

Geometry Formula and Proof Strategy Guide

A print-friendly Geometry guide for proofs, angle relationships, triangle congruence, similarity, right triangles, circles, coordinate geometry, area, surface area, and volume. Work a section, then try the matching questions in the practice worksheet.

SECTIONS	6	WORKED EXAMPLES	6	FORMAT	Print friendly
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How to use this guide

A formula you cannot place is not knowledge yet. Work the recall drill below before the questions.

- Mark the diagram before solving. Add givens, equal sides, angle marks, parallel lines, and right angles.
- Name the theorem before using it. A Geometry answer is stronger when the reason is visible.
- Check units and reasonableness. Area uses square units, volume uses cubic units, and diagrams are not proof by themselves.

1. Lines, angles, and constructions

NAME	FORMULA	WHEN TO USE
Linear pair	angles add to 180	Adjacent angles form a straight line.
Vertical angles	vertical angles are congruent	Two lines intersect.
Parallel lines	corresponding and alternate interior angles match	A transversal crosses parallel lines.
Triangle angle sum	$A + B + C = 180$	Finding a missing triangle angle.
Exterior angle	exterior angle = sum of remote interior angles	A side of a triangle is extended.

WORKED EXAMPLE

Two parallel lines are cut by a transversal. One corresponding angle is 68 degrees. Find its matching corresponding angle.

1. Corresponding angles are congruent when lines are parallel.
2. Matching angle = 68 degrees

Check: The answer is an angle measure, so degrees are required.

2. Proof structure and congruent triangles

NAME	FORMULA	WHEN TO USE
SSS	three sides match	Proving triangles congruent from side lengths.
SAS	two sides and included angle match	The angle is between the two known sides.
ASA	two angles and included side match	The side is between the two known angles.
AAS	two angles and a non-included side match	The side is not between the two known angles.
HL	hypotenuse and leg match	Right triangles only.
CPCTC	corresponding parts of congruent triangles are congruent	After triangles have already been proved congruent.

WORKED EXAMPLE

Given $AB = DE$, $AC = DF$, and angle $A = \text{angle } D$. Which congruence theorem applies?

- Two sides are known: $AB = DE$ and $AC = DF$.
- The included angle is known: angle $A = \text{angle } D$.
- Therefore the triangles are congruent by SAS.

Check: SAS requires the angle between the two sides.

3. Similarity and right triangles

NAME	FORMULA	WHEN TO USE
AA similarity	two angles match	Proving two triangles are similar.
Scale factor	new length / original length	Comparing similar figures.
Pythagorean theorem	$a^2 + b^2 = c^2$	Right triangle side lengths.
45-45-90 triangle	legs x, x ; hypotenuse $x\sqrt{2}$	Isosceles right triangles.
30-60-90 triangle	short x ; long $x\sqrt{3}$; hypotenuse $2x$	Special right triangles.
Trig ratios	$\sin = \text{opp/hyp}$, $\cos = \text{adj/hyp}$, $\tan = \text{opp/adj}$	Right triangle angle and side problems.

WORKED EXAMPLE

A right triangle has legs 9 and 12. Find the hypotenuse.

- $9^2 + 12^2 = c^2$
- $81 + 144 = 225$
- $c = \sqrt{225} = 15$

Check: 9-12-15 is a scaled 3-4-5 triangle.

4. Quadrilaterals, polygons, and coordinate geometry

NAME	FORMULA	WHEN TO USE
Polygon interior sum	$(n - 2) \times 180$	Finding total interior angle measure.
Each regular polygon angle	$((n - 2) \times 180) / n$	A regular polygon has equal angles.
Slope	$(y_2 - y_1) / (x_2 - x_1)$	Checking parallel or perpendicular sides.
Distance	$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$	Finding length on a coordinate plane.
Midpoint	$((x_1 + x_2) / 2, (y_1 + y_2) / 2)$	Finding the center of a segment.
Parallelogram test	opposite sides parallel or congruent	Classifying a quadrilateral.

WORKED EXAMPLE

Find the midpoint of A(2, -4) and B(8, 6).

- x-coordinate = $(2 + 8) / 2 = 5$
- y-coordinate = $(-4 + 6) / 2 = 1$
- Midpoint = (5, 1)

Check: The midpoint is halfway between both x-values and both y-values.

5. Circles

NAME	FORMULA	WHEN TO USE
Circumference	$2 \times \pi \times r$ or $\pi \times d$	Distance around a circle.
Area of a circle	$\pi \times r^2$	Surface inside a circle.
Arc length	$(\text{central angle} / 360) \times 2 \times \pi \times r$	Length of part of the circumference.
Sector area	$(\text{central angle} / 360) \times \pi \times r^2$	Area of a slice of a circle.
Inscribed angle	half the intercepted arc	Angle has vertex on the circle.
Tangent radius	radius to tangent point is perpendicular	A tangent line touches a circle once.

WORKED EXAMPLE

A circle has radius 6 and central angle 120 degrees. Find the sector area in terms of π .

1. Sector area = $(120/360) \times \pi \times 6^2$
2. = $(1/3) \times 36 \times \pi$
3. = $12 \times \pi$

Check: 120 degrees is one third of the circle, so one third of $36 \times \pi$ is $12 \times \pi$.

6. Area, surface area, and volume

NAME	FORMULA	WHEN TO USE
Triangle area	$(1/2) \times \text{base} \times \text{height}$	Base and perpendicular height are known.
Parallelogram area	$\text{base} \times \text{height}$	Height must be perpendicular to base.
Trapezoid area	$(1/2) \times (b_1 + b_2) \times h$	Two parallel bases are known.
Rectangular prism volume	$\text{length} \times \text{width} \times \text{height}$	Box-shaped solid.
Cylinder volume	$\pi \times r^2 \times h$	Circular base prism.
Cone volume	$(1/3) \times \pi \times r^2 \times h$	Circular base with one vertex.

WORKED EXAMPLE

Find the volume of a cylinder with radius 3 and height 10.

1. $V = \pi \times r^2 \times h$
2. $V = \pi \times 3^2 \times 10$
3. $V = 90 \times \pi$

Check: Volume is in cubic units.

Notes and tutor hand-off

Bring this page to your next session so the tutor can start from what actually blocked you.

Which theorem or formula did you need to look up more than once?

One proof step you could not justify:

Worksheet question numbers to review with a tutor:
