

- Step 3 Check your conjecture by repeating Step 2 until the prism is filled.
- Step 4 Choose a cone-cylinder pair with congruent bases and the same height and repeat the procedure in Steps 2 and 3. (Try to use a pair with bases different from those of other groups.)

Compare your results with the results of others. Did you get similar results with both your pyramid-prism and cone-cylinder pairs? You should be ready to make a conjecture.



C-98 If B is the area of the base of a pyramid or a cone and H is the height of the solid, then the formula for the volume is $V = \frac{1}{3}BH$. (*Pyramid-Cone Volume Conjecture*).

Notice that all pyramids, regardless of the type of base they have, use the same volume formula. To calculate the volume of a pyramid, first identify the type of base the pyramid has and use the area formula for that base to calculate its area. Then find the product of the area of the base and the height of the pyramid and multiply by the fraction you discovered in Investigation 11.4.

Take Another Look 11.4

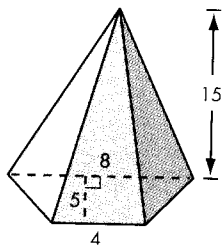
- Use algebra to show that if you double the height of a prism, a cylinder, a pyramid, or a cone, you double the volume, but that if you double the dimensions of the base, you increase the volume by more than two times. By how many times does the volume increase?
- Use algebra to show that if you double all three dimensions of a prism, a cylinder, a pyramid, or a cone, the volume is increased eightfold but the surface area is increased only four times.
- * Build a model of three pyramids with equal volumes that can be assembled into a prism.

Exercise Set 11.4

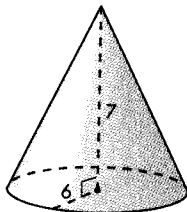
- Draw and label two different rectangular pyramids with volumes of 384 cm^3 .
- Draw and label two different circular cones with volumes of $2304\pi \text{ cm}^3$.

Find the volume of each solid named in Exercises 3-8. All measurements are given in centimeters.

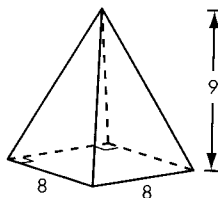
3.* Trapezoidal pyramid



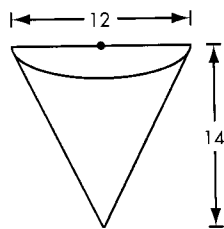
4.* Right cone



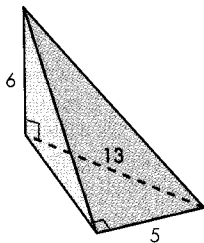
5. Square pyramid



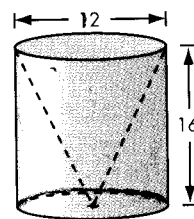
6. Semicircular cone



7.* Right triangular pyramid



8.* Cylinder with cone removed

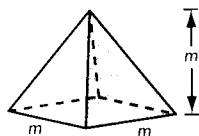


9. Use the information about the base and height of each solid to find the volume. All measurements are given in centimeters.

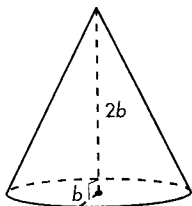
Information about base of solid	Height of solid	Use $b, h, H.$	Use $b, h, H.$	Use $b, b_2, h, H.$	Use $r, H.$
$b = 6, b_2 = 7, h = 6, r = 3$	$H = 20$	a. $V = ?-?$	d. $V = ?-?$	g. $V = ?-?$	j. $V = ?-?$
$b = 9, b_2 = 22, h = 8, r = 6$	$H = 20$	b. $V = ?-?$	e. $V = ?-?$	h. $V = ?-?$	k. $V = ?-?$
$b = 13, b_2 = 29, h = 17, r = 8$	$H = 24$	c. $V = ?-?$	f. $V = ?-?$	i. $V = ?-?$	l. $V = ?-?$

In Exercises 10-12, express the volume of each solid with the help of algebra. All measurements are given in centimeters. The pyramid has a square base.

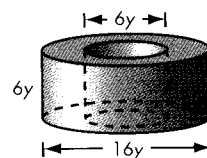
10.



11.*

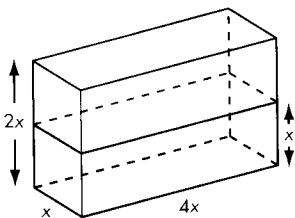


12.

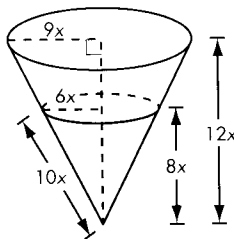


In Exercises 13-15, find the volume of the liquid in each rectangular prism and in the cone. All measurements are given in centimeters.

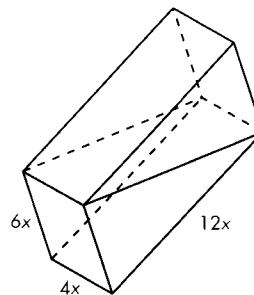
13.



14.*



15.



For Exercises 16 and 17, sketch and label each solid described, then find the volume.

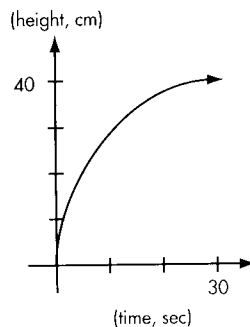
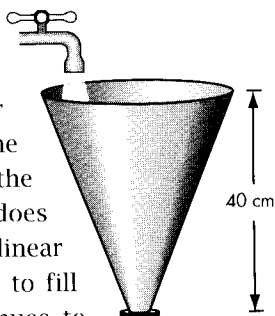
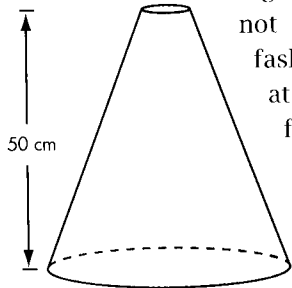
16. A square pyramid. The height of the pyramid is H feet, and the altitude meets the square base at the intersection of the two diagonals. Each side of the base measures M feet.

17. A right cone. The slant height is $13B$. (The slant height is the length of a segment from the vertex to the circumference of the base of a right cone.) The radius of the base is $5B$. Calculate and label the height of the cone.

18.* As horrific as tanker oil spills are, they contribute only about 12% of the 3.5 million tons of oil that enters the oceans each year. The rest comes from routine tanker operations such as loading and off-loading oil, tank washings and wastewater discharges, runoff from sewage treatment plants, natural sources, and offshore oil rigs. One month's maintenance and routine operation of a single supertanker produces up to 17,000 gallons of oil sludge that gets into the ocean! If a cylindrical barrel is about 1.6' in diameter and 2.8' tall, about how many such barrels would be needed to hold 17,000 gallons of oil sludge?

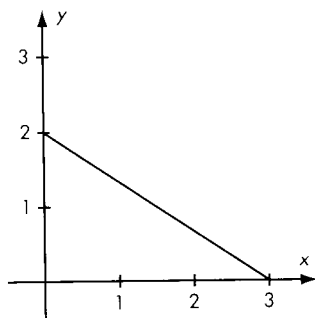
19. The conical-shaped container shown at right is to be filled at a steady rate.

The time in seconds it takes to fill the container to the top is graphed at far right. As you see in the graph, because the container is not uniform in radius, the height of the water does not increase in a linear fashion. It is quick to fill at first but continues to fill at a slower and slower rate.



Sketch an approximate graph for the container shown at left, showing the relationship between time and height of water. Assume the container takes 30 seconds to fill.

20. Find the volume of the solid formed by rotating the shaded figure about the x -axis.



21. Sketch the prism that can be formed from this net.

