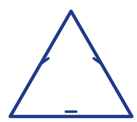
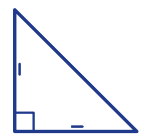
Drawing Geometric Figures with Given Conditions

Name: ______________________	Date: ______________	Score: _____ / 17

Drawing a figure from a set of conditions is part art, part logic! You are not just sketching—you are deciding whether the information given determines *one* figure, *many* figures, or *no* figure at all. Side lengths, angle measures, and other constraints each restrict the shape in different ways. This topic helps you think like a true geometer by focusing on what is possible and *why*.

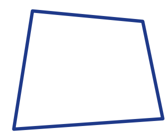


Equilateral
all sides equal; angles $60°$



Right isosceles
$90°,\ 45°,\ 45°$

Scalene obtuse
all sides different



Quadrilateral
4 sides; angles sum to $360°$

Key Concepts & Quick Review

Unique figure: SSS, SAS, ASA all produce exactly one triangle (up to flips).
No triangle: sum of two sides $\leq$ third side; or angles don't sum to $180°$.
Infinitely many: AAA (angles only) or just one/two side(s) with no angle condition.
Quadrilateral interior angles: always sum to $360°$.

Examples

① How many different triangles can be drawn with angles $50°$, $60°$, and $70°$?

Think It Through: The three angles add to $180°$, so they do describe a valid triangle. But angles alone fix only the shape, not the size. That means you can draw the same shape larger or smaller forever. So there are infinitely many similar triangles, even though they are not all congruent.

Answer: *Infinitely many (similar but not congruent)*

② Draw a quadrilateral with three angles $85°$, $100°$, and $92°$. Find the fourth angle. Is this quadrilateral unique?

Think It Through: The interior angles of any quadrilateral add to $360°$. Add the three known angles: $85° + 100° + 92° = 277°$. Then subtract from $360°$ to get the missing angle: $360° - 277° = 83°$. Even though the four angles are now known, the figure is still not unique because many different quadrilaterals can share the same angle measures.

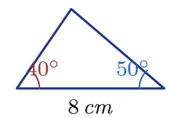
Answer: *Fourth angle* $= 83°$; *not a unique figure*

Practice Problems

For each set of conditions: state whether 0, 1, or infinitely many figures are possible, and find any missing angles or sides.

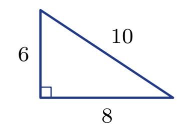
1. A triangle has angles $60°, 60°, 60°$. How many different triangles can be drawn? ______
2. A triangle has side lengths $4, 4, 4\ cm$. How many different triangles can be drawn? Classify it by side lengths. ______
3. A triangle has angles $90°, 90°, 10°$. Decide whether the triangle is possible. ______
4. A triangle has side lengths $3, 3, 7\ cm$. Decide whether the triangle is possible. ______

5. A triangle has angles $40°$ and $50°$ with an included side of $8\ cm$. How many different triangles can be drawn? ______

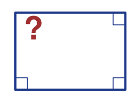


6. A triangle has angles $70°, 70°$, and $c°$. Find c and classify the triangle. ______

7. A triangle has side lengths $6, 8, 10\ cm$. Decide whether it is possible and whether it is a right triangle. ______

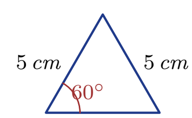


8. Quadrilateral angles: $90°, 90°, 90°, ?°$. Find the fourth angle. ______



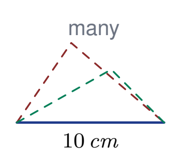
9. A triangle has side lengths $5\ cm$, $12\ cm$, and $c\ cm$. Find the possible range for c. ______
10. A triangle has angles $50°, 60°, 70°$ and a $5\ cm$ side included between the $50°$ and $60°$ angles. How many different triangles can be drawn? ______
11. Quadrilateral: three angles are $80°$ each. Find the fourth angle. ______

12. A triangle has two sides of $5\ cm$ with an included angle of $60°$. Classify the triangle and state how many different triangles can be drawn. ______



13. A triangle has angles $110°, 40°$, and $c°$. Find c and classify the triangle. ______
14. Quadrilateral angles: $100°, 85°, 95°, ?°$. Find the fourth angle. ______

15. A triangle is described by one side length of $10\ cm$ and no angle measures. How many different triangles are possible? ______



Study Tips

- ☞ Before drawing anything, **check the conditions**: do angles sum correctly? Do sides satisfy the triangle inequality? Invalid conditions produce zero figures.
- ☞ Angles alone (AAA) $\rightarrow$ infinitely many similar figures. Adding one side length pins down the size and gives exactly one figure (ASA or AAS).
- ☞ For quadrilaterals: interior angles sum to $360°$ always. Knowing three angles determines the fourth, but the shape is still not unique — you also need side information.

✍ Word Problems

16. An artist wants to cut a triangular piece of stained glass with angles $(2x+10)°$, $(3x-5)°$, and $(x+15)°$. Find x and all three angles. Does this give a unique triangle shape? If the artist also specifies one side as $20\ cm$ (between the first two angles), is the triangle now unique? __________

17. A city planner sketches a quadrilateral park with three known corner angles: $78°$, $102°$, and $95°$. Find the fourth angle. Is the park's exact shape (perimeter and layout) determined by these angles? What additional information would be needed to uniquely describe the park? __________

Answer Keys

1) infinitely many
2) one; equilateral
3) impossible
4) impossible
5) one
6) $c = 40°$; isosceles acute
7) possible; right triangle
8) $90°$
9) $7 < c < 17$
10) one
11) $120°$
12) equilateral; one
13) $c = 30°$; obtuse
14) $80°$
15) infinitely many
16) $x \approx 26.67$; angles $63.3°, 75°, 41.7°$; infinitely many from angles alone; one with ASA
17) Fourth angle $85°$; shape not determined; needs side lengths and/or diagonals

Step-by-Step Explanations

Strategy: For Solving One-Step and Two-Step Inequalities, solve as you would an equation, but reverse the inequality sign whenever you multiply or divide by a negative. Inequality work stays simple when the variable is isolated before the graph is drawn.

Practice 1: x+4>9 **Answer:** $x > 5$
For the first sample, undo the operations in order and pause at any negative coefficient before choosing the symbol direction.

Practice 15: $7 - 2x \geq -3$ **Answer:** $x \leq 5$
Late in the set, check one value from the solution side of the graph to confirm the inequality direction.

Word-problem notes:

16. Answer: $3 - \frac{1}{4}m \geq 0 \Rightarrow m \leq 12\,mi$; yes, $42 > 12$ — fuel stop needed!
Start with the amount of gas left after driving m miles. Since the car begins with $3\,gal$ and uses $\frac{1}{4}\,gal$ per mile, the amount remaining is $3 - \frac{1}{4}m$. To avoid running out, that amount must stay at least 0, so write $3 - \frac{1}{4}m \geq 0$. Solving gives $m \leq 12$, which means the car can go at most $12\,mi$. Because 42 is much greater than 12, the driver definitely needs fuel before making that trip.

17. Answer: $35 + 5\ell > 120 \Rightarrow \ell > 17$; exactly 17: $35 + 85 = 120$, which is *not* more than 120 — does not qualify.
Anya already has 35 laps, and over the next 5 days she adds 5ℓ more laps, so the total is $35 + 5\ell$. Because she needs more than 120 laps, write the inequality $35 + 5\ell > 120$. Subtract 35 to get $5\ell > 85$, then divide by 5 to find $\ell > 17$. If she swims exactly 17 laps per day, her total would be $35+5(17) = 120$, and 120 is not more than 120, so she would not qualify.

18. Answer: $x \geq -3$; closed circle at -3, ray to the right. Check $x = 0$: $-2(0) + 5 = 5 \leq 11$ ✓.
Subtract 5 from both sides to get $-2x \leq 6$. Then divide both sides by -2 and *flip* the inequality (because we divided by a negative): $x \geq -3$. Graph by drawing a closed circle at -3 and shading the ray to the right. Test $x = 0$ in the original inequality: $-2(0) + 5 = 5$, and $5 \leq 11$ is true, so the solution checks.

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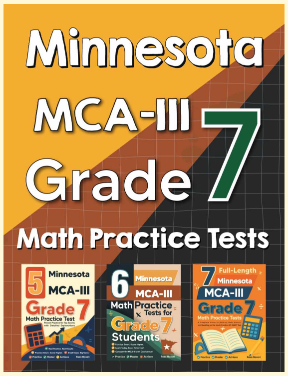

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