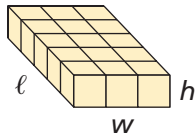


## Applications

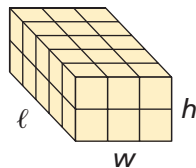
In Exercises 1–3, rectangular prisms are made using 1-inch cubes.

- Find the length, width, and height of each prism.
- Find the amount of material needed to make a box for each prism.
- Find the number of cubes in each prism.

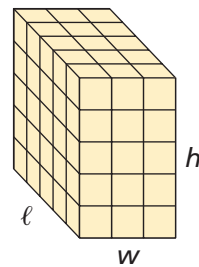
1.



2.

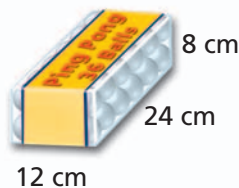


3.



- Suppose you plan to make a box that will hold exactly 40 one-inch cubes.
  - Give the dimensions of all the possible boxes you can make.
  - Which box has the least surface area? Which box has the greatest surface area?
  - Why might you want to know the dimensions of the box with the least surface area?

- Each of these boxes holds 36 ping-pong balls.



- Without figuring, which box has the least surface area? Why?
- Check your guess by finding the surface area of each box.

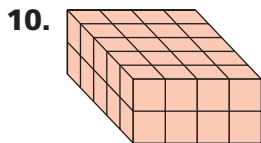
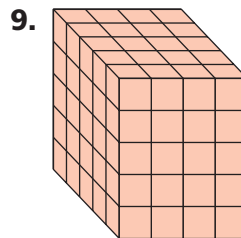
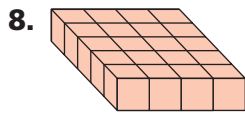
6. a. The box at the right is a  $6 \times 2 \times 1$  arrangement of drink cans. Suppose the dimensions of the box are, in centimeters,  $39 \times 13 \times 12.25$ . Compare the surface area of the box with the more traditional  $4 \times 3 \times 1$  arrangement, which measures, in centimeters,  $26 \times 19.5 \times 12.25$ .
- b. The box at the right is a  $4 \times 3 \times 2$  arrangement of drink cans. Suppose the dimensions of the box are, in centimeters,  $26 \times 19.5 \times 24.5$ . Compare the surface area of the box with the more traditional  $6 \times 4 \times 1$  arrangement, which measures, in centimeters,  $39 \times 26 \times 12.25$ .



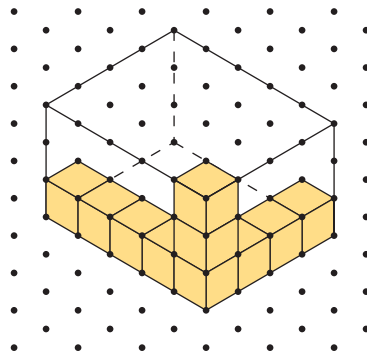
7. a. Sketch a rectangular box with dimensions 2 centimeters by 7 centimeters by 3 centimeters.
- b. What is the surface area of the box?
- c. Draw a net for the box on grid paper. What is the relationship between the area of the net and the surface area of the box?

**In Exercises 8–10, rectangular prisms are drawn using inch cubes.**

- a. Find the length, width, and height of each prism.
- b. Find the volume of each prism. Describe how you found the volume.
- c. Find the surface area of each prism. Describe how you found the surface area.



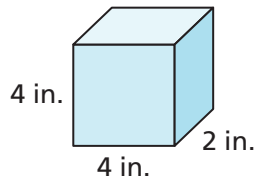
- 11. a.** What is the total number of cubes, including the cubes already shown, needed to fill the closed box below?



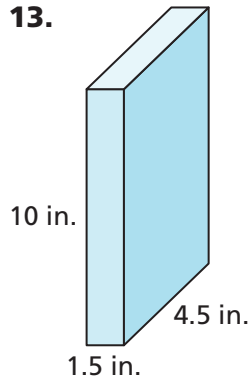
- b.** What is the surface area of the box?

**For Exercises 12–14, find the volume and surface area of the closed box.**

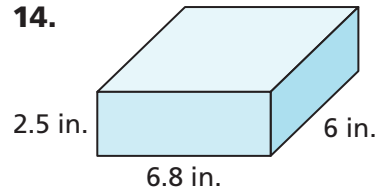
**12.**



**13.**



**14.**



- 15. a.** Make a sketch of a closed box with dimensions 2 centimeters by 3 centimeters by 5 centimeters.
- b.** How many centimeter cubes will fit in one layer at the bottom of the box?
- c.** How many layers are needed to fill the box?
- d.** Find the volume of the box.
- e.** Find the surface area of the box.
- 16.** Mr. Turner’s classroom is 20 feet wide, 30 feet long, and 10 feet high.
- a.** Sketch a scale model of the classroom. Label the dimensions of the classroom on your sketch.

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- b. Find the volume of the classroom. Why might this information be useful?
- c. Find the total area of the walls, the floor, and the ceiling. Why might this information be useful?



17. Each expression below will help you to find the volume or surface area of one of the boxes pictured. Simplify each expression. Decide whether you have found a volume or a surface area, and for which box.

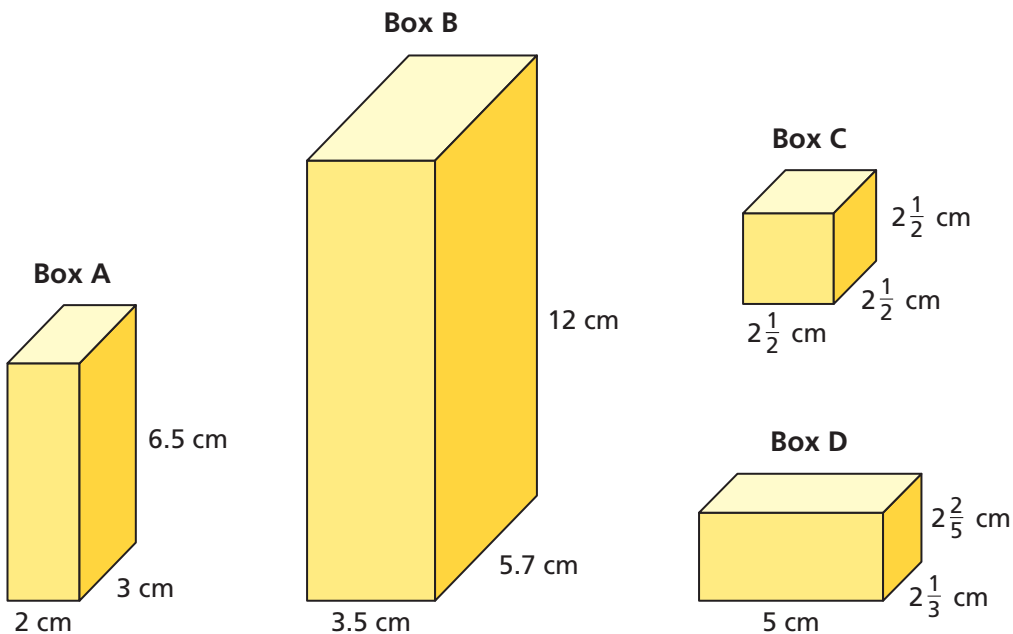
a.  $2 \times (3.5 \times 5.7) + 2 \times (5.7 \times 12) + 2 \times (3.5 \times 12)$

b.  $6\frac{1}{4} \times 6$

c.  $6 \times 6\frac{1}{2}$

d.  $2\frac{1}{3} \times 2\frac{2}{5} \times 5$

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- 18.** The city of Centerville plans to dig a rectangular landfill. The landfill will have a base with dimensions 700 ft by 200 ft and a depth of 85 ft.
- How many cubic feet of garbage will the landfill hold?
  - What information do you need to determine how long the landfill can be used until it is full?
  - Centerville hires an excavator to dig the hole for the landfill. How many cubic yards of dirt will he have to haul away?



- 19.** Describe the dimensions of a rectangular prism with a volume of 80 cubic inches but a surface area of less than 132 square inches.

## Connections

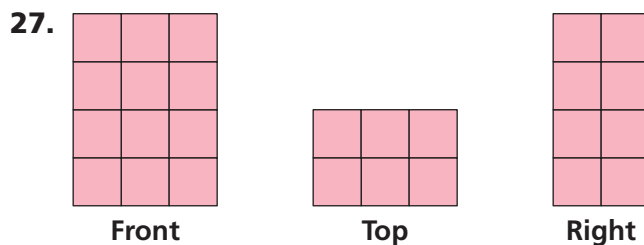
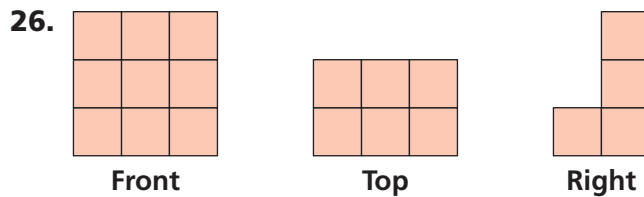
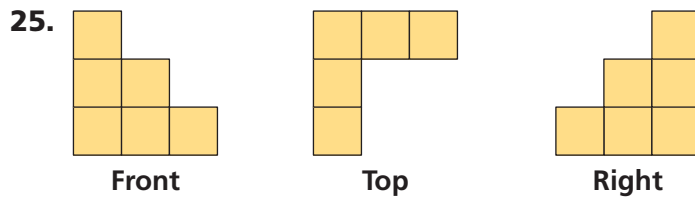
- 20.**
- There is only one way to arrange five identical cubes into the shape of a rectangular prism. Sketch the rectangular prism made from five identical cubes.
  - Find more numbers of cubes that can be arranged into a rectangular prism in only one way. What do these numbers have in common?
- 21.**
- Sketch every rectangular prism that can be made from ten identical cubes.
  - Find the surface area of each prism you sketched.
  - Give the dimensions of the prism that has the least surface area.
- 22.**
- Each of the boxes you designed in Problem 2.1 had a rectangular base and a height. Use a graph to show the relationship between the area of the base and the height of each box.
  - Describe the relationship between the height and the area of the base.
  - How might your graph be useful to a packaging engineer at ATC Toy Company?

23. The dimensions of the recreation center floor are 150 ft by 45 ft, and the walls are 10 ft high. A gallon of paint will cover  $400 \text{ ft}^2$ . About how much paint is needed to paint the walls of the recreation center?



24. If a small can of paint will cover 1,400 square inches, about how many small cans are needed to paint the walls of the recreation center described in Exercise 23?

**For Exercises 25–27, use the three given views of a three-dimensional building to sketch the building. Then, find its volume.**



## Extensions

- 28.** Many drinks are packaged in rectangular boxes of 24 cans.
- During the spring of 1993, a company announced that it was going to package 24 twelve-ounce cans into a more cube-like shape. Why might the company have decided to change their packaging?
  - List all the ways 24 twelve-ounce cans of soda can be arranged and packaged in a rectangular box. Which arrangement do you recommend that a drink company use? Why?
- 29.** Slam Dunk Sporting Goods packages its basketballs in cubic boxes with 1-foot edges. For shipping, the company packs 12 basketballs (in its boxes) into a large rectangular shipping box.
- Find the dimensions of every possible shipping box into which the boxes of basketballs would exactly fit.
  - Find the surface area of each shipping box in part (a).
  - Slam Dunk uses the shipping box that requires the least material. Which shipping box does it use?
  - Slam Dunk decides to ship basketballs in boxes of 24. It wants to use the shipping box that requires the least material. Find the dimensions of the box it should use. How much more packaging material is needed to ship 24 basketballs than to ship 12 basketballs?

