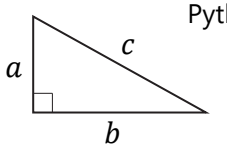
LESSON 121 Applications of Radicals

☐ SOLVING WORD PROBLEMS INVOLVING RIGHT TRIANGLES

Recall from geometry that the **Pythagorean Theorem** states that, if a triangle is a right triangle, the sum of the squares of its legs equals the square of its hypotenuse. See the diagram on the right.

You can use the Pythagorean Theorem to find the unknown side lengths of right triangles.



Pythagorean Theorem

$a^2 + b^2 = c^2$

➔ **EXAMPLE** Find b when $a = 9$ and $c = 12$.

$9^2 + b^2 = 12^2$	Pythagorean Theorem
$b^2 = 63$	Isolate b.
$b = \sqrt{63}$	Take the squre root.
$b = 3\sqrt{7}$	Simplify.

➔ **TRY IT** Find the missing side.

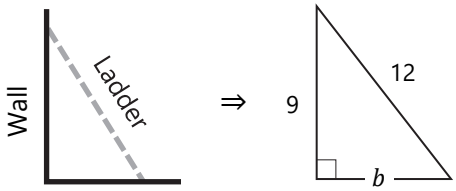
1. Find c when $a = 3$ and $b = 3$.

2. Find a when $b = 5$ and $c = 13$.

When solving a word problem involving right triangles, draw a picture to illustrate the situation.

➔ **EXAMPLE** A 12-foot ladder is leaning against a wall. The top of the ladder is 9 feet above the ground. How far is the bottom of the ladder from the wall?

See the pictures on the right. Notice that this problem is essentially the same as the example above.



➔ **TRY IT 3.** A 13-foot ladder is leaning against a wall. The bottom of the ladder is 5 feet from the wall. How high up on the wall will the top of the ladder reach?

☐ SOLVING WORD PROBLEMS INVOLVING RADICALS

Many real-world formulas involve radicals. When solving a word problem given a formula, 1) plug the given value(s) into the formula and 2) solve for the unknown.

➔ **EXAMPLE** The formula $v = \sqrt{64d}$ gives the speed v in feet per second of an object in free fall after falling d feet. What is the distance an object has fallen when its speed reaches 32 feet per second?

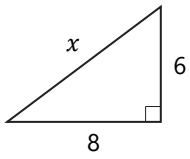
1. Plug v = 32 into the formula.
   $32 = \sqrt{64d}$
2. Square both sides and solve for d, and you get d = 16.
   The object has fallen 16 feet.

➔ **TRY IT 4.** Use the formula above to find the distance that an object has fallen when its speed reaches 24 feet per second.

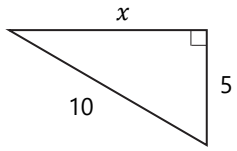
☐ **EXERCISE YOUR SKILLS**

Find the missing side. Leave your answer in simplest radical form, if applicable.

5.



6.



Solve. Leave your answer in simplest radical form, if applicable.

7. A 10-foot ladder is leaning against a wall. The ladder reaches a height of 8 feet. How far is the bottom of the ladder from the wall?

8. Mike's house is 3 km east and 6 km north of Leah's house. What is the straight-line distance between the two houses?

9. The diagonal of a monitor is 16 inches. The width of the monitor is 12 inches. What is the height of the monitor?

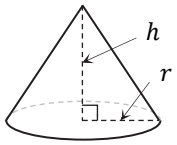
10. The hypotenuse of a right triangle is 15 cm, and one of its legs is 12 cm. What is the perimeter of the triangle?

11. The area of a square is 49 cm^2. What is the length of the diagonal?

12. The formula $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ gives the distance d between two points (x_1, y_1) and (x_2, y_2). What is the distance between the two points $(1, 5)$ and $(2, 7)$?

13. The period of a pendulum is the time it takes the pendulum to swing back and forth once. The formula $P = 2\pi\sqrt{\frac{L}{32}}$ gives the period P in seconds for a pendulum with length L feet. What is the length of a pendulum with period 2 seconds? Give your answer in terms of π.

14. The formula $S = \pi r^2 + \pi r\sqrt{r^2 + h^2}$ gives the surface are of a cone with radius r and height h. What is the height of a cone with radius 3 cm and surface area 24π cm^2?



(EXTRA) Solve. Leave your answer in simplest radical form, if applicable.

15. The distance d in miles that a lookout can see is given by the formula $d = \sqrt{1.5h}$, where h is the height in feet above the surface of the water. How far would a submarine periscope have to be above the water to see a ship 3 miles away?

16. The radius r of a cylinder with volume V is given by the formula $r = \sqrt{\frac{V}{\pi h}}$, where h is the height of the cylinder. What is the height of a cylinder with radius 2 cm and volume 36π cm^3?