Angles and Lines

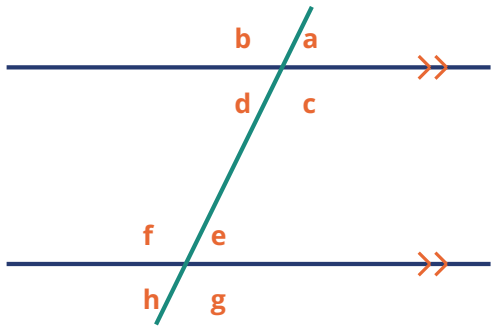
Everything in geometry builds on angles. Learn the names, then the rules that connect them.

Type	Size	Type	Size
Acute	less than 90°	**Straight**	exactly 180°
Right	exactly 90°	**Reflex**	between 180° and 360°
Obtuse	between 90° and 180°	**Full turn**	exactly 360°

Angle pairs

Pair	Rule	Example
Complementary	add up to 90°	35° and 55°
Supplementary	add up to 180°	110° and 70°
Linear pair	adjacent angles on a straight line add up to 180°	65° and 115°
Vertically opposite	opposite angles at an intersection are equal	both 40°
Around a point	all angles add up to 360°	90° + 120° + 150°

Parallel lines cut by a transversal



- **Corresponding angles**
  a = e, b = f, c = g, d = h
- **Alternate interior angles**
  c = f, d = e
- **Co-interior angles**
  c + e = 180°, d + f = 180°
- **Vertically opposite**
  a = d, b = c

Remember

- The two parallel lines must be truly parallel (marked with matching arrows) before you use these rules.
- Alternate and corresponding angles are **equal**. Co-interior angles **add up to 180°**.

Triangles and Pythagoras

A triangle has three sides and three angles. Its angles always add up to **180°**.

By sides	Meaning	By angles	Meaning
Equilateral	3 equal sides, each angle 60°	**Acute**	all angles under 90°
Isosceles	2 equal sides, 2 equal angles	**Right**	one angle of 90°
Scalene	no equal sides or angles	**Obtuse**	one angle over 90°

Key triangle facts

Fact	Rule
Angle sum	A + B + C = 180°
Exterior angle	equals the sum of the two opposite interior angles
Triangle inequality	any two sides together are longer than the third side
Area	½ × base × height

The Pythagorean theorem

In a **right-angled** triangle, the square of the hypotenuse (the longest side) equals the sum of the squares of the other two sides.

Formula	Also written as
$\mathbf{a^2 + b^2 = c^2}$	$c = \sqrt{(a^2 + b^2)}$ or $a = \sqrt{(c^2 - b^2)}$

Common Pythagorean triples	3, 4, 5	5, 12, 13	8, 15, 17	7, 24, 25

Multiples work too: 6, 8, 10 and 9, 12, 15 are also right triangles.

Special lines in a triangle

- **Median:** vertex to the midpoint of the opposite side.
- **Altitude:** perpendicular from a vertex to the opposite side.
- **Angle bisector:** splits an angle into two equal parts.
- **Perpendicular bisector:** cuts a side in half at 90°.

Quadrilaterals and Polygons

The angles of any quadrilateral add up to **360°**.

Shape	Sides	Angles	Diagonals	Area
Square	4 equal	all 90°	equal, bisect at 90°	s^2
Rectangle	opposite equal	all 90°	equal, bisect each other	$l \times w$
Parallelogram	opposite equal and parallel	opposite equal	bisect each other	$b \times h$
Rhombus	4 equal	opposite equal	bisect at 90°	$\frac{1}{2} \times d_1 \times d_2$
Trapezium	one pair parallel	co-interior add to 180°	not equal in general	$\frac{1}{2}(a + b) \times h$

Polygons

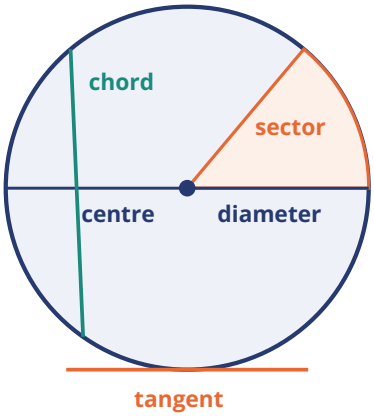
Rule	Formula	Example
Sum of interior angles	$(n - 2) \times 180°$	hexagon (n = 6): 720°
Each interior angle, regular polygon	$(n - 2) \times 180° \div n$	regular hexagon: 120°
Sum of exterior angles	always 360°	any polygon
Each exterior angle, regular polygon	$360° \div n$	regular hexagon: 60°

Common mistakes

- Calling a square "not a rectangle": a square is a special rectangle with 4 equal sides.
- Using $a^2 + b^2 = c^2$ when the triangle has no right angle.
- Mixing up the sum of interior angles with each angle of a regular polygon.
- Forgetting that a trapezium needs only **one** pair of parallel sides.

Circles

Know the parts, then the four formulas.



Radius (r)	centre to any point on the circle
Diameter	chord through the centre = 2r
Chord	line joining two points on the circle
Arc	a part of the circle's edge
Sector	region between two radii and an arc
Tangent	touches at one point, at 90° to the radius

Quantity	Formula
Circumference	$2\pi r$
Area	πr^2
Arc length (angle θ)	$\theta/360 \times 2\pi r$
Sector area (angle θ)	$\theta/360 \times \pi r^2$

Congruence and Similarity

Congruent triangles (same shape and size)	Similar triangles (same shape)
SSS: three sides equal **SAS:** two sides and the angle between them **ASA / AAS:** two angles and a side **RHS:** right angle, hypotenuse, one side	**AA:** two angles equal **SSS:** sides in the same ratio **SAS:** one equal angle between sides in the same ratio Areas are in the ratio (scale factor)^2

Tip

- Similar means same shape, not same size. Congruent means identical in both.

Worked Examples and Practice

Example 1: parallel lines

Q. Two parallel lines are cut by a transversal. One angle is 65°. Find the corresponding angle and the co-interior angle.

Solution. Corresponding angles are equal, so the corresponding angle is **65°**. Co-interior angles add up to 180°, so the co-interior angle is 180° − 65° = **115°**.

Example 2: Pythagoras

Q. A right-angled triangle has hypotenuse 13 cm and one side 5 cm. Find the third side.

Solution. $a^2 = 13^2 - 5^2 = 169 - 25 = 144$, so the third side is $\sqrt{144}$ = **12 cm** (a 5, 12, 13 triple).

Example 3: exterior angle

Q. Two angles of a triangle are 50° and 60°. Find the exterior angle at the third vertex.

Solution. The exterior angle equals the sum of the two opposite interior angles: 50° + 60° = **110°**.

Your turn

1. One of two complementary angles is 35°. Find the other.

2. The angles of a triangle are 2x, 3x and 4x. Find each angle.

3. The two shorter sides of a right-angled triangle are 6 cm and 8 cm. Find the hypotenuse.

4. Find each interior angle of a regular hexagon.

5. A circle has radius 7 cm. Find its circumference and area (use π = 22/7).

6. Find the area of a sector of angle 90° in a circle of radius 14 cm (use π = 22/7).

Answers

- 1) 55° | 2) 40°, 60°, 80° | 3) 10 cm | 4) 120° | 5) 44 cm, 154 cm^2 | 6) 154 cm^2

More practice and the full guide:
thepractiseground.in/blog/geometry-essentials-shapes-angles-theorems-explained