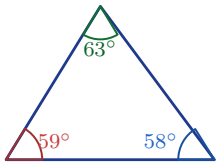
CCSS • 8.G.5

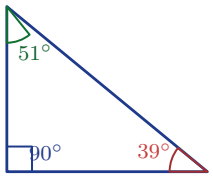
Triangle Angle-Sum Theorem

Name: _____	Date: _____	Score: _____ / 17

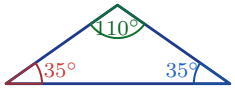
Here is one of the most powerful facts in all of geometry: the three angles inside *any* triangle always add up to $180°$! This is the **Triangle Angle-Sum Theorem**, and it means that if you know two angles you can *always* find the third. It also helps you classify triangles as acute, right, or obtuse just by looking at their angles. Simple to state, endlessly useful—this theorem will follow you through every geometry course you take!



Acute



Right



Obtuse

Key Concepts & Quick Review

Theorem: $\angle A + \angle B + \angle C = 180°$ for any triangle.

Find the third angle: $\angle C = 180° - \angle A - \angle B$.

Acute triangle: all angles $< 90°$. **Right triangle:** one angle $= 90°$. **Obtuse triangle:** one angle $> 90°$.

Examples

① A triangle has angles $48°$ and $73°$. Find the third angle and classify the triangle.

Think It Through: The three angles in any triangle add to $180°$. Add the two known angles first: $48° + 73° = 121°$. Then subtract from $180°$ to get the missing angle: $180° - 121° = 59°$. Since all three angles are less than $90°$, the triangle is acute.

Answer: *Third angle $= 59°$; acute triangle*

② A triangular roof section has angles $(x + 10)°$, $(2x - 5)°$, and $(x + 15)°$. Find x and all three angles. Is the roof peak obtuse or acute?

Think It Through: Use the triangle angle-sum theorem and add the three expressions: $(x + 10) + (2x - 5) + (x + 15) = 180$. Combine like terms to get $4x + 20 = 180$, so $x = 40$. Substituting back gives angles of $50°$, $75°$, and $55°$. Because every angle is less than $90°$, the roof peak is acute.

Answer: *$x = 40$; $50°$, $75°$, $55°$; acute*

Practice Problems

Find the missing angle(s) and classify the triangle (acute, right, or obtuse).

1. A triangle has two angles measuring $40°$ and $75°$. Find the third angle and classify the triangle. _____
2. A triangle has two angles measuring $90°$ and $37°$. Find the third angle and classify the triangle. _____
3. A triangle has two angles measuring $60°$ and $60°$. Find the third angle and classify the triangle. _____
4. A triangle has two angles measuring $110°$ and $30°$. Find the third angle and classify the triangle. _____
5. A triangle has two angles measuring $45°$ and $45°$. Find the third angle and classify the triangle. _____
6. A triangle has two angles measuring $85°$ and $52°$. Find the third angle and classify the triangle. _____
7. A triangle has angle measures $x°$, $(2x)°$, and $(3x)°$. Find each angle. _____
8. A triangle has angle measures $(x + 10)°$, $x°$, and $(x + 20)°$. Find each angle. _____
9. A triangle has angle measures $(3x)°$, $(2x + 5)°$, and $(x - 5)°$. Find each angle. _____
10. A triangle has angle measures $(4x)°$, $(x + 20)°$, and $(x + 40)°$. Find each angle. _____
11. An isosceles triangle has two equal angles, each measuring $55°$. Find the third angle. _____
12. A right triangle has one acute angle measuring $34°$. Find the other acute angle. _____
13. A triangle has angle measures $(5x - 4)°$, $(3x + 8)°$, and $48°$. Find x. _____
14. An isosceles triangle has vertex angle $40°$. Find each base angle. _____
15. An equilateral triangle has three equal angles. Find the measure of each angle. _____

Study Tips

- Add the two known angles first, then subtract from $180°$. One arithmetic step, not two.
- An **equilateral** triangle has all $60°$ angles. An **isosceles** triangle has two equal angles. Use these as shortcuts.
- After solving for x, **verify**: substitute back and confirm all three angles sum to $180°$.

Word Problems

16. An architect designs a triangular skylight. Two of its angles are $(2n + 8)°$ and $(3n - 12)°$. The third angle must be a right angle for the skylight to fit flush against the wall. Write and solve an equation to find n. Are both other angles acute? Is this a valid right triangle? _____

17. Three scouts hike from camp (point A) to a lake (B) then to a peak (C) and back to camp. The angle at camp is $(4k - 5)°$, at the lake $(2k + 15)°$, and at the peak $(k + 10)°$. Find k and all three angles. What type of triangle does their route form? Which leg of the hike had the sharpest turn? _____

Answer Keys

1) $65°$
2) $53°$
3) $60°$
4) $40°$
5) $90°$
6) $43°$
7) $30°, 60°, 90°$
8) $60°, 50°, 70°$
9) $90°, 65°, 25°$
10) $80°, 40°, 60°$
11) $70°$
12) $56°$
13) $x = 16$
14) $70°$ each
15) $60°$
16) $n = 18.8$; angles $45.6°$, $44.4°$, $90°$; valid right triangle
17) $k \approx 22.9$; angles $86.4°$, $60.7°$, $32.9°$; acute

Step-by-Step Explanations

Strategy: For Solving One-Step Equations, undo the single operation attached to the variable and do the same thing to both sides. One equation line is enough when it shows the inverse operation clearly.

Practice 1: x+7=15 **Answer:** 8
For the first worked item, isolate the variable by undoing the addition or subtraction attached to it.

Practice 15: 1.5x=9 **Answer:** 6
Near the end of this topic, substitute the solution back into the equation to make sure both sides match.

Word-problem notes:

16. Answer: $d - 85 = -240 \Rightarrow d = -155\,m$; still underwater; needs 155 more meters.
Since the submarine rose $85\ m$, the new depth is $85\ m$ less deep than before. One way to write that is $d - 85 = -240$, which means if you go $85\ m$ down from the new depth, you get back to the old depth. Add 85 to both sides to solve: $d = -155$. The submarine is still underwater because the depth is still negative. To reach the surface at $0\ m$, it must rise 155 more meters.

17. Answer: Current: $c = \frac{5}{8}(400) = 250°$F; minutes equation: $20m = 150$.
The current temperature is $\frac{5}{8}$ of the target, so multiply: $c = \frac{5}{8}(400) = 250°$F. That means the oven still needs $400 - 250 = 150°$F more to reach the target. Since it heats at $20°$F per minute, the equation for the remaining time is $20m = 150$. The problem only asks you to write that equation, not solve it yet.

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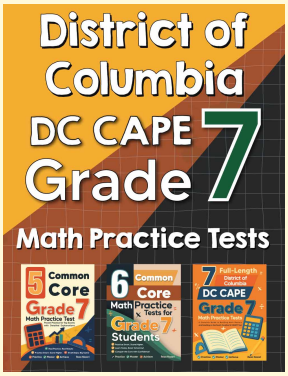

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