pi r^3$, $A = 4\pi r^2$

Pyramid $V = \frac{1}{3} \times \text{base area} \times h$

Similar shapes, scale factor k lengths $\times k$, areas $\times k^2$, volumes $\times k^3$

More on the full formula sheet.

WORKED EXAMPLE

Find the area of a triangle with sides 7 cm and 9 cm and included angle 40° .

1. $\frac{1}{2} \times 7 \times 9 \times \sin 40^\circ = 20.2 \text{ cm}^2$ (3 s.f.).