

Geometry Final Exam Review

Everything on a typical Geometry final, one unit at a time: the theorems and formulas you need, the mistakes that cost the most points, and three practice questions per unit with answers. Start with the quick checks to find your weak units, then use the linked lessons to fix them.

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What’s on the Geometry final

Most schools teach the basics of points, lines and angles, parallel lines, reasoning and proof, transformations and triangle congruence in the first semester, then polygons and quadrilaterals, similarity, right triangles and trigonometry, circles, and area and volume in the second. Some schools finish quadrilaterals before winter break, so check your review packet. If your final is in December, focus on the Semester 1 units.

Unit	Usually on	Lessons
1. Foundations, angles & parallel lines	Semester 1	Geometry: Rigid Motions & Congruence, Geometry, Distance on the Coordinate Plane
2. Reasoning & proof	Semester 1	Geometry: Rigid Motions & Congruence
3. Transformations	Semester 1	Geometry: Rigid Motions & Congruence, Transformations & Similarity
4. Triangles & congruence	Semester 1	Geometry: Rigid Motions & Congruence
5. Polygons & quadrilaterals	Semester 2	Geometry: Rigid Motions & Congruence
6. Similarity	Semester 2	Geometry: Similarity & Right-Triangle Trigonometry, Similarity Arguments with Transformations
7. Right triangles & trigonometry	Semester 2	Geometry: Similarity & Right-Triangle Trigonometry, Pythagorean Theorem
8. Circles	Semester 2	Geometry: Circles, Coordinates & Volume

Unit	Usually on	Lessons
9. Area & volume	Semester 2	Geometry: Circles, Coordinates & Volume, Volume of Cylinders, Cones & Spheres

A two-week study plan

DAY 14

Find your weak units

Do the quick checks for all 9 units without notes. Mark each unit solid, shaky or lost. This tells you where your study time goes.

DAYS 13–6

Fix the lost and shaky units, one a day

Start with the units you marked lost, then shaky. For each one, read the must-know list, work through the linked lesson, and redo that unit's quick checks until you get all three right.

DAYS 5–3

Mixed practice

Finals mix units together, so practice that way: pick problems from different units, work them without looking at which unit they came from, and check each answer.

DAY 2

Formulas and mistakes

Review the formula sheet and every "common mistakes" list. Write out from memory the formulas you still look up.

DAY 1

Light review and sleep

Redo only the questions you missed before. Then stop: a full night of sleep helps your memory more than a late cram session.

UNIT 1 • SEMESTER 1

Foundations, angles & parallel lines

MUST KNOW

- Midpoint: $M = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$. Distance: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.
- Complementary angles add to 90° and supplementary angles add to 180° . Vertical angles are congruent, and a linear pair is supplementary.
- When parallel lines are cut by a transversal, corresponding, alternate interior and alternate exterior angles are congruent, and same-side interior angles are supplementary.
- The converses work too: if corresponding or alternate interior angles are congruent, the lines are parallel.
- Parallel lines have equal slopes; perpendicular lines have slopes that are negative reciprocals, so their product is -1 .

COMMON MISTAKES

- Setting same-side interior angles equal to each other. They add to 180° ; only the corresponding and alternate pairs are equal.
- Assuming two lines are parallel because they look parallel. Use the angle pairs only when the problem says the lines are parallel, or when you are proving it.
- Subtracting the coordinates in the midpoint formula. The midpoint averages them, so you add and divide by 2.

QUICK CHECK

1.1 Find the midpoint and the length of the segment from $(-2, 3)$ to $(4, 11)$.

1.2 Two parallel lines are cut by a transversal. Alternate interior angles measure $(3x + 10)^\circ$ and $(5x - 30)^\circ$. Find x and the angle.

1.3 Same-side interior angles between parallel lines measure $(2x + 15)^\circ$ and $(3x - 5)^\circ$. Find both angles.

UNIT 2 · SEMESTER 1

Reasoning & proof

MUST KNOW

- A conditional "if p , then q " has hypothesis p and conclusion q . The converse is "if q , then p "; the inverse is "if not p , then not q "; the contrapositive is "if not q , then not p ".
- A conditional and its contrapositive are always both true or both false. The converse and inverse can be different.
- One counterexample, a case where the hypothesis is true and the conclusion is false, proves a conditional false.
- Inductive reasoning uses patterns to make a conjecture; deductive reasoning uses definitions, postulates and proved theorems, so its conclusion must be true.
- Common proof reasons: reflexive ($\overline{AB} \cong \overline{AB}$), symmetric, transitive and substitution properties, plus the addition and subtraction properties of equality.
- In a two-column proof, every statement needs a reason: given, a definition, a postulate, or a theorem already proved.

COMMON MISTAKES

- Assuming the converse is true. "If an angle measures 30° , it is acute" is true, but "if an angle is acute, it measures 30° " is false.
- Using a fact you only see in the diagram, like a right angle or equal lengths that were not given or marked.

QUICK CHECK

2.1 Write the contrapositive of "If two angles are vertical angles, then they are congruent." Is it true?

2.2 Give a counterexample to "If $x^2 = 25$, then $x = 5$."

2.3 Name the property: if $\angle 1 \cong \angle 2$ and $\angle 2 \cong \angle 3$, then $\angle 1 \cong \angle 3$.

UNIT 3 · SEMESTER 1

Transformations

MUST KNOW

- Translations, reflections and rotations are rigid motions: they keep every length and angle, so the image is congruent to the original.
- Translation by $\langle a, b \rangle$: $(x, y) \rightarrow (x + a, y + b)$.
- Reflections: over the x -axis $(x, y) \rightarrow (x, -y)$; over the y -axis $(x, y) \rightarrow (-x, y)$; over $y = x$, $(x, y) \rightarrow (y, x)$.
- Rotations about the origin: 90° counterclockwise $(x, y) \rightarrow (-y, x)$; 180° $(x, y) \rightarrow (-x, -y)$; 270° counterclockwise $(x, y) \rightarrow (y, -x)$.
- Two figures are congruent exactly when a sequence of rigid motions carries one onto the other. In a sequence, do the moves in the order given.

COMMON MISTAKES

- Mixing up the rotation rules. Check with a sketch: $(4, 2)$ rotated 90° counterclockwise should land in Quadrant II, at $(-2, 4)$.
- Changing the wrong sign in a reflection. Reflecting over the x -axis keeps x and changes the sign of y .

QUICK CHECK

3.1 Reflect $A(3, -5)$ over the y -axis.

3.2 Rotate $(4, 1)$ by 90° counterclockwise about the origin.

3.3 Translate $(5, 1)$ by $(x, y) \rightarrow (x - 3, y + 2)$, then reflect the image over the x -axis. Where does it end up?

Triangles & congruence

MUST KNOW

- The angles of a triangle add to 180° . An exterior angle equals the sum of the two remote interior angles.
- SSS, SAS, ASA and AAS prove triangles congruent, and HL works for right triangles. SSA and AAA do not prove congruence.
- After proving triangles congruent, CPCTC (corresponding parts of congruent triangles are congruent) gives you the remaining sides and angles.
- Isosceles triangle theorem: the base angles opposite the congruent sides are congruent, and the converse is also true. Each angle of an equilateral triangle is 60° .
- Triangle inequality: any two sides must add to more than the third side.

COMMON MISTAKES

- Using SAS when the angle is not between the two sides. The angle must be the included angle, or you have SSA, which does not work.
- Naming the triangles with vertices out of order. In $\triangle ABC \cong \triangle DEF$, A matches D , B matches E and C matches F .
- Using CPCTC before you have proved the triangles congruent. It always comes after the congruence step.

QUICK CHECK

4.1 Two angles of a triangle measure 47° and 68° . Find the third angle and the exterior angle at that vertex.

4.2 You know $\overline{AB} \cong \overline{DE}$, $\angle B \cong \angle E$ and $\overline{BC} \cong \overline{EF}$. Which criterion proves $\triangle ABC \cong \triangle DEF$?

4.3 Can 4, 7 and 12 be the side lengths of a triangle?

UNIT 5 • SEMESTER 2

Polygons & quadrilaterals

MUST KNOW

- The interior angles of an n -sided polygon add to $(n - 2) \cdot 180^\circ$. Each interior angle of a regular polygon is $\frac{(n-2) \cdot 180^\circ}{n}$.
- The exterior angles of a convex polygon, one at each vertex, always add to 360° .
- A parallelogram has opposite sides parallel and congruent, opposite angles congruent, consecutive angles supplementary, and diagonals that bisect each other.
- A rectangle also has congruent diagonals, a rhombus has perpendicular diagonals, and a square has both.
- In a trapezoid the parallel sides are the bases and the midsegment is half their sum; an isosceles trapezoid has congruent base angles and congruent diagonals.

COMMON MISTAKES

- Multiplying $n \cdot 180$ instead of $(n - 2) \cdot 180$. A quadrilateral has 360° , not 720° .
- Giving every parallelogram congruent or perpendicular diagonals. Those belong to rectangles and rhombuses.

QUICK CHECK

5.1 Find the sum of the interior angles of a hexagon and the measure of each angle of a regular hexagon.

5.2 Each exterior angle of a regular polygon measures 24° . How many sides does it have?

5.3 In parallelogram $ABCD$, $m\angle A = (3x + 20)^\circ$ and $m\angle B = (2x + 10)^\circ$. Find both angles.

UNIT 6 · SEMESTER 2

Similarity

MUST KNOW

- Similar figures have congruent corresponding angles and proportional corresponding sides. A similarity is a sequence of rigid motions and a dilation.
- Triangles are similar by AA, SSS similarity (all three sides in the same ratio) or SAS similarity (two sides in the same ratio and the included angles congruent).
- A dilation with scale factor k multiplies every length and the perimeter by k and the area by k^2 ; angles do not change.
- Triangle proportionality: a line parallel to one side of a triangle divides the other two sides proportionally.
- Write the similarity statement with matching vertices in order, then set up the proportion from it.

COMMON MISTAKES

- Matching the wrong sides. Corresponding sides sit opposite congruent angles; follow the vertex order in the similarity statement.
- Scaling area by k . If lengths triple, area is multiplied by $3^2 = 9$.

QUICK CHECK

6.1 A 5 ft student casts a 4 ft shadow at the same time a tree casts a 24 ft shadow. How tall is the tree?

6.2 In $\triangle ABC$, $\overline{DE} \parallel \overline{BC}$ with D on $\overline{AB}$ and E on $\overline{AC}$. If $AD = 4$, $DB = 6$ and $AE = 6$, find EC .

6.3 Two similar figures have a scale factor of $3 : 5$. The smaller has an area of 36 square units. Find the larger area.

UNIT 7 · SEMESTER 2

Right triangles & trigonometry

MUST KNOW

- Pythagorean theorem: $a^2 + b^2 = c^2$, where c is the hypotenuse. If $c^2 = a^2 + b^2$ the triangle is right; if $c^2 < a^2 + b^2$ it is acute; if $c^2 > a^2 + b^2$ it is obtuse.
- In a 45° - 45° - 90° triangle the hypotenuse is $\text{leg} \cdot \sqrt{2}$. In a 30° - 60° - 90° triangle the hypotenuse is twice the short leg and the long leg is $\text{short leg} \cdot \sqrt{3}$.
- SOH CAH TOA: $\sin \theta = \frac{\text{opp}}{\text{hyp}}$, $\cos \theta = \frac{\text{adj}}{\text{hyp}}$, $\tan \theta = \frac{\text{opp}}{\text{adj}}$.
- To find an angle, use an inverse: $\theta = \tan^{-1} \left(\frac{\text{opp}}{\text{adj}} \right)$, with the calculator in degree mode.
- Angles of elevation and depression are measured from the horizontal. For complementary angles, $\sin \theta = \cos(90^\circ - \theta)$.

COMMON MISTAKES

- Labeling opposite and adjacent from the wrong angle. Opposite and adjacent depend on which acute angle you are using; the hypotenuse never changes.
- Leaving the calculator in radian mode, which gives answers that make no sense for a triangle.
- Putting the long leg across from the 30° angle. The short leg is opposite 30° .

QUICK CHECK

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

7.2 A 30° - 60° - 90° triangle has a hypotenuse of 14. Find both legs.

7.3 A 20 ft ladder makes a 65° angle with the ground. How high up the wall does it reach?

UNIT 8 · SEMESTER 2

Circles

MUST KNOW

- A central angle equals its intercepted arc. An inscribed angle is half its intercepted arc, so an inscribed angle that intercepts a semicircle is 90° .
- A tangent is perpendicular to the radius at the point of tangency, and two tangent segments from the same outside point are congruent.
- Opposite angles of a quadrilateral inscribed in a circle are supplementary.
- Circumference is $C = 2\pi r$ and area is $A = \pi r^2$. Arc length is $\frac{\theta}{360^\circ} \cdot 2\pi r$ and sector area is $\frac{\theta}{360^\circ} \cdot \pi r^2$.
- The equation of a circle with center (h, k) and radius r is $(x - h)^2 + (y - k)^2 = r^2$. Complete the square to find the center and radius.

COMMON MISTAKES

- Reading the radius as r^2 . In $(x - 1)^2 + (y + 2)^2 = 49$ the radius is 7, and the center is $(1, -2)$: the signs flip.
- Setting an inscribed angle equal to its arc. That is true only for central angles; an inscribed angle is half.

QUICK CHECK

8.1 An inscribed angle intercepts an arc of 110° . Find the angle.

8.2 Find the length of an arc with central angle 80° in a circle of radius 9.

8.3 Find the center and radius of $x^2 + y^2 + 8x - 2y - 8 = 0$.

UNIT 9 · SEMESTER 2

Area & volume

MUST KNOW

- Area: triangle $\frac{1}{2}bh$, parallelogram bh , trapezoid $\frac{1}{2}(b_1 + b_2)h$, circle πr^2 . The height is always perpendicular to the base.
- Prisms and cylinders: $V = Bh$, where B is the area of the base, so a cylinder is $V = \pi r^2 h$.
- Pyramids and cones are one third of the matching prism or cylinder: $V = \frac{1}{3}Bh$ and $V = \frac{1}{3}\pi r^2 h$.
- Sphere: $V = \frac{4}{3}\pi r^3$ and surface area $4\pi r^2$.
- For similar solids with scale factor k , surface areas multiply by k^2 and volumes by k^3 .

COMMON MISTAKES

- Using the diameter as the radius. Halve the diameter before you substitute.
- Using the slant height in the cone or pyramid volume formula. Volume needs the perpendicular height.
- Forgetting the $\frac{1}{3}$ for cones and pyramids.

QUICK CHECK

9.1 Find the volume of a cone with radius 3 and height 8.

9.2 Find the volume of a sphere with a diameter of 12.

9.3 Two similar cylinders have a scale factor of 2. The smaller holds 50 cubic centimeters. How much does the larger hold?

Answer key

Unit 1: Foundations, angles & parallel lines

1.1 Midpoint $(1, 7)$, length 10. Average the coordinates for the midpoint; the length is $\sqrt{6^2 + 8^2} = \sqrt{100}$.

1.2 $x = 20$ and each angle is 70° . Alternate interior angles are congruent, so $3x + 10 = 5x - 30$.

1.3 83° and 97° . They are supplementary, so $5x + 10 = 180$ and $x = 34$.

Unit 2: Reasoning & proof

2.1 "If two angles are not congruent, then they are not vertical angles." It is true, because the original statement is true and a contrapositive always matches it.

2.2 $x = -5$. It makes the hypothesis true, since $(-5)^2 = 25$, but the conclusion false.

2.3 The transitive property of congruence. Two things congruent to the same thing are congruent to each other.

Unit 3: Transformations

3.1 $(-3, -5)$. A reflection over the y -axis changes the sign of x only.

3.2 $(-1, 4)$. The rule is $(x, y) \rightarrow (-y, x)$.

3.3 $(2, -3)$. The translation gives $(2, 3)$, and the reflection changes the sign of y .

Unit 4: Triangles & congruence

4.1 65° and 115° . $180 - 47 - 68 = 65$, and the exterior angle is $47 + 68 = 115$.

4.2 SAS. Angle B is between sides AB and BC , so it is the included angle.

4.3 No. $4 + 7 = 11$, which is less than 12, so the two short sides cannot meet.

Unit 5: Polygons & quadrilaterals

5.1 720° and 120° . $(6 - 2) \cdot 180 = 720$, and $720 \div 6 = 120$.

5.2 15. The exterior angles add to 360° , and $360 \div 24 = 15$.

5.3 $m\angle A = 110^\circ$ and $m\angle B = 70^\circ$. Consecutive angles are supplementary, so $5x + 30 = 180$ and $x = 30$.

Unit 6: Similarity

6.1 30 ft. The triangles are similar by AA, so $\frac{h}{24} = \frac{5}{4}$.

6.2 $EC = 9$. By triangle proportionality, $\frac{4}{6} = \frac{6}{EC}$, so $4 \cdot EC = 36$.

6.3 100 square units. Areas scale by $\left(\frac{5}{3}\right)^2 = \frac{25}{9}$, and $36 \cdot \frac{25}{9} = 100$.

Unit 7: Right triangles & trigonometry

7.1 $9^2 + 12^2 = 81 + 144 = 225$, and $\sqrt{225} = 15$.

7.2 Short leg 7, long leg $7\sqrt{3} \approx 12.12$. The hypotenuse is twice the short leg.

7.3 About 18.1 ft. The height is opposite the angle and the ladder is the hypotenuse, so $h = 20 \sin 65^\circ \approx 18.13$.

Unit 8: Circles

8.1 55° . An inscribed angle is half its intercepted arc.

8.2 $4\pi \approx 12.57$. $\frac{80}{360} \cdot 2\pi(9) = \frac{2}{9} \cdot 18\pi$.

8.3 Center $(-4, 1)$, radius 5. Complete the square: $(x + 4)^2 + (y - 1)^2 = 8 + 16 + 1 = 25$.

Unit 9: Area & volume

9.1 $24\pi \approx 75.4$ cubic units. $\frac{1}{3}\pi(3^2)(8) = \frac{1}{3}\pi(72)$.

9.2 $288\pi \approx 904.8$ cubic units. The radius is 6, and $\frac{4}{3}\pi(6^3) = \frac{4}{3}\pi(216)$.

9.3 400 cubic centimeters. Volume scales by $2^3 = 8$.