

Hi everyone!

This week we will continue our look at **surface area**, with respect to cylinders. We will then move on to developing and applying the formula for the **volume** of right prisms and cylinders.

To start, let's remember from last week:

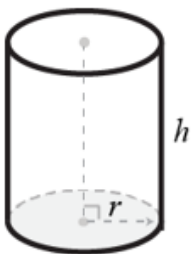
A prism or cylinder is defined as "right" when all the faces, other than the bases, are rectangles and are perpendicular to the bases.

\*When we looked at these shapes earlier in the year, we explored their nets. Often the net of the shape is used so we can clearly see each of the faces of the prism.

To find the **surface area** of a prism or cylinder is to find the **sum of the area of all the faces of a 3D object**.

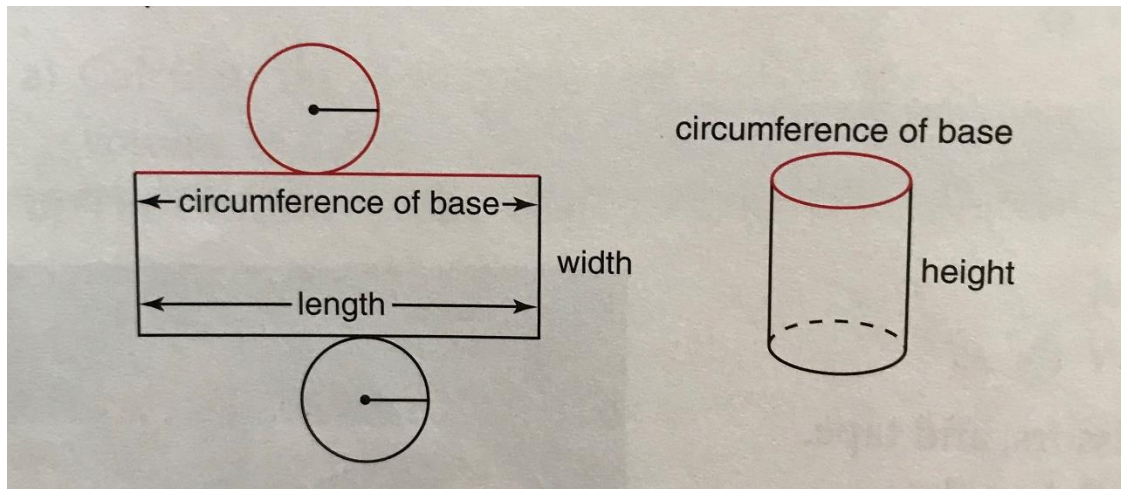
A **right cylinder** is made up of two circular bases and the curved surface is a rectangle when laid flat.

\*The best way to show yourself this, is to try it! Take a tissue paper roll, draw a straight line from top to bottom, and cut along the line. When you unroll the tube, you will have a rectangle! (we did this earlier in the year when looking at nets)



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The net for the right cylinder looks like this:



Where the circumference (perimeter) of the circular base is the length of the rectangle.

The height of the cylinder is the width (height) of the rectangle.

Again, the best way to see this is to TRY it!

Remember too:

Squares & rectangles:  $A = \text{base} \times \text{height}$



$$= bh$$

Circles:  $A = \pi r^2$  \*Remember:  $r^2 = r \times r$



$C = \pi d$  OR if given the radius,  $C = 2\pi r$  where  $d = 2r$

The surface area of the right cylinder will then be the sum of the area of the two circular bases and the rectangle.

SA = area of top circle + area of bottom circle + area of rectangle

$$= \pi r^2 + \pi r^2 + bh$$

\*base = length of rectangle, is the circumference of the circle

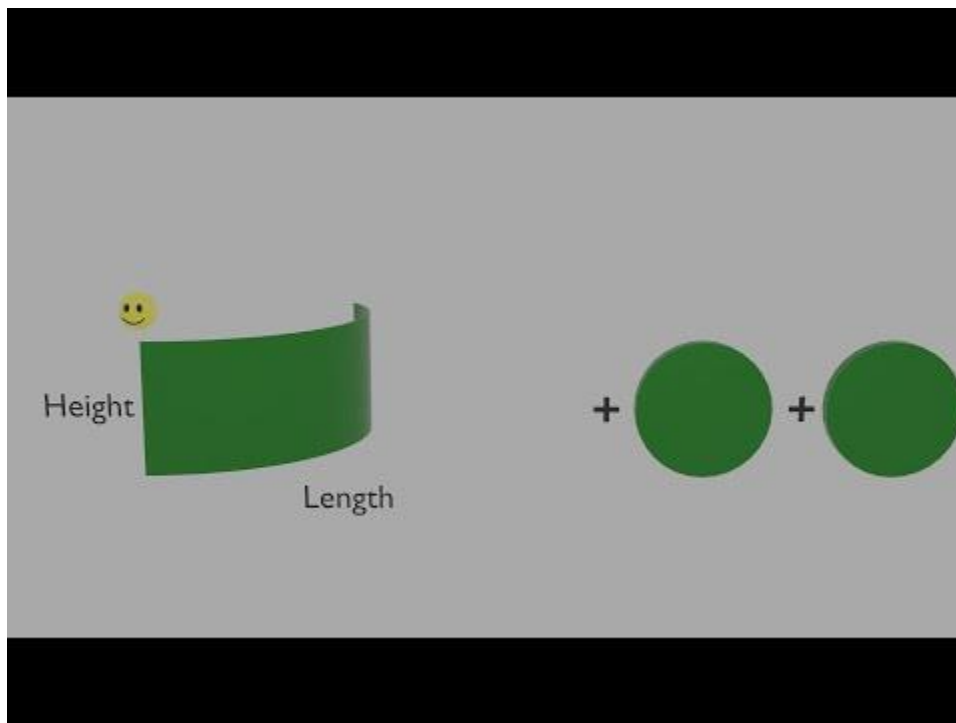
$$= 2 \times (\pi r^2) + \pi d \times h$$

Note again:  $C = \pi d$

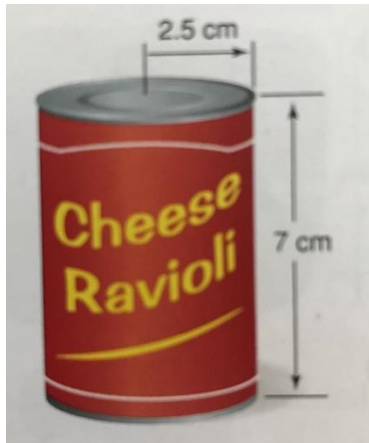
$$\text{Or} = 2(\pi r^2) + 2\pi r \times h$$

$$= 2\pi r$$

The following video will help to clarify what you have been reading:



Let's try an example: Find the surface area of the Ravioli can



SA = area of top circle + area of bottom circle + area of rectangle side

$$= \pi r^2 + \pi r^2 + \pi d \times h$$

$$* r^2 = r \times r$$

$$* d = 2r$$

$$= 2 (\pi r^2) + \pi dh$$

$$= 2 \times 2.5 \text{ cm}$$

$$= 2 (3.14 \times 2.5 \text{ cm} \times 2.5 \text{ cm}) + 3.14 \times 5 \text{ cm} \times 7 \text{ cm}$$

$$= 5 \text{ cm}$$

$$= 2 (19.625 \text{ cm}^2) + 109.9 \text{ cm}^2$$

$$= 39.25 \text{ cm}^2 + 109.9 \text{ cm}^2$$

$$= 149.15 \text{ cm}^2$$

From here, let's try the circled questions on the next pages to practice.

## Practice

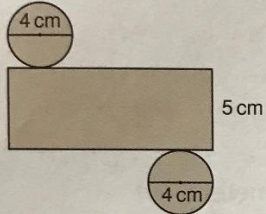
Hint: the curved surface is only the rectangle

### Check

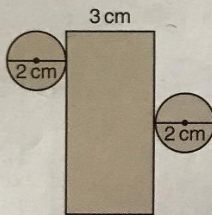
Give each area to the nearest square unit.

4. Find the area of each net.

a)

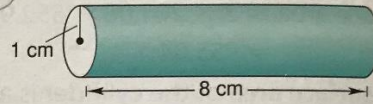


b)

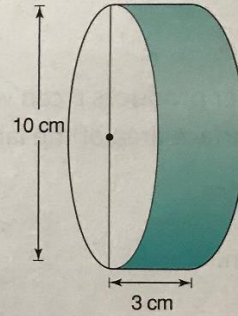


6. Calculate the curved surface area of each tube.

a)



b)

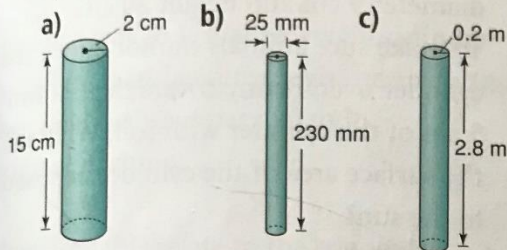


(see next page)



### Apply

8. Calculate the surface area of each cylinder.



9. A cylindrical tank has diameter 3.8 m and length 12.7 m. What is the surface area of the tank?
10. Cylindrical paper dryers are used in pulp and paper mills. One dryer has diameter 1.5 m and length 2.5 m. What is the area of the curved surface of this dryer?
11. A wooden toy kit has different painted solids. One solid is a cylinder with diameter 2 cm and height 14 cm.

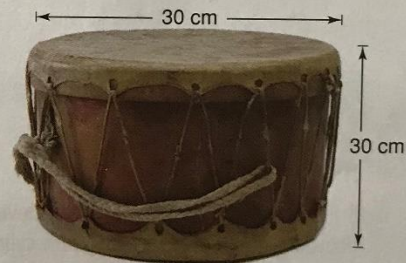


- a) What is the surface area of the cylinder?
- b) One can of paint covers  $40 \text{ m}^2$ . Each cylinder is painted with one coat of paint. How many cylinders can be painted with one can of paint?

### 12. Assessment Focus

A soup can has diameter 6.6 cm. The label on the can is 8.8 cm high. There is a 1-cm overlap on the label. What is the area of the label?

13. A hot water tank is cylindrical. Its interior is insulated to reduce heat loss. The interior has height 1.5 m and diameter 65 cm. What is the surface area of the interior of the tank? Give the answer in two different square units.
14. A tom-tom hoop drum is made of stretched membranes, called heads, which are held tightly across a tubular shell. The drum has diameter 30 cm and height 30 cm. The shell of the drum is made of 5 layers of birch sheathing.



- a) How much sheathing is needed to make the shell?
- b) Suppose the drum has two heads. How much membrane would you need to make the heads? What assumptions do you make?

For some online practice, check Netmath at [www.netmath.ca](http://www.netmath.ca) for lesson: Solving problems involving calculating the area of a cylinder

**\*Note: solving for lateral area means to solve for the area of the rectangular part of the cylinder**

The second part of this week's lessons is developing and applying the formula for the **volume** of right prisms and cylinders.

**Let's refresh our memory a little about volume:**

The **volume** of an object is a measure that describes the amount of space that an object occupies (measured in cubic units -  $\text{mm}^3$ ,  $\text{cm}^3$ , etc.)

Volume is not affected by the orientation of the object.

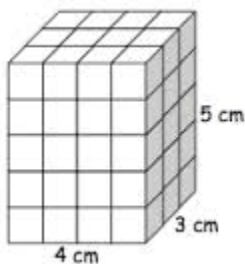
An object's volume should be thought of as the area of the base, multiplied by it's height.

The relationship between volume and capacity (the amount a container can hold) states:  $1\text{cm}^3 = 1\text{mL}$

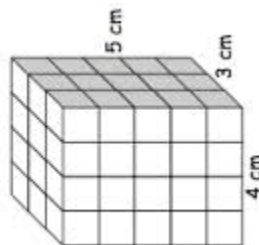
We know from previous years that the formula for volume is

$$V = b \times w \times h \quad \text{OR} \quad V = A_b \times h \quad (\text{where } A_b \text{ is the area of the base})$$

**1. Volume of a right rectangular prism:**



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If we went back to grade 5, and counted the number of unit cubes in the prism, we would most likely count how many cubes are in one layer first.

We can see in the top layer, there are 3 rows of 4 cubes, so 12 cubes in one layer.

Then, because there are 5 layers, we would multiply the 12 cubes in one layer by 5 to get 60 cubes, so the volume would be 60 cubic units. ( $60u^3$ )

Instead of counting cubes, we can simply use our formula:

$$\begin{aligned} V &= A_b \times h \\ &= \underline{4\text{cm} \times 3\text{cm}} \times 5\text{cm} \\ &\quad \swarrow A_b \\ &= 12\text{cm}^2 \times 5\text{cm} \\ &= 60\text{cm}^3 \end{aligned}$$

We can see too, regardless of the orientation of the shape, the volume will stay the same as the dimensions do not change, and the order we multiply doesn't affect the product. (commutative property)

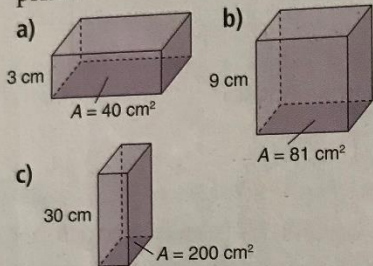
Let's try a few from the text, you do not have to do all parts of each circled question, even one will give you practice. (see next pages)



## Practice

q.4 Hint:  $V = A_b \times h$ , the area of the base is given, so just multiply by the height!

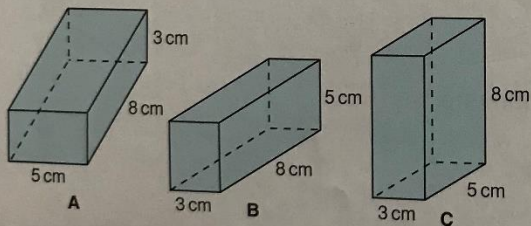
4. The base area and height of each prism are given. Find the volume of each prism.



5. A box of laundry detergent has dimensions 28 cm by 16 cm by 25 cm.

- Sketch the box. Label each dimension.
- What volume of detergent will fill the box?

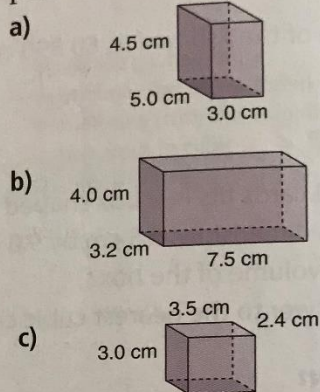
6. a) Find the volume of each prism.



- What do you notice about the volumes in part a?
- Does the volume of a rectangular prism change when you place the prism on a different base? Justify your answer.

## Apply

7. Find the volume of each rectangular prism.



8. Find a right rectangular prism in the classroom. Measure its dimensions. Find its volume.

9. Each dogsled team that enters the Iditarod has a portable doghouse for each sled dog. Two mushers are comparing the sizes of their doghouses. Each of Rick's doghouses is 94 cm by 63 cm by 71 cm. Each of Susan's doghouses is 109 cm by 71 cm by 81 cm.

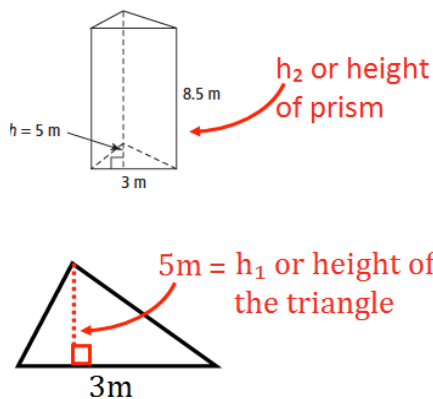
- What is the volume of each doghouse?
- About how many times as great as the volume of Rick's doghouse is the volume of Susan's doghouse?

Hint: 1 L = 1 000 mL

10. Suppose a milk carton is 10 cm wide and 10 cm long. How tall must the carton be to hold 1 L of milk?

Recall  $1 \text{ cm}^3 = 1 \text{ mL}$ .

## 2. Volume of a right triangular prism:



$$\begin{aligned}v &= AOB \cdot h \\v &= \left(\frac{b \cdot h_1}{2}\right) \cdot h_2 \\v &= \left(\frac{3 \cdot 5}{2}\right) \cdot 8.5 \\v &= \left(\frac{15}{2}\right) \cdot 8.5 \\v &= 7.5 \text{ m}^2 \cdot 8.5 \\v &= 63.75 \text{ m}^3\end{aligned}$$

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In the above example, finding the volume is done using the same formula,  $V = A_b \times h$ .

For a right triangular prism, the base is a triangle, so the formula becomes:

$$\begin{aligned}V &= A_b \times h & * \text{ Remember, } A_b, \text{ the area of a triangle is } A &= \frac{bh}{2} \\&= \frac{bh}{2} \times h & \text{ height of the prism (length between the bases)}\end{aligned}$$

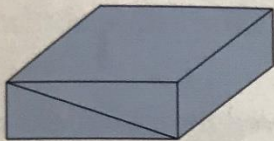
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Let's try some of these. Remember, even try just one in each question.

**check**

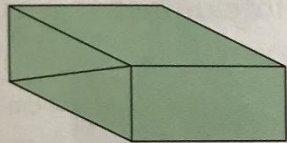
3. Each rectangular prism is divided into 2 congruent triangular prisms along the diagonal shown. The volume of each rectangular prism is given. Find the volume of each triangular prism.

a)



Volume =  $450 \text{ cm}^3$

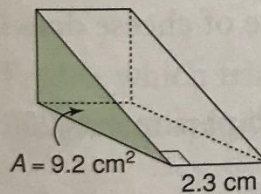
b)



Volume =  $624 \text{ cm}^3$

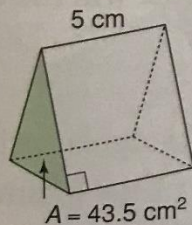
4. The base area and length of each triangular prism are given. Find the volume of each prism.

a)

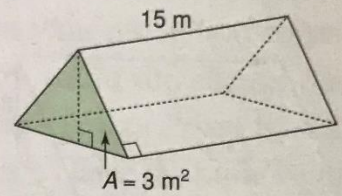


Hint: Area of base is given, just multiply by the height (length of prism)

b)

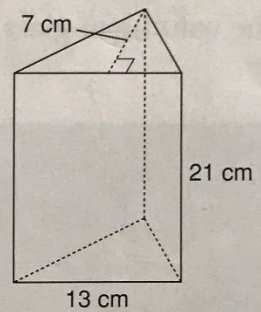


c)

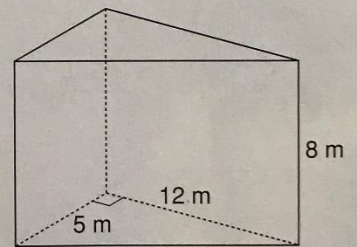


5. Find the volume of each triangular prism.

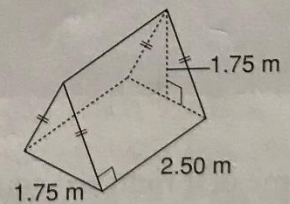
a)



b)



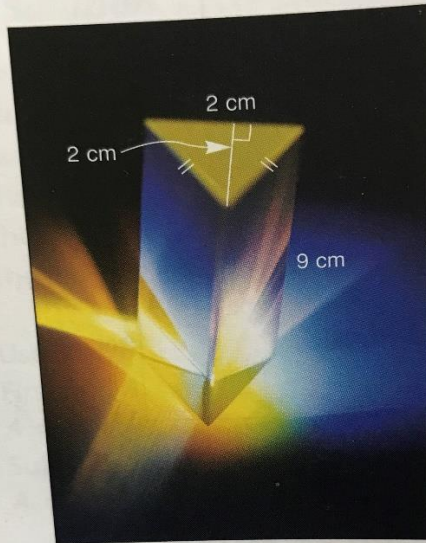
c)





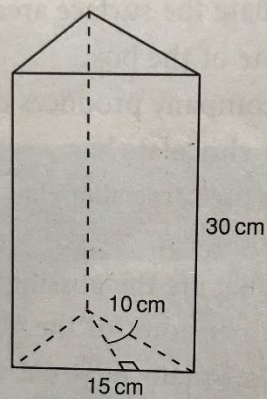
12.0 cm

7. What is the volume of glass in this glass prism?



8. The volume of a right triangular prism is  $30 \text{ cm}^3$ . Each triangular face has area  $4 \text{ cm}^2$ .  
How long is the prism?

14. a) Find the volume of this prism.



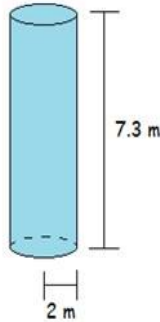
- b) Suppose the prism contains 1350 mL of water.  
What is the depth of the water?
- c) What percent of the volume of the prism is water?

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### 3. Volume of a right cylinder:

Again, finding the volume is done using the same formula

$$V = A_b \times h$$



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For a right cylinder, **the base is a circle**, so the formula becomes

$$\begin{aligned} V &= A_b \times h & * \text{Remember } A_b, \text{ the area of a circle is } A &= \pi r^2 \\ &= \pi r^2 \times h & \rightarrow \text{height of the prism (length between the bases)} \\ & & * \text{Remember too, } r^2 &= r \times r \end{aligned}$$

To find the volume of the above cylinder:

$$\begin{aligned} V &= A_b h \\ &= \pi r^2 h \\ &= 3.14 \times 2\text{m} \times 2\text{m} \times 7.3\text{m} \\ &= 3.14 \times 4\text{m}^2 \times 7.3\text{m} \\ &= 91.688 \text{ m}^3 \\ &= 91.69 \text{ m}^3 \quad (\text{rounded to two decimal places}) \end{aligned}$$

**Note:** If given the diameter of the circular base first, you will have to use  $r = d \div 2$ , to find the radius before solving for the volume.

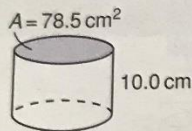
Let's try some of these (see next page)

## Practice

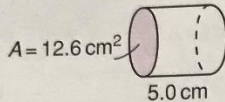
q.4 Hint: the area of the base is given, just multiply by the height

4. The base area and height of each cylinder are given to one decimal place. Calculate the volume of each cylinder.

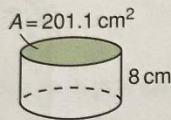
a)



b)

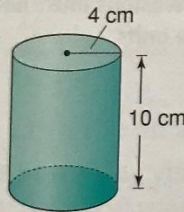


c)

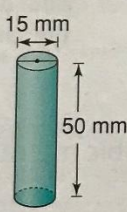


5. Calculate the volume of each cylinder.

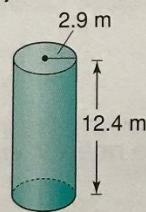
a)



b)



c)

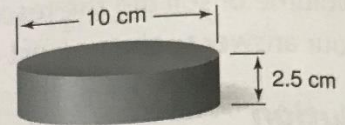


6. A candle mould is cylindrical. Its radius is 5 cm and its height is 20 cm. What volume of wax will fit in the mould?

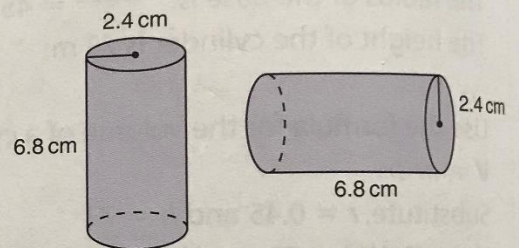
## Apply

7. Find a right cylinder in the classroom.
- Measure its height and diameter.
  - Calculate its base area.
  - Calculate its volume.

8. A hockey puck is a solid piece of rubber with the dimensions shown. How much rubber is used to make a hockey puck?



9. How do the volumes of these cylinders compare? How can you tell without calculating each volume?



10. Kari has 125 mL of water. She wants to pour it into one of these cylindrical bottles. Which bottle will hold all the water? How do you know?

Bottle A:  $d = 7$  cm,  $h = 3$  cm

Bottle B:  $r = 2$  cm,  $h = 6$  cm

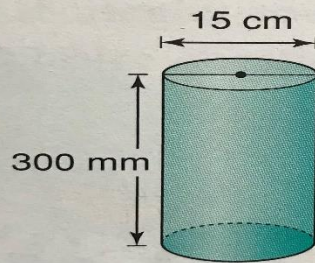
Bottle C:  $r = 3.5$  cm,  $h = 7$  cm

Bottle D:  $d = 3$  cm,  $h = 4$  cm

11. **Assessment Focus** Frozen apple juice comes in cylindrical cans. A can is 12 cm high with radius 3.5 cm.
- What is the capacity of the can?
  - What happens to the capacity of the can if the dimensions of the radius and height are switched? Why does this happen?



12. A core sample of soil is cylindrical. The length of the core is 300 mm. Its diameter is 15 cm. Calculate the volume of soil.



For some online practice on Volume check Netmath at [www.netmath.ca](http://www.netmath.ca) for the lesson:

1. Calculating the volume of right prisms 1
2. Calculating the volume of cylinders

**Remember** this is a lot of information! Space it out, you do NOT have to do every question, take your time and simply do your best 😊 Have a fantastic week!

For a little fun I'll leave you with the following video:

