The formulas for cones are related to those for pyramids: L.A. $= \frac{1}{2}pl$ and $V = \frac{1}{3}Bh$. Since the base of a cone is a circle, we again substitute $2\pi r$ for p and πr^2 for B and get the following formulas.

Theorem 12-7

The lateral area of a cone equals half the circumference of the base times the slant height. (L.A. $= \frac{1}{2} \cdot 2\pi r \cdot l$, or L.A. $= \pi rl$)

Theorem 12-8

The volume of a cone equals one third the area of the base times the height of the cone. ($V = \frac{1}{3}\pi r^2 h$)

So far our study of solids has not included formulas for oblique solids. The volume formulas for cylinders and cones, but *not* the area formulas, can be used for the corresponding oblique solids. (See the Extra on pages 516–517.)

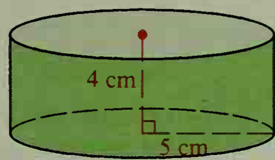
Example 1 A cylinder has radius 5 cm and height 4 cm. Find the **(a)** lateral area, **(b)** total area, and **(c)** volume of the cylinder.

Solution

a. L.A. $= 2\pi rh = 2\pi \cdot 5 \cdot 4 = 40\pi$ (cm^2)

b. T.A. $=$ L.A. $+ 2B$
$= 40\pi + 2(\pi \cdot 5^2) = 90\pi$ (cm^2)

c. $V = \pi r^2 h = \pi \cdot 5^2 \cdot 4 = 100\pi$ (cm^3)



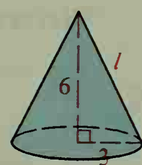
Example 2 Find the **(a)** lateral area, **(b)** total area, and **(c)** volume of the cone shown.

Solution

a. First use the Pythagorean Theorem to find l.
$l = \sqrt{6^2 + 3^2} = \sqrt{45} = 3\sqrt{5}$
L.A. $= \pi rl = \pi \cdot 3 \cdot 3\sqrt{5} = 9\pi\sqrt{5}$

b. T.A. $=$ L.A. $+ B = 9\pi\sqrt{5} + \pi \cdot 3^2 = 9\pi\sqrt{5} + 9\pi$

c. $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi \cdot 3^2 \cdot 6 = 18\pi$



Classroom Exercises

1. **a.** When the label of a soup can is cut off and laid flat, it is a rectangular piece of paper. (See the diagram below.) How are the length and width of this rectangle related to r and h?
   b. What is the area of this rectangle?