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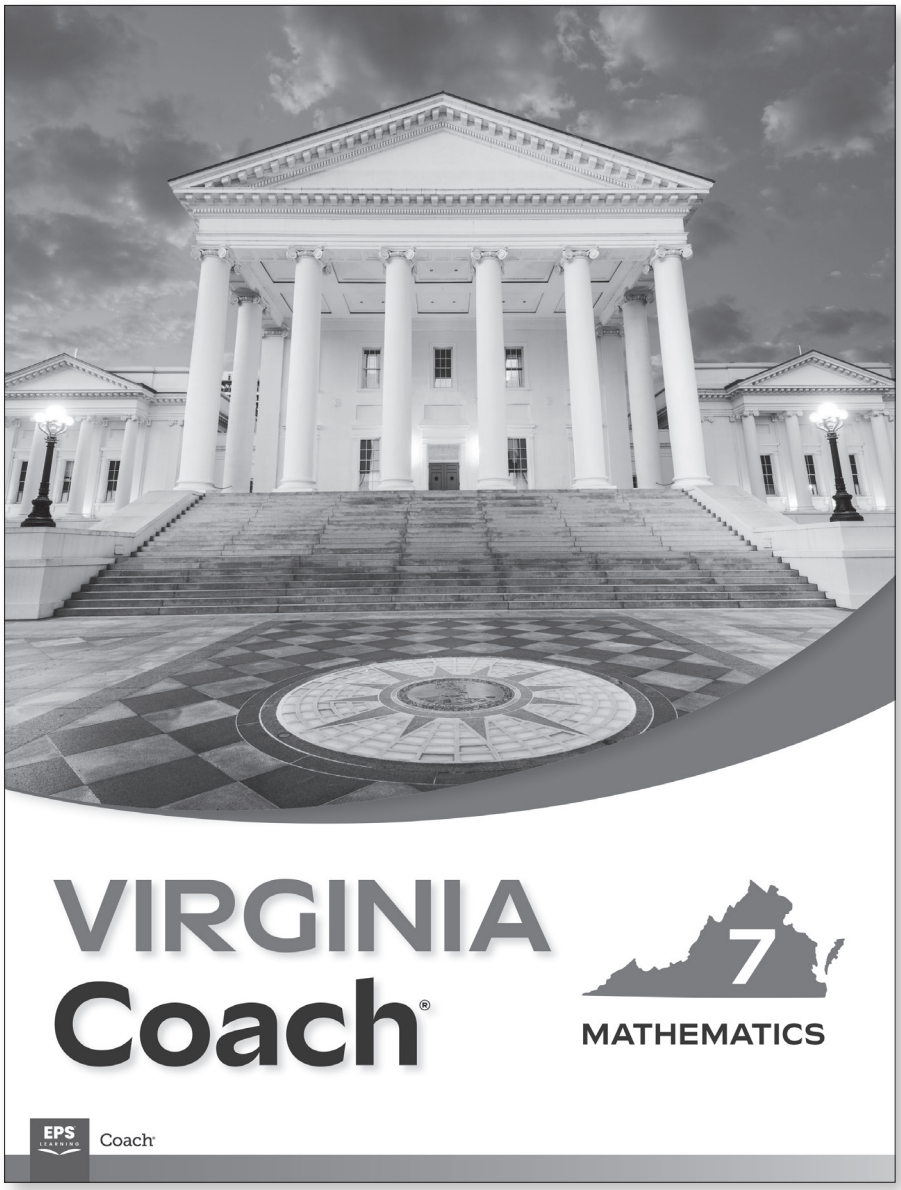
7

MATHEMATICS

EPS LEARNING Coach®

Contents



GRADE 7

LESSON 11 SAMPLE

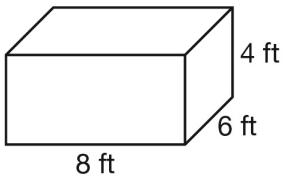
Effects of Changing Dimensions

Getting the Idea

When one dimension of a rectangular prism—such as its length, width, or height—is multiplied by a **scale factor**, the volume of that prism will change by the same scale factor. For example, if the length of a rectangular prism were multiplied by a scale factor of 2, the volume would also by multiplied by 2, or doubled.

Example 1

McCabe & Co. regularly use a packing crate, in the shape of a rectangular prism, to ship orders to its customers. The crate measures 8 feet long, 6 feet wide, and 4 feet tall. The company wants to start using a new crate that is half as tall as the regular crate. Compare the volumes of the two crates.



Strategy **Use the formula for the volume of a rectangular prism.**

Step 1 Find the volume of the regular crate.

$V = lwh$

$V = 8 \times 6 \times 4$

$V = 192 \text{ ft}^3$

Step 2 Determine the dimensions of the new crate.

length $= 8$ ft

width $= 6$ ft

height $= \frac{1}{2} \times 4 = 2$ ft

Step 3 Find the volume of the new crate.

$V = lwh$

$V = 8 \times 6 \times 2$

$V = 96 \text{ ft}^3$

Step 4 Compare the volume of the two crates.

$\frac{96}{192} = \frac{1}{2}$

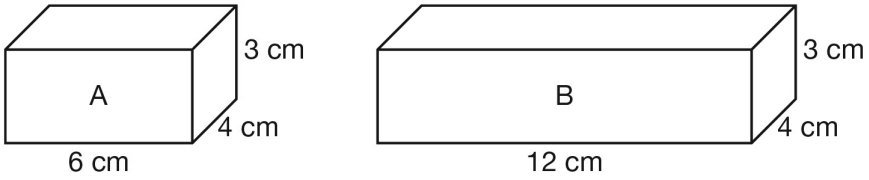
The new crate's volume is half the volume of the regular crate, which matches the scale factor by which the height of the regular crate was changed.

Solution **The new crate's volume is half the volume of the regular crate.**

When you change one dimension of a rectangular prism, the surface area of the prism also is changed, but not in the same way as its volume. The change in the surface area will not match the scale factor by which the dimension is changed. But if the dimension is multiplied by a scale factor less than 1—such as $\frac{1}{2}$—the surface area will decrease. If the dimension is multiplied by a scale factor greater than 1—such as 2—the surface area will increase.

Example 2

Rectangular prisms A and B have the dimensions shown below. Compare the surface areas of the two prisms.



Strategy **Use the formula for the surface area of a rectangular prism.**

Step 1 Compare the dimensions of the two prisms.

The length of prism B is twice that of prism A: $6 \times 2 = 12$.

The widths and heights of the prisms are the same.

Step 2 Find the surface area of prism A.

$S.A. = 2lw + 2lh + 2wh$

$S.A. = (2 \times 6 \times 4) + (2 \times 6 \times 3) + (2 \times 4 \times 3)$

$S.A. = 108 \text{ cm}^2$

Step 3 Find the surface area of prism B.

$S.A. = 2lw + 2lh + 2wh$

$S.A. = (2 \times 12 \times 4) + (2 \times 12 \times 3) + (2 \times 4 \times 3)$

$S.A. = 192 \text{ cm}^2$

Step 4 Compare the surface areas of the two prisms.

$\frac{192}{108} = 1\frac{7}{9}$

Prism B's surface area is greater than that of prism A. But prism B's surface area is not twice that of prism A, even though prism B is twice as long as prism A.

Solution **The surface area of prism B is greater than, but not twice, the surface area of prism A.**

Coached Example

Sarita built a rectangular prism with a volume of 98.4 cubic inches. James built a rectangular prism with a volume of 24.6 cubic inches. The lengths and heights of the two prisms are the same. How does the width of James's prism compare to the width of Sarita's prism?

How many dimensions are different in the two prisms? _____

When only one dimension is different in two prisms, the scale factor of that dimension will match the scale factor of the prisms' _____.

Find the scale factor of the volume of James's prism to the volume of Sarita's prism:

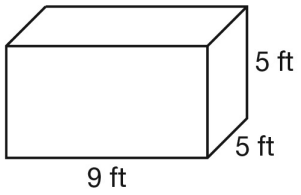
_____ ÷ _____ = _____ = _____

So, the width of James's prism is _____ the width of Sarita's prism.

Lesson Practice

Choose the correct answer.

Use the rectangular prism for questions 1 and 2.



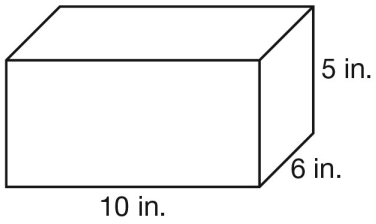
1. What is the surface area of the prism?

A. 280 ft^2
B. 230 ft^2
C. 140 ft^2
D. 115 ft^2

2. If the length of the prism is changed by a scale factor of $\frac{1}{2}$, what will be the surface area of the new prism?

A. 280 ft^2
B. 230 ft^2
C. 140 ft^2
D. 115 ft^2

Use the rectangular prism for questions 3 and 4.



3. What is the volume of the prism?

A. 8,100 $in.^3$
B. 900 $in.^3$
C. 300 $in.^3$
D. 100 $in.^3$

4. If the height of the prism is changed by a scale factor of 3, what will be the volume of the new prism?

A. 8,100 $in.^3$
B. 900 $in.^3$
C. 300 $in.^3$
D. 100 $in.^3$

5. If the width of rectangular prism A is changed by a scale factor of $\frac{1}{2}$ to create prism B, which of the following statements is true?

A. The surface area of prism B is twice the surface area of prism A.

B. The surface area of prism B is $\frac{1}{2}$ the surface area of prism A.

C. The surface area of prism B is greater than the surface area of prism A.

D. The surface area of prism B is less than the surface area of prism A.

6. Box A has a volume of 262.8 cubic meters. Box B has a volume of 87.6 cubic meters. The lengths and widths of the boxes are the same. What is the ratio of Box B's height to Box A's height?

A. $\frac{1}{27}$

B. $\frac{1}{3}$

C. $\frac{3}{1}$

D. $\frac{27}{1}$

7. The length of a rectangular prism is changed by a scale factor of 4 to create a new prism. The other dimensions remain the same. Which of the following statements is true?

A. The volume of the new prism is 4 times that of the original prism.

B. The volume of the new prism is 8 times that of the original prism.

C. The volume of the new prism is 16 times that of the original prism.

D. The volume of the new prism is 64 times that of the original prism.

8. A rectangular prism is 15 inches long, 8.5 inches wide, and 6.75 inches tall. If the width of the prism were changed to 17 inches, what would be the surface area of the new prism?

A. 471 $in.^2$

B. 572.25 $in.^2$

C. 942 $in.^2$

D. 1,144.50 $in.^2$

9. Rectangular prism A has a volume of 98.6 cubic centimeters. Rectangular prism B has a volume of 197.2 cubic centimeters. The widths and heights of the prisms are the same. If prism A has a length of 14.3 centimeters, what is the length of prism B?

A. 7.15 cm

B. 28.60 cm

C. 57.20 cm

D. 114.40 cm

10. A rectangular prism is 11 feet long, 6.25 feet wide, and 5.5 feet tall. If the length of the prism were changed to 2.75 feet, what would be the volume of the new prism to the nearest hundredth?

A. 378.13 ft^3

B. 189.06 ft^3

C. 94.53 ft^3

D. 5.91 ft^3

11. The height of a rectangular prism is changed by a factor of $\frac{1}{3}$. The other dimensions remain the same. Which of the following statements is true?

A. The volume of the new prism will be $\frac{1}{3}$ of the volume of the original prism.

B. The volume of the new prism will be 3 times the volume of the original prism.

C. The surface area of the new prism will be $\frac{1}{3}$ of the volume of the original prism.

D. The surface area of the new prism will be 3 times the volume of the original prism.

12. Rectangular prism A has a volume of 36.4 cubic feet. Rectangular prism B has a volume of 145.6 cubic feet. The lengths and heights of the boxes are the same. What is the ratio of Prism B's width to Prism A's width?

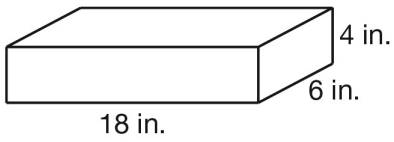
A. $\frac{4}{1}$

B. $\frac{2}{1}$

C. $\frac{1}{2}$

D. $\frac{1}{4}$

13. Cooper built the box shown below. He then built a second box that was half as long as the original box. The widths and heights of the two boxes are the same.



A. Create a drawing of the new box. Label its dimensions. Then find its surface area. Show your work.

B. What is the difference of the surface areas of the two boxes? Show your work.

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GRADES 3–8

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