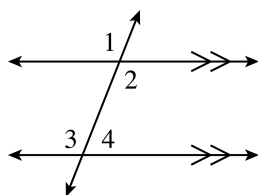


Students learn the relationships created when two parallel lines are intersected by a transversal. They also study angle relationships in triangles.

Parallel lines



- corresponding angles are equal: $m\angle 1 = m\angle 3$
- alternate interior angles are equal: $m\angle 2 = m\angle 3$
- same-side interior angles are supplementary: $m\angle 2 + m\angle 4 = 180^\circ$

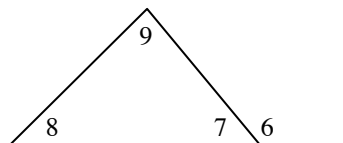
Also shown in the above figures:

- vertical angles are equal: $m\angle 1 = m\angle 2$
- straight angles measure 180° : $m\angle 3 + m\angle 4 = 180^\circ$ and $m\angle 6 + m\angle 7 = 180^\circ$

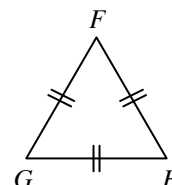
In addition, an isosceles triangle, $\triangle ABC$, has $BA = BC$ and $m\angle A = m\angle C$. An equilateral triangle, $\triangle GFH$, has $GF = FH = HG$ and $m\angle G = m\angle F = m\angle H = 60^\circ$.

For more information, see the Math Notes boxes in Lessons 9.1.2, 9.1.3, and 9.1.4 of the *Core Connections, Course 3* text.

Triangles



- interior angles are supplementary: $m\angle 7 + m\angle 8 + m\angle 9 = 180^\circ$
- exterior angle equals sum of remote interior angles: $m\angle 6 = m\angle 8 + m\angle 9$

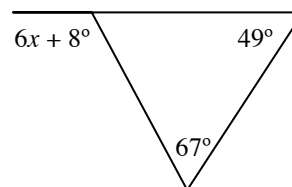


Example 1

Solve for x .

Use the Exterior Angle Theorem:

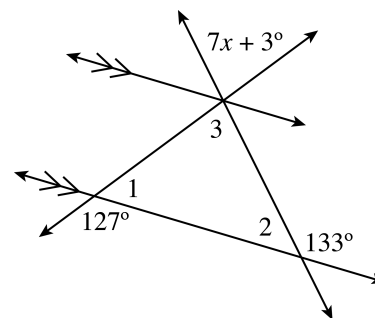
$$6x + 8^\circ = 49^\circ + 67^\circ \Rightarrow 6x^\circ = 108^\circ \Rightarrow x = \frac{108^\circ}{6} \Rightarrow x = 18^\circ$$



Example 2

Solve for x .

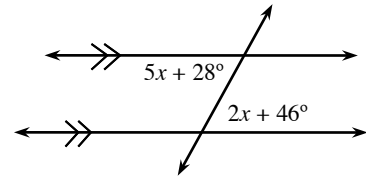
There are a number of relationships in this diagram. First, $\angle 1$ and the 127° angle are supplementary, so we know that $m\angle 1 + 127^\circ = 180^\circ$ so $m\angle 1 = 53^\circ$. Using the same idea, $m\angle 2 = 47^\circ$. Next, $m\angle 3 + 53^\circ + 47^\circ = 180^\circ$, so $m\angle 3 = 80^\circ$. Because angle 3 forms a vertical pair with the angle marked $7x + 3^\circ$, $80^\circ = 7x + 3^\circ$, so $x = 11^\circ$.



Example 3

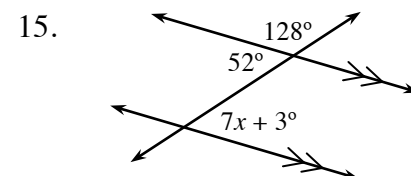
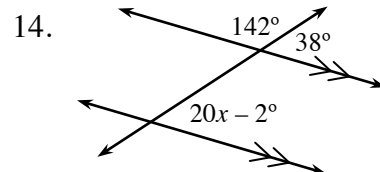
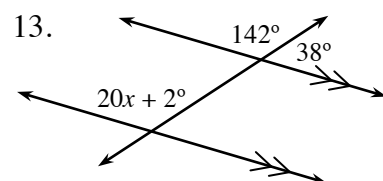
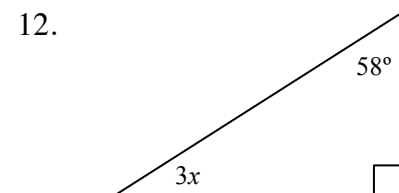
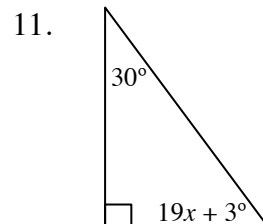
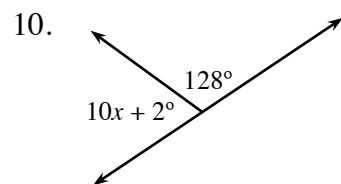
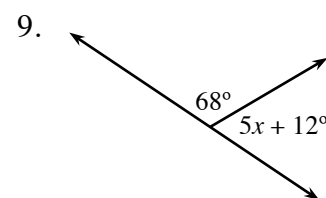
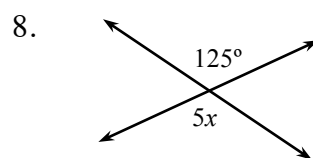
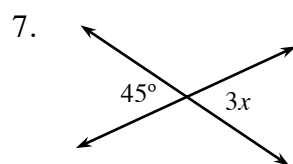
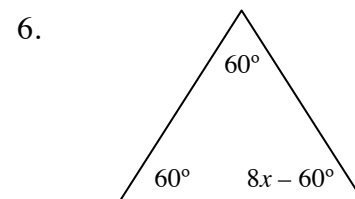
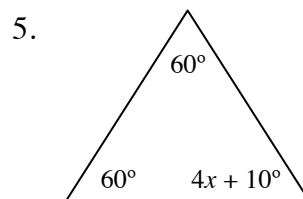
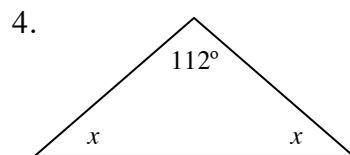
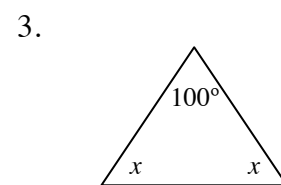
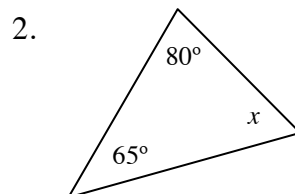
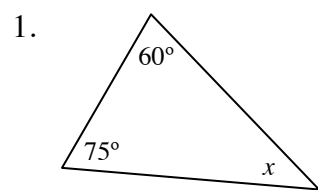
Find the measure of the acute alternate interior angles.

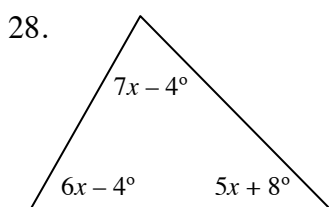
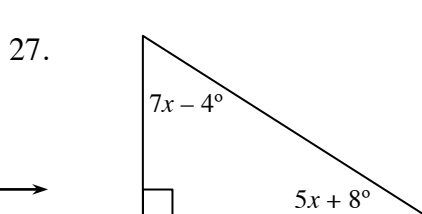
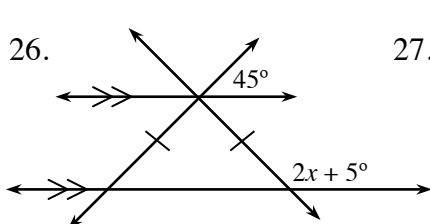
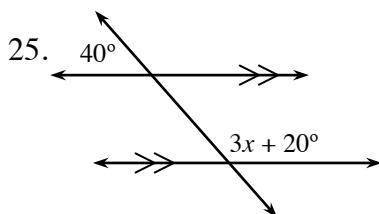
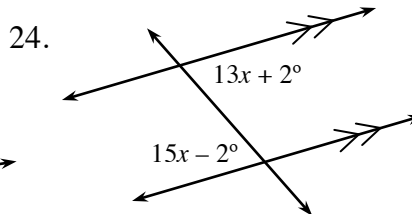
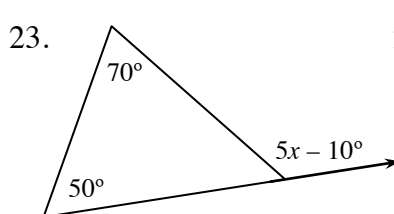
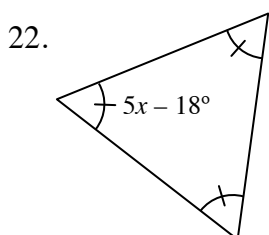
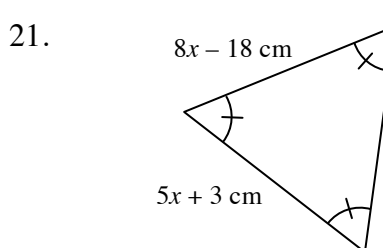
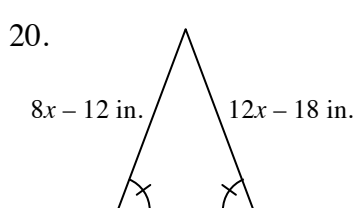
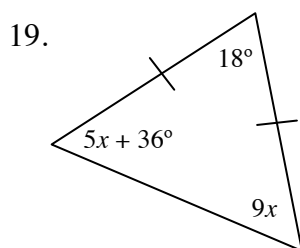
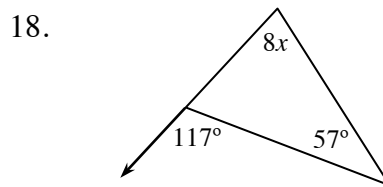
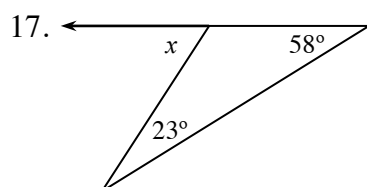
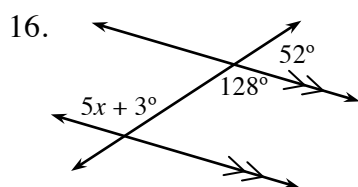
Parallel lines mean that alternate interior angles are equal, so $5x + 28^\circ = 2x + 46^\circ \Rightarrow 3x = 18^\circ \Rightarrow x = 6^\circ$. Use either algebraic angle measure: $2(6^\circ) + 46^\circ = 58^\circ$ for the measure of the acute angle.



Problems

Use the geometric properties you have learned to solve for x in each diagram and write the property you use in each case.





Answers

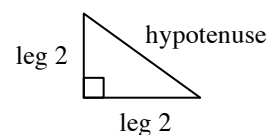
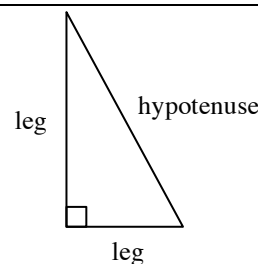
- | | | | | | |
|----------------|-----------------|--------------------------|------------------|-----------------|---------------------------|
| 1. 45° | 2. 35° | 3. 40° | 4. 34° | 5. 12.5° | 6. 15° |
| 7. 15° | 8. 25° | 9. 20° | 10. 5° | 11. 3° | 12. $10\frac{2}{3}^\circ$ |
| 13. 7° | 14. 2° | 15. 7° | 16. 25° | 17. 81° | 18. 7.5° |
| 19. 9° | 20. 7.5° | 21. 7° | 22. 15.6° | 23. 26° | 24. 2° |
| 25. 40° | 26. 65° | 27. $7\frac{1}{6}^\circ$ | 28. 10° | | |

A right triangle is a triangle in which the two shorter sides form a right angle. The shorter sides are called legs. Opposite the right angle is the third and longest side called the hypotenuse.

The Pythagorean Theorem states that for any right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

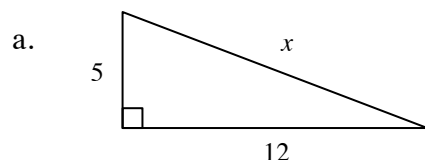
$$(\text{leg } 1)^2 + (\text{leg } 2)^2 = (\text{hypotenuse})^2$$

For additional information, see Math Notes box in Lesson 9.2.3 of the *Core Connections, Course 3* text.



Example 1

Use the Pythagorean Theorem to find x .

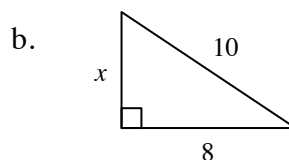


$$5^2 + 12^2 = x^2$$

$$25 + 144 = x^2$$

$$169 = x^2$$

$$13 = x$$



$$x^2 + 8^2 = 10^2$$

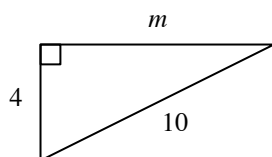
$$x^2 + 64 = 100$$

$$x^2 = 36$$

$$x = 6$$

Example 2

Not all problems will have exact answers. Use square root notation and your calculator.



$$4^2 + m^2 = 10^2$$

$$16 + m^2 = 100$$

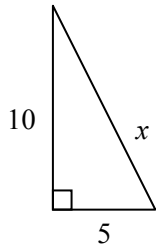
$$m^2 = 84$$

$$m = \sqrt{84} \approx 9.17$$

Example 3

A guy wire is needed to support a tower. The wire is attached to the ground five meters from the base of the tower. How long is the wire if the tower is 10 meters tall?

First draw a diagram to model the problem, then write an equation using the Pythagorean Theorem and solve it.



$$x^2 = 10^2 + 5^2$$

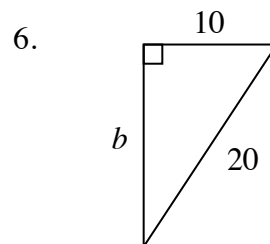
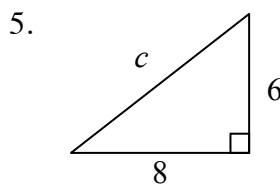
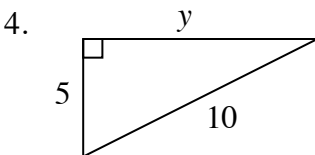
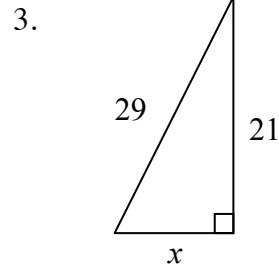
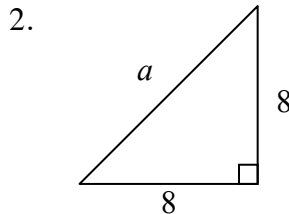
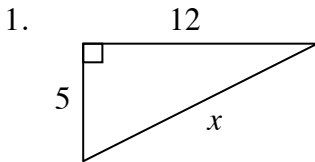
$$x^2 = 100 + 25$$

$$x^2 = 125$$

$$x = \sqrt{125} \approx 11.18 \text{ cm}$$

Problems

Write an equation and solve it to find the length of the unknown side. Round answers to the nearest hundredth.



Draw a diagram, write an equation, and solve it. Round answers to nearest hundredth.

7. Find the diagonal of a television screen 30 inches wide by 35 inches tall.
8. A 9-meter ladder is one meter from the base of a building. How high up the building will the ladder reach?
9. Sam drove eight miles south and then five miles west. How far is he from his starting point?

10. The length of the hypotenuse of a right triangle is six centimeters. If one leg is four centimeters, how long is the other leg?
11. Find the length of a path that runs diagonally across a 55-yard by 100-yard field.
12. How long an umbrella will fit in the bottom of a suitcase 1.5 feet by 2.5 feet?

Answers

1. 13
2. 11.31
3. 20
4. 8.66
5. 10
6. 17.32
7. 46.10 in.
8. 8.94 m
9. 9.43 mi
10. 4.47 cm
11. 114.13 yd
12. 2.92 ft