



Foundation Tier GCSE Mathematics – **Given formulae** details section 1.

1. Students are **not** expected to know the following formulae included in the subject content; they are given these on the formulae sheet insert in the exam for 2025. **Students should know how to use these formulae.** Students should refer to the formulae sheet insert that they have been given to see how these are presented on this insert.

Circumference and area of a circle

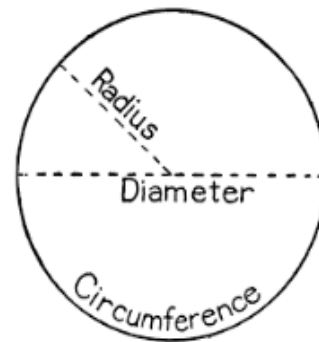
Where r is the radius and d is the diameter:

Circumference of a circle (the perimeter)

$$C = \pi d \text{ or } C = 2\pi r \quad (\text{because } d = 2r)$$

Area of a circle

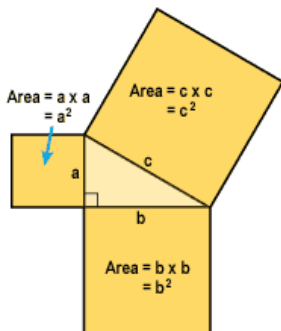
$$A = \pi r^2$$



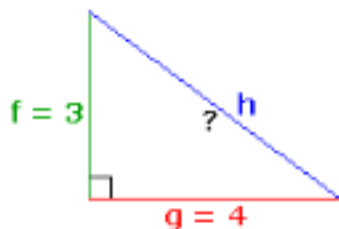
Pythagoras' theorem

This only applies in right angled triangles and used to find a missing side length when the other two side lengths are known. In any right-angled triangle where a , b and c are lengths of the sides and c is the hypotenuse (the longest side):

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

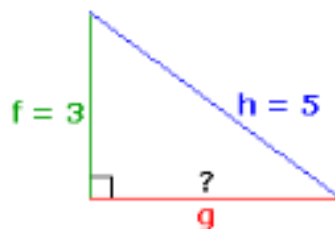


Note: To find the longest side the (hypotenuse), c in the diagram, we 'square square **add** then square root'. To find either of the other two shorter sides we 'square square **subtract** then square root'.



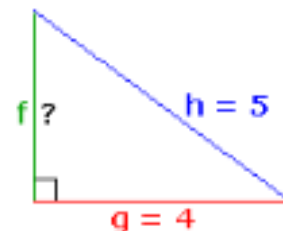
$$\begin{aligned} h^2 &= f^2 + g^2 \\ h^2 &= (3)^2 + (4)^2 \\ h^2 &= 9 + 16 \\ h^2 &= 25 \end{aligned}$$

$$h = \sqrt{25} = 5$$



$$\begin{aligned} h^2 &= f^2 + g^2 \\ g^2 &= h^2 - f^2 \\ g^2 &= (5)^2 - (3)^2 \\ g^2 &= 25 - 9 \\ g^2 &= 16 \end{aligned}$$

$$g = \sqrt{16} = 4$$



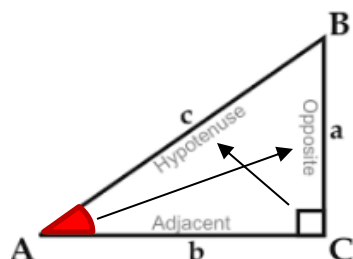
$$\begin{aligned} h^2 &= f^2 + g^2 \\ f^2 &= h^2 - g^2 \\ f^2 &= (5)^2 - (4)^2 \\ f^2 &= 25 - 16 \\ f^2 &= 9 \end{aligned}$$

$$f = \sqrt{9} = 3$$

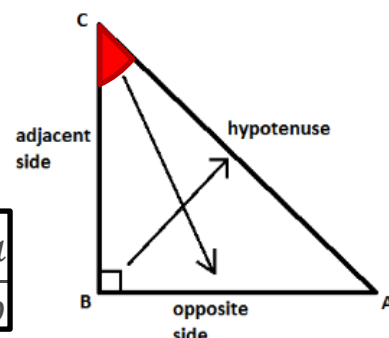


Trigonometry formulae - SOHCAHTOA

In any **right-angled** triangle ABC where a , b and c are lengths of the sides and c is the hypotenuse (the longest side).



$$\sin A = \frac{a}{c}, \cos A = \frac{b}{c}, \tan A = \frac{a}{b}$$



(A represents the angle at the vertex A which is opposite the side a)

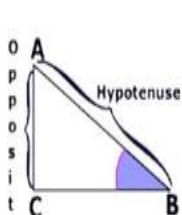
To find a side length select the correct trig ratio $\sin$, $\cos$ or $\tan$ and re-arrange as necessary.

To find an angle select the correct ratio and the two side lengths and use the inverse function e.g. inverse $\cos$ function $\cos^{-1}$ on a calculator.

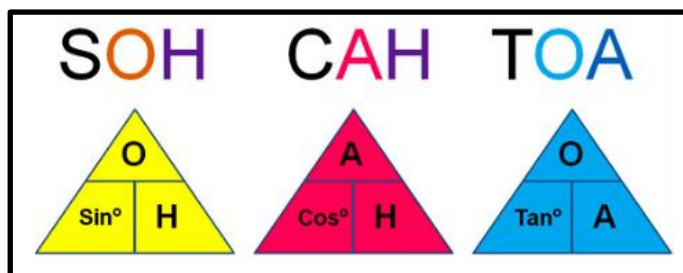
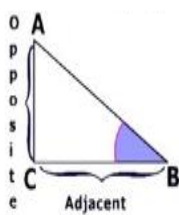
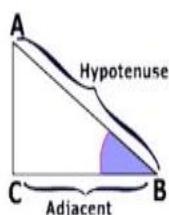
$$\sin(B) = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos(B) = \frac{\text{adjacent}}{\text{hypotenuse}}$$

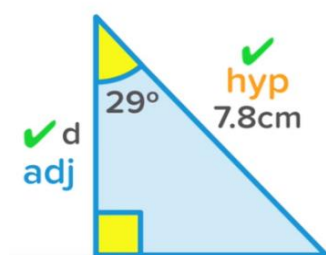
$$\tan(B) = \frac{\text{opposite}}{\text{adjacent}}$$



Find side d (to 1 d.p.)



Find y (to 1 d.p.)



$$\begin{aligned} \cos \theta &= \frac{\text{adj}}{\text{hyp}} \\ \cos(29) &= \frac{d}{7.8} \\ &\times 7.8 \times 7.8 \\ 7.8 \times \cos(29) &= d \\ d &= 6.8220... \\ &= 6.8\text{cm} \end{aligned}$$



$$\begin{aligned} \sin \theta &= \frac{\text{opp}}{\text{hyp}} \\ \sin(64) &= \frac{17.3}{y} \\ y &= \frac{17.3}{\sin(64)} \\ y &= 19.24801... \\ &= 19.2\text{cm} \end{aligned}$$

Find Angle ' x '

Give your answer to 1 decimal place.



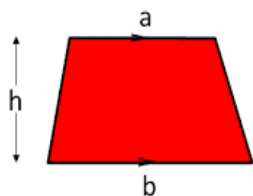
$$\begin{aligned} \tan \theta &= \frac{\text{opp}}{\text{adj}} \\ \tan(x) &= \frac{8.6}{9.9} \\ x &= \tan^{-1}\left(\frac{8.6}{9.9}\right) \\ x &= 40.9804... \\ &= 41.0^\circ \end{aligned}$$



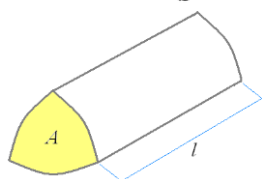
Foundation Tier GCSE Mathematics – **Given formulae** details section 1 continued..

Perimeter, area, surface area and volume formulae

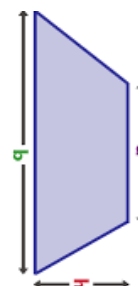
Where a and b are the lengths of the parallel sides and h is the perpendicular distance between these two parallel sides:



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



$$\text{Volume of any prism} = \text{area of cross section} \times \text{length}$$



Students should also know how to calculate the perimeter and surface area of common shapes. This will include the surface area of a cylinder.

Compound interest

Where P is the principal amount (the amount invested), r is the interest rate over a given period and n is number of times that the interest is compounded (could be years, months etc)

$$\text{Total accrued (total amount at the end of the period } n) = P\left(1 + \frac{r}{100}\right)^n$$

(Note that r divided by 100 just changes the interest rate to a decimal value)

Repeated Percentage Change

This formula for compound interest may be applied for repeated percentage changes that are not just compound interest. For example a population may be decreasing by 15% per month for 34 months from an initial population of 40,000. To find the population after 34 months then the formula becomes:-

$$\text{Final population} = 40000 \times (1 - 0.15)^{34} \quad (\text{note: } 1 - 0.15 = 0.85 \text{ a decrease of } 15\%)$$

Probability

Where $P(A)$ is the probability of outcome A and $P(B)$ is the probability of outcome B then:

$$\begin{aligned} P(A \text{ or } B) &= P(A) + P(B) \\ P(A \text{ and } B) &= P(A) \times P(B) \end{aligned}$$

Note - Relative Frequency – This is just another term used for **Probability** calculated using data from real-life or an experiment/test. Quite often this is given as a decimal value.

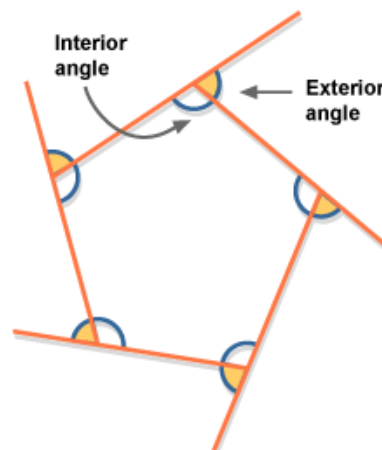


Foundation Tier GCSE Mathematics – Formulae **not given** details section 2.

2. Students **are expected to know the following** formulae or be able to derive them; **they will not be given in the exam.**

Angles in polygons (2D shapes)

The following three formulae/rules relating to angles in polygons need to be learnt and students need to be able to apply them to solve problems.



The total sum of the interior angles of any polygon

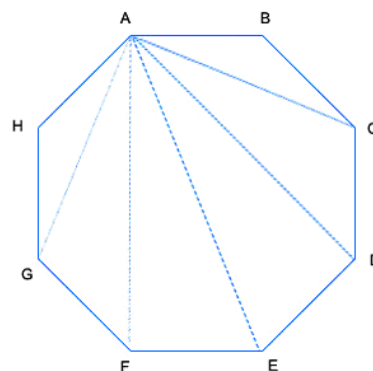
There are altogether $(n-2)$ triangles in a polygon where n is the number of sides of the polygon.

Sum of angles of each triangle = 180°

Total sum of the **interior angles** of n -sided polygon

$$= (n-2) \times 180^\circ$$

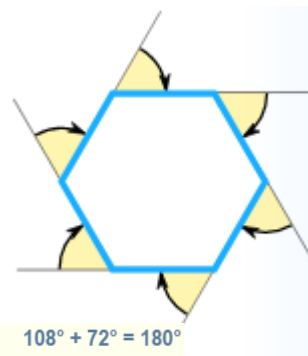
where n is the number of sides



The total sum of the exterior angles of any polygon

Total sum of the **exterior angles** of a polygon

$$\text{Total of exterior angles} = 360^\circ$$

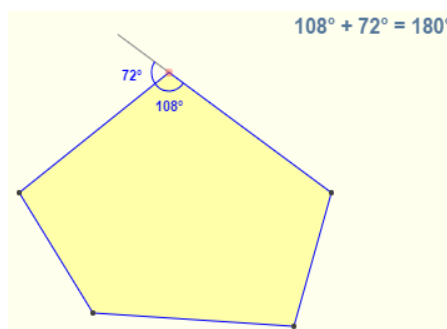


Sum of an interior and exterior angle of a polygon

Sum of the **interior and exterior angle** of a polygon

$$= 180^\circ$$

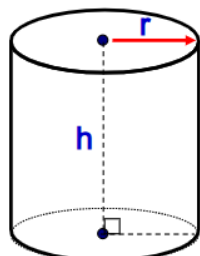
(as angles on a straight line = 180°)





Foundation Tier GCSE Mathematics – Formulae **not given** details section 2 continued.

Volume and Surface Area of a Cylinder

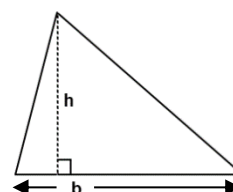


$$\text{Volume} = \pi r^2 h$$

$$\text{Surface Area} = 2\pi r h + 2\pi r^2$$

Area of a Triangle

$$\frac{1}{2} \text{ base } \times \text{ height or } \frac{b \times h}{2}$$



Foundation Tier GCSE Mathematics – Formulae details section 3.

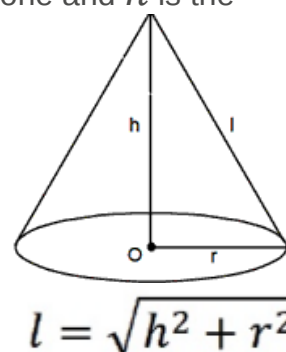
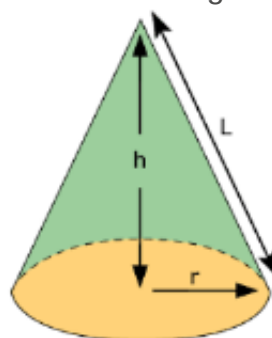
3. Students **are not expected to memorise the following formulae**; they will be given in the exam with the relevant question. The diagrams below **may not be given** so students will need to know what each part of each formula represents and be able to use the formula.

Perimeter, area, surface area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone or a pyramid:

$$\text{Curved surface area of a cone} = \pi r l$$

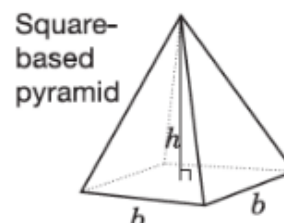
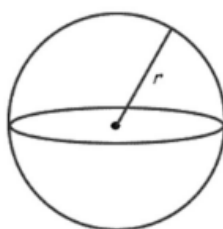
$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$



$$\text{Volume of any pyramid} = \frac{1}{3} (\text{base area}) h$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$



$$V = \frac{(\text{area of base})(\text{height})}{3}$$

$$V = \frac{1}{3} b^2 h \quad \text{or} \quad V = \frac{b^2 h}{3}$$



Foundation Tier GCSE Mathematics – Formulae details section 3 continued...

Kinematics formulae (motion)

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement (distance) from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Foundation Tier GCSE Mathematics – Formulae details section 4.

4. Students should be **able to recall** these additional facts as they may be required to solve problems on any of the three papers and **are not likely to be given** in the question.

Trigonometric Ratios that need to be learnt

In addition to knowing how to use trigonometry in right angled triangles the following need to be learnt. You should also learn how to derive these using isosceles and equilateral triangles.

$$\sin 0^\circ = 0 \quad \sin 30^\circ = \frac{1}{2} \quad \sin 45^\circ = \frac{\sqrt{2}}{2} \quad \sin 60^\circ = \frac{\sqrt{3}}{2} \quad \sin 90^\circ = 1$$

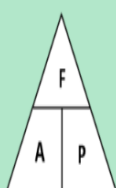
$$\cos 0^\circ = 1 \quad \cos 30^\circ = \frac{\sqrt{3}}{2} \quad \cos 45^\circ = \frac{\sqrt{2}}{2} \quad \cos 60^\circ = \frac{1}{2} \quad \cos 90^\circ = 0$$

$$\tan 0^\circ = 0 \quad \tan 30^\circ = \frac{\sqrt{3}}{3} \quad \tan 45^\circ = 1 \quad \tan 60^\circ = \sqrt{3}$$

Compound measures that need to be learnt

The following compound measures **need to be learnt**:-

Force Area Pressure

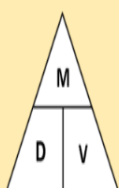


$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Area} = \frac{\text{Force}}{\text{Pressure}}$$

$$\text{Force} = \text{Area} \times \text{Pressure}$$

Mass Density Volume

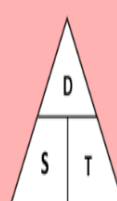


$$\text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Mass} = \text{Density} \times \text{Volume}$$

Speed Distance Time



$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

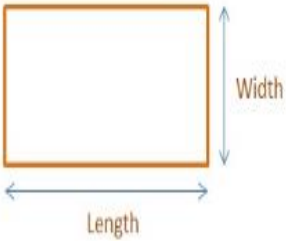
$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

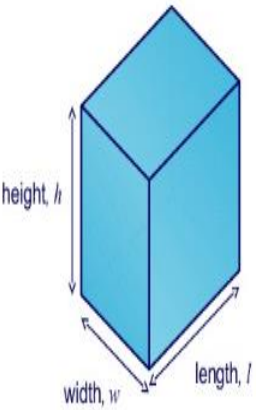


Don't forget to learn these simple area and volume formulae

RECTANGLE



Area of rectangle = $Length \times Width$

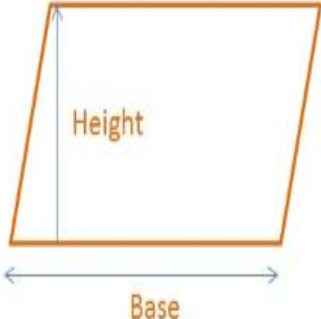


The area of the base
= $length \times width$

So,

Volume of a cuboid
= $length \times width \times height$
= lwh

PARALLELOGRAM



Area of parallelogram = $Base \times Height$

Conversion facts that should be learnt (they may/may not be given)

5 miles $\approx$ 8 kilometres so 1 mile $\approx$ 1.6 kilometres

1 gallon $\approx$ 4.5 litres (note this is UK gallons)

2.2 lbs = 1 kilogram 1 lb = 0.45kg (lbs is weight in pounds)

1 gallon = 8 pints (note this is UK gallons)

1 inch $\approx$ 2.5 centimetres

10mm = 1cm, 1000mm = 1m, 100cm = 1m, 1000m = 1km (km = kilometres)

1000mg = 1g, 1000g = 1kg, 1000kg = 1 tonne (mg = milligrams)

1000ml = 1l, 100cl = 1l (ml = millilitres)

1 million is 1000000 (6 zeros)

1000cm³ = 1l (one thousand cubic centimetres equals one litre)

Students should also be able to convert between different units of area and between different units of volume. For example:-

$$1m^2 = 1 \times 100 \times 100 \text{ cm}^2 = 10000\text{cm}^2$$

$$1m^2 = 1 \times 1000 \times 1000 \text{ mm}^2 = 1000000\text{mm}^2$$

$$50\text{cm}^2 = 50 \div 100 \div 100 \text{ m}^2 = 0.005\text{m}^2$$

$$5.2\text{km}^2 = 5.2 \times 1000 \times 1000\text{m}^2 = 5200000\text{m}^2$$

$$1m^3 = 1 \times 100 \times 100 \times 100 \text{ cm}^3 = 1000000\text{cm}^3$$

$$1\text{mm}^3 = 1 \div 10 \div 10 \div 10 \text{ cm}^3 = 0.001\text{cm}^3$$

$$356900\text{cm}^3 = 356900 \div 100 \div 100 \div 100 \text{ m}^3 = 0.3569\text{m}^3$$

$$6.43\text{m}^3 = 1 \times 1000 \times 1000 \times 1000 \text{ mm}^3 = 6430000000\text{mm}^3$$