

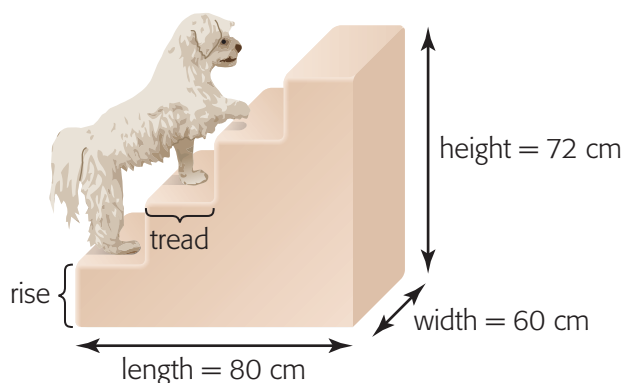
Composite Objects and Their Components

GOAL

Decompose objects into right rectangular prisms, right triangular prisms, and right cylinders.

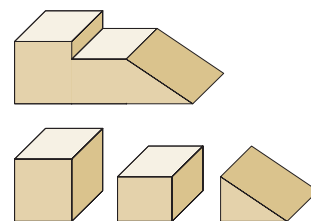
LEARN ABOUT the Math

Yvonne wants to build a set of carpeted pet stairs, as shown. Yvonne could make this **composite object** using rectangular prisms or triangular prisms.



composite object

an object that can be decomposed into component parts, such as prisms and cylinders; e.g., this composite object can be decomposed into two rectangular prisms and one triangular prism.



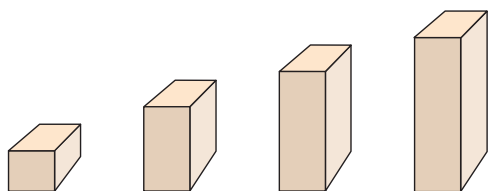
Communication Tip

In this book, when you are asked to decompose an object, it means to decompose it into triangular prisms, rectangular prisms, or cylinders.

? What are the dimensions of the components?

EXAMPLE 1 Using different sizes of an object

Nicole's Solution: Using rectangular prisms



height of 4 steps = 72 cm

rise of each step = $72 \div 4 = 18$ cm

I saw that I could decompose the stairs into four rectangular prisms.

I determined the rise of each step.

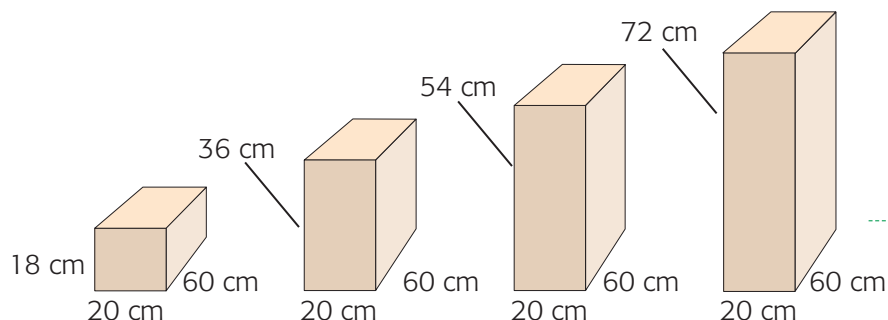
I assumed that each rise was the same.

The shortest prism has a height equal to the rise of the first step, or 18 cm.

Each prism should be 18 cm taller than the previous one.

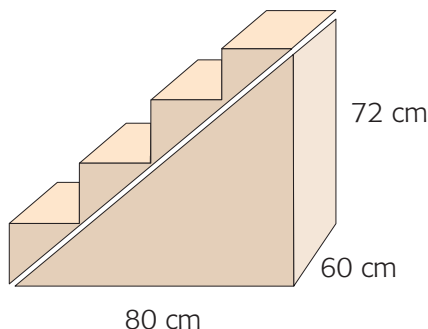
length of four steps = 80 cm
 tread = $80 \div 4 = 20$ cm

Next, I determined the tread of each step.



I knew that each step was 60 cm wide, so I could label all the dimensions in my diagram.

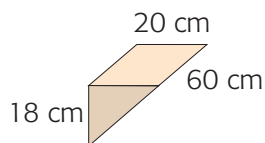
Austin's Solution: Using right triangular prisms



Looking at the side view, I saw that I could decompose the steps to form a large right triangular prism and some smaller ones. The large prism is 80 cm long, 60 cm wide, and 72 cm high.

$$\begin{aligned} \text{rise} &= \frac{1}{4} \times 72 \\ &= 18 \text{ cm} \end{aligned} \quad \begin{aligned} \text{tread} &= \frac{1}{4} \times 80 \\ &= 20 \text{ cm} \end{aligned}$$

I assumed that all of the steps on the stairs are the same size. Each step must have a rise of $\frac{1}{4}$ of the total height, and a tread of $\frac{1}{4}$ of the total length. The width of each step is 60 cm.



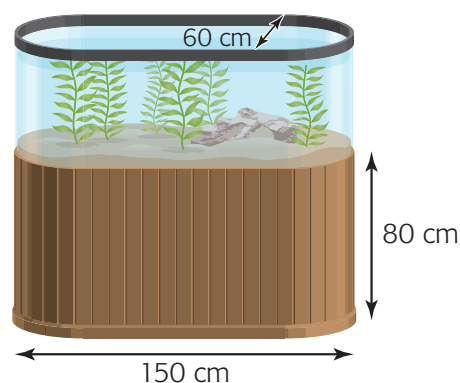
Reflecting

- Whose solution did you prefer, and why?
- Suggest another possible solution.
- Explain how decomposing a composite object makes it easier to determine its volume.

WORK WITH the Math

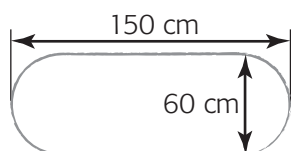
EXAMPLE 2 Determining component parts

An aquarium has this object for a base. What component parts make up this base and what are their dimensions?



Derek's Solution

top view



I drew a top view of the base, with its dimensions.
I noticed that each end is semicircular.

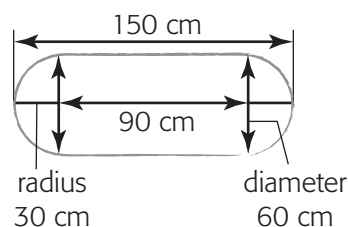
The width is a diameter, so the radius of the semicircles is 30 cm.

$$150 - 30 = 120$$

$$120 - 30 = 90 \text{ cm}$$

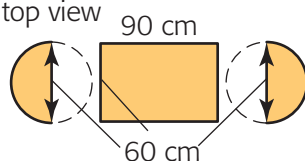
I subtracted the radius twice from the overall length to calculate the distance between the two semicircles.

top view

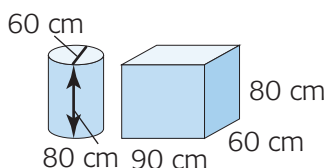


I added the new dimensions to my diagram.

top view



I drew the diagram again, decomposing it into two semicircles and a rectangle.



The semicircles in my diagram are the tops of half-cylinders in the actual object. I joined them to form a whole cylinder. The rectangle is the top of a prism.

The components are a rectangular prism and two half-cylinders, which are like a single cylinder.

In Summary

Key Idea

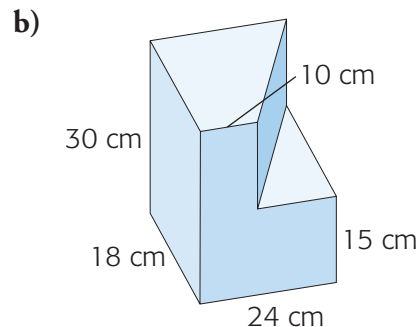
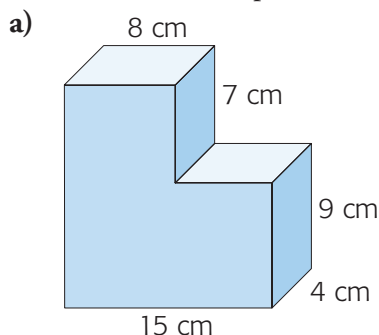
- It is possible to decompose a composite object in more than one way.

Need to Know

- When decomposing a composite object, look for the following component parts: triangular prisms, rectangular prisms, and cylinders.

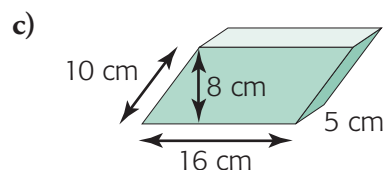
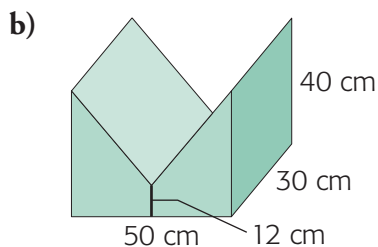
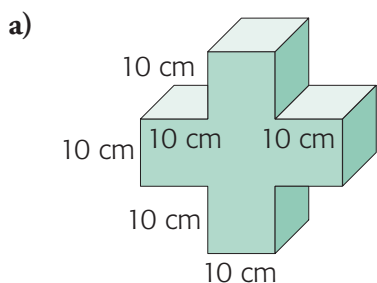
Checking

- Sketch two different ways to decompose each object. Include dimensions of each part.

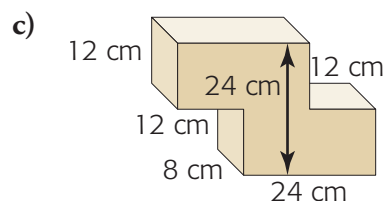
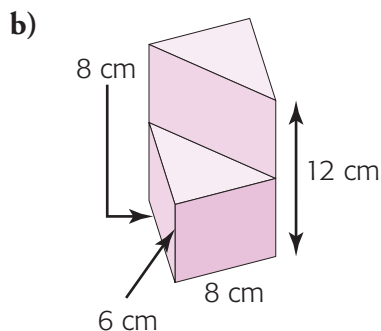
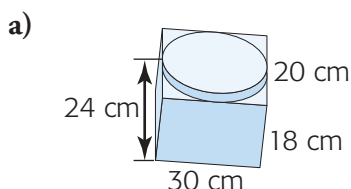


Practising

- Sketch two different ways to decompose each object. Include dimensions of each part.

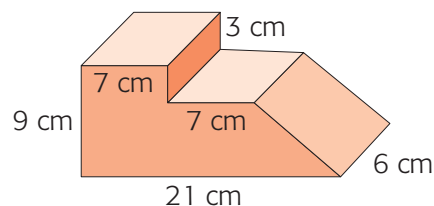
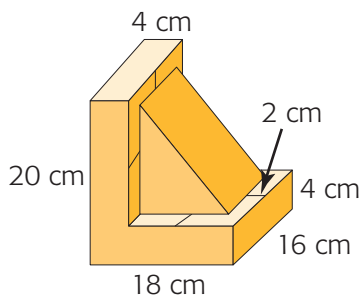


- Decompose each object into two components. Include dimensions of each part.



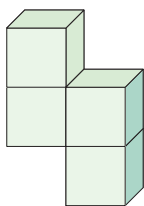
4. Sketch one way to decompose the red object at right.

5. William wants to make a set of bookends, one of which is shown. The triangular-prism support is inset by 2 cm on all sides. What are the dimensions of the components for each bookend?

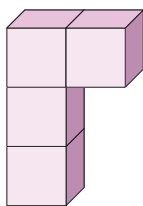


6. **Multiple choice.** A video game involves filling a space using the following four objects. Each individual cube measures 1 unit on each edge. Which one of these objects cannot be decomposed into two prisms, each with two cubes?

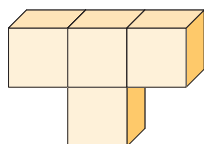
A.



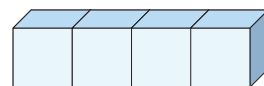
B.



C.

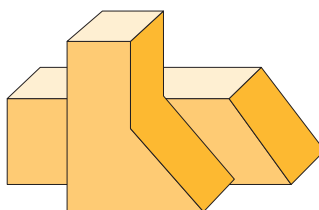


D.



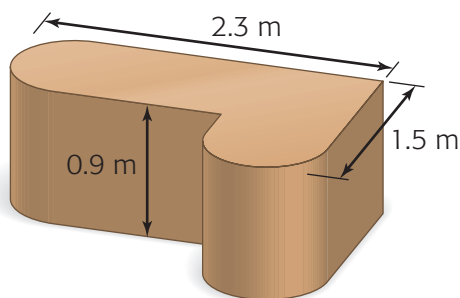
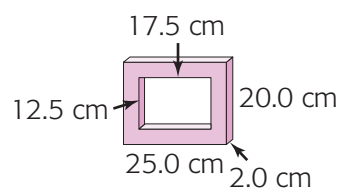
7. **Multiple choice.** What is the least number of triangular or rectangular prism components in this object?

- A. 3
- B. 4
- C. 5
- D. 6

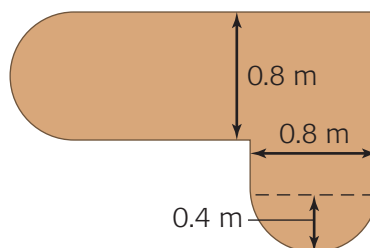


8. Sketch one way to decompose the picture frame shown at right.

9. Describe one way to decompose this desk.

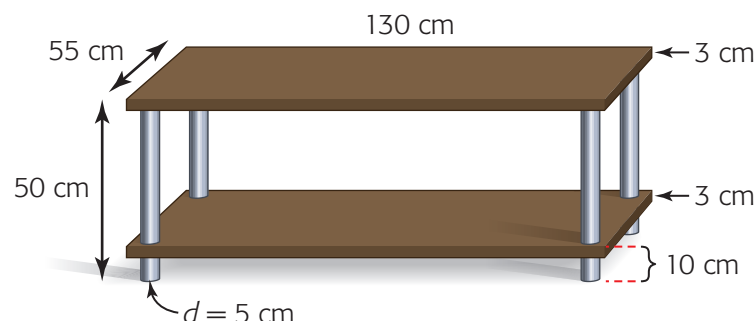


side view



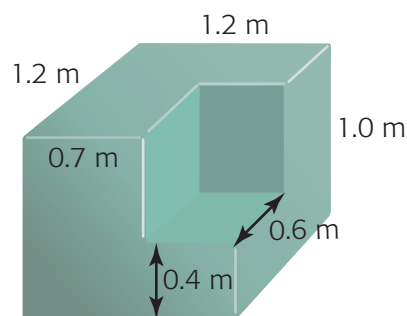
top view

10. Describe one way to decompose this television stand. Assume that the cylindrical posts do not go through the bottom shelf.



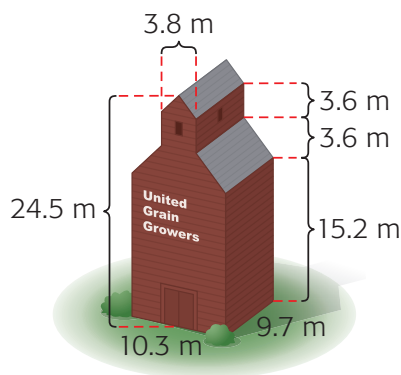
11. This chair was made by combining foam blocks and covering them with upholstery.

- a) Describe three ways in which the chair might have been made from component pieces of foam. State the dimensions of each component part.
- b) Could the chair have been made from a single foam block? Explain.



12. Determine the component objects and their dimensions for this grain elevator.

13. a) Find an example of a composite object in your school, at home, or in your town. Sketch the object and its component parts.
- b) Exchange your example with a classmate. Sketch the component parts of your classmate's composite object.
- c) Compare your solutions for both objects. Did both of you decompose them in the same way?



Closing

14. Composite objects can be decomposed in more than one way. Explain with an example why one way might be preferable to another.

Extending

15. This piece of foam is packed around a circular vase for shipping. What are the component parts and what are their dimensions?
16. Sketch a set of component parts, including their dimensions, for this model of a toy.

