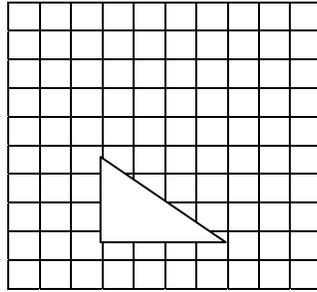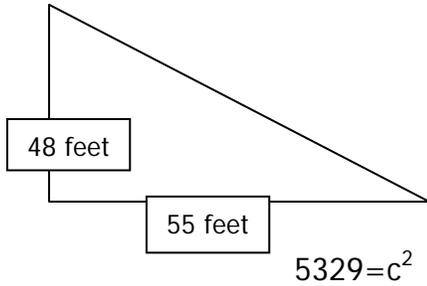# 5-5-2 Working with the Pythagorean Theorem

The short sides of a right triangle are called legs. The long side is the hypotenuse.

Pythagorean Theorem

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

The theorem says for this triangle with one leg 3 units long and another leg 4 units long, the hypotenuse can be found by $3^2+4^2=c^2$ This simplifies to $9+16=c^2$. So $25=c^2$. c, the hypotenuse must be 5 units long.

48 feet

55 feet

Example: Find the length of the hypotenuse for a right triangle with legs 55 feet and 48 feet.
Solution: Because the triangle is a right triangle and two dimensions are known, use the Pythagorean Theorem.
$a^2+b^2=c^2$ so $48^2+55^2=c^2$ The 48 and 55 could be switched.
$$2304+3025=c^2$$
$5329=c^2$ Now take the square root of both sides $73=c$ of the equation.

A problem has to specify the triangle is a right triangle. It could say there is one ninety degree angle, or it could draw a picture with a little square in one corner of a picture of a triangle.

Practice: Find the hypotenuse for each set of legs given for these right triangles.
a) 3 in. and 4 in.   24 cm and 7 cm   6 ft. and 8 ft.

b) 21 m and 20 m   45 in. and 28 in.   65 mm and 72 mm

c) 5 miles and 12 miles   30 yards and 40 yards   91 furlongs and 60 furlongs

d) 75 ft. and 100 ft.   80 in. and 84 in.   30 ft. and 16 ft.

In the next problems the answer will not be an integer. Round the calculator answer to the nearest hundredth.
e) 2 in. and 2 in.   4 cm and 7 cm   6 ft. and 6 ft.

f) 10 m and 5 m   1 in. and 1 in.   6.5 mm and 7.2 mm

g) 5 miles and 9 miles   1 yards and 8 yards   8.4 furlongs and 6.2 furlongs

h) $^1/_3$ ft. and $^1/_3$ ft.   2 $^1/_4$ in. and $^7/_8$ in.   ½ ft. and ¾ ft.

Problems are more complicated if one leg and the hypotenuse is known and the measurement of the other leg is what is asked.

23 feet

265 feet

X

The hypotenuse is 265 feet and one leg is 23 feet. What is the length of the other leg?

Use the Pythagorean Theorem $a^2+b^2=c^2$ $(23)^2 + b^2 = (265)^2$
This simplifies. $529 + b^2 = 70225$
Subtract 529 form both sides. $b^2 = 69696$
Take the square root of both sides. $b = 264$ feet
Because a length is needed, only the positive root is used for an answer.

Practice: Find the other leg of each right triangle for the given leg and hypotenuse.

a) leg 4 in. and hypotenuse 5 in.	leg 12 cm. and hypotenuse 13 cm.	leg 72 m. and hypotenuse 97 m.	leg 21 in. and hypotenuse 29 in.
b) leg 51 in. and hypotenuse 149 in.	leg 84 in. and hypotenuse 116 in.	leg 42 in. and hypotenuse 58 in.	leg 65 in. and hypotenuse 97 in.
c) leg $1\,^3/_5$ in. and hypotenuse $3\,^2/_5$ in.	leg 0.5 cm and hypotenuse 1.3 cm	leg $^3/_4$ in and hypotenuse 1 ¼ in.	leg 0.68955 m and hypotenuse 1 m. Use a calculator and approximate.

Practice: Solve the following problems using the Pythagorean Theorem.

d) A septic tank is on one corner of a lot. The owner wants to drill a well in the opposite corner. By code these must be 100 feet apart. Unfortunately the house is between the septic tank and the well, so direct measurement is impossible. Using the drawing of the house, well, and tank decide if the well and tank are at least 100 feet apart.

Well

60 feet

Tank

91 feet

e) Jack needs to know how much decorative trim to cut for an awning. He can hook his tape measure from the peak of the roof, but he would be unable to use one ladder to measure the slanted length. Use the drawing to find the length needed.

Trim

27 feet

20 feet

48 feet

2