

Geometry

Formulas, rules and quick reference - Primary to lower secondary

A practical reference covering angles, lines, triangles, quadrilaterals, polygons, circles, symmetry, transformations and coordinate geometry.

1. Basic Geometry Vocabulary

Point	An exact location; it has position but no size.
Line	A straight path extending infinitely in both directions.
Line segment	A part of a line with two endpoints.
Ray	A part of a line with one endpoint extending in one direction.
Parallel lines	Lines in the same plane that never meet.
Perpendicular lines	Lines that meet at a right angle.

2. Types of Angles

Acute	Greater than 0 degrees and less than 90 degrees.
Right	Exactly 90 degrees.
Obtuse	Greater than 90 degrees and less than 180 degrees.
Straight	Exactly 180 degrees.
Reflex	Greater than 180 degrees and less than 360 degrees.
Full turn	Exactly 360 degrees.

3. Angle Relationships

Complementary	Two angles whose sum is 90 degrees.
Supplementary	Two angles whose sum is 180 degrees.
Angles on a line	Angles on a straight line add to 180 degrees.
Angles around a point	Angles around a point add to 360 degrees.
Vertically opposite	Vertically opposite angles are equal.

Triangles

Triangle types and essential angle rules

4. Triangle Types by Sides

Equilateral	All 3 sides equal; all 3 angles are 60 degrees.
Isosceles	Two equal sides; the angles opposite those sides are equal.
Scalene	All three sides are different.

5. Triangle Types by Angles

Acute triangle	All three angles are less than 90 degrees.
Right triangle	One angle is exactly 90 degrees.
Obtuse triangle	One angle is greater than 90 degrees.

6. Triangle Angle Rules

Angle sum	Interior angles of a triangle add to 180 degrees.
Exterior angle	An exterior angle equals the sum of the two opposite interior angles.
Isosceles rule	Base angles opposite equal sides are equal.
Equilateral rule	Each interior angle is 60 degrees.

7. Right-Angled Triangles

Pythagoras	For a right triangle: $a^2 + b^2 = c^2$, where c is the hypotenuse.
Hypotenuse	The side opposite the right angle and the longest side.
Find a leg	$a^2 = c^2 - b^2$
Check	The two shorter sides are the legs; the longest side is the hypotenuse.

Quadrilaterals & Polygons

Interior angles and key properties

8. Quadrilateral Rules

Angle sum	Interior angles of any quadrilateral add to 360 degrees.
Square	4 equal sides, 4 right angles; opposite sides parallel.
Rectangle	Opposite sides equal and parallel; 4 right angles.
Parallelogram	Opposite sides equal and parallel; opposite angles equal.
Rhombus	4 equal sides; opposite angles equal; diagonals meet at right angles.
Trapezium / trapezoid	A quadrilateral with at least one pair of parallel sides.

9. Polygon Vocabulary

Polygon	A closed 2D shape made from straight line segments.
Regular polygon	All sides and all interior angles are equal.
Irregular polygon	Sides or angles are not all equal.
Interior angle sum	For an n-sided polygon: $(n - 2) \times 180$ degrees.
Exterior angle sum	The exterior angles of any simple polygon add to 360 degrees.
Regular polygon exterior angle	$\text{Exterior angle} = 360 \text{ degrees} / n$.

10. Regular Polygon Interior Angles

Each interior angle	For a regular n-sided polygon: $((n - 2) \times 180 \text{ degrees}) / n$.
Number of sides	For a regular polygon: $n = 360 \text{ degrees} / \text{exterior angle}$.
Triangle	3 sides.
Quadrilateral	4 sides.
Pentagon	5 sides.
Hexagon	6 sides.
Octagon	8 sides.

Circles

Key parts, formulas and angle facts

11. Parts of a Circle

Centre	The fixed point at the middle of the circle.
Radius	Distance from the centre to the circumference.
Diameter	A line segment through the centre joining two points on the circle.
Chord	A line segment joining two points on the circumference.
Circumference	The distance around the circle.
Arc	Part of the circumference.

12. Circle Measurements

Diameter and radius	Diameter = $2 \times$ radius.
Radius	Radius = diameter / 2.
Circumference	$C = \pi \times \text{diameter} = 2 \times \pi \times \text{radius}$.
Area	Area = $\pi \times \text{radius} \times \text{radius}$.
Pi	Pi is approximately 3.14 or $22/7$ for suitable calculations.

13. Circle Parts & Proportions

Semicircle	Half of a circle; central angle is 180 degrees.
Quarter circle	One quarter of a circle; central angle is 90 degrees.
Arc length	Arc length = fraction of full turn $\times$ circumference.
Sector area	Sector area = fraction of full turn $\times$ circle area.

14. Circle Angle Facts

Angle at centre	The angle at the centre subtended by an arc is twice the angle at the circumference standing on the same arc.
Angle in a semicircle	An angle subtended by a diameter is 90 degrees.
Same segment	Angles standing on the same chord/arc are equal in appropriate configurations.

Symmetry & Transformations

Rules for reflections, rotations, translations and enlargements

15. Symmetry

Line symmetry	A shape has line symmetry if one half is a mirror image of the other.
Line of symmetry	A line that divides a shape into two matching mirror halves.
Rotational symmetry	A shape matches itself after a rotation of less than 360 degrees.
Order of rotational symmetry	Number of times a shape matches itself during one full turn.

16. Reflection

Rule	A reflection creates a mirror image across a line of reflection.
Distance	Each point and its image are the same perpendicular distance from the mirror line.
Orientation	Reflection reverses orientation.

17. Rotation

Rule	A rotation turns a shape about a fixed centre through a stated angle.
Direction	State clockwise or anticlockwise.
Full turn	360 degrees.
Half turn	180 degrees.
Quarter turn	90 degrees.

18. Translation & Enlargement

Translation	Every point moves the same distance in the same direction.
Vector	A translation can be described by horizontal and vertical movement.
Enlargement	An enlargement changes size using a scale factor from a centre of enlargement.
Scale factor	$\text{New length} = \text{original length} \times \text{scale factor}.$

Coordinates & Geometric Relationships

Coordinate rules and useful line relationships

19. Coordinates

Ordered pair	A point is written as (x, y): move along x first, then y.
x-coordinate	Horizontal position.
y-coordinate	Vertical position.
Origin	The point where the axes meet: (0, 0).
Quadrants	The coordinate plane is divided into four quadrants by the x- and y-axes.

20. Horizontal & Vertical Lines

Horizontal line	All points have the same y-coordinate.
Vertical line	All points have the same x-coordinate.
Distance horizontally	For points on the same horizontal line, distance = absolute difference of x-coordinates.
Distance vertically	For points on the same vertical line, distance = absolute difference of y-coordinates.

21. Midpoint & Gradient

Midpoint	For points (x1, y1) and (x2, y2), midpoint = $((x1 + x2)/2, (y1 + y2)/2)$.
Gradient	Gradient = change in y / change in x.
Parallel lines	Parallel straight lines have the same gradient.
Perpendicular lines	For non-vertical lines, perpendicular gradients have product -1.

Geometry Quick Reference

Essential formulas, facts and common mistakes

22. Essential Angle Facts

Straight line	180 degrees.
Around a point	360 degrees.
Triangle	180 degrees.
Quadrilateral	360 degrees.
n-sided polygon	$(n - 2) \times 180$ degrees.
Regular polygon exterior angle	360 degrees / n .

23. Essential Shape Facts

Square	4 equal sides and 4 right angles.
Rectangle	Opposite sides equal and 4 right angles.
Parallelogram	Opposite sides parallel and equal.
Rhombus	All 4 sides equal.
Equilateral triangle	3 equal sides and 3 angles of 60 degrees.
Circle	Diameter = $2 \times$ radius; circumference = $2 \times \pi \times$ radius; area = $\pi \times$ radius $\times$ radius.

24. Common Mistakes to Watch

Angle units	Check whether an angle is given in degrees and label answers clearly.
Pythagoras	Use the formula only for right-angled triangles.
Circle formulas	Do not confuse radius with diameter.
Polygon formula	Use the correct number of sides for n .
Coordinates	Always write x-coordinate first and y-coordinate second.
Symmetry	Distinguish line symmetry from rotational symmetry.

25. Estimation & Checking

Reasonableness	Check whether an angle, length or area is sensible for the shape.
Units	Use appropriate units such as cm, cm squared or degrees.
Diagram	Use a labelled diagram when a problem contains several relationships.

Maths Connects Us All

Geometry helps us describe the shapes, spaces, patterns and structures we see in buildings, design, nature, maps and everyday life.