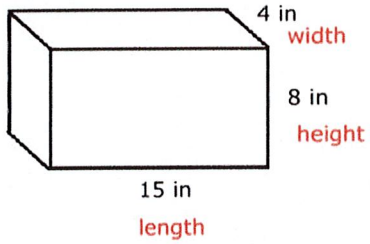
Another Explanation for V = l x w x h
V = Bh

p. 1

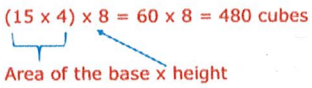
Volume of a Rectangular Prism

Filling and wrapping is a great way to think about volume and surface area. When you fill something up, the space that is filled is the volume. When you wrap up a present or cover something you are now working with surface area.
Companies need to know the volume of a box in order to determine how much of their product will fit inside.

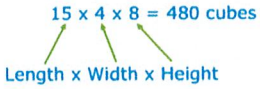
Here is an example:



The volume is equal to the number of 1 in x 1 in x 1 in cubes we can fit inside this box. There could be 15 cubes across the length by 4 across the width, making a bottom layer of 15 x 4 = 60 cubes. You can also think of this as the area of the base.
Notice that the height of the box is 8 in. That means that we could fit 8 layers of 60 cubes.

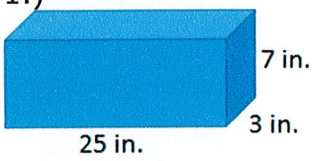


OR



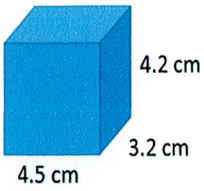
In other words, the volume of this box is 480 cubic inches.
This could be simplified to the formulas **V = Bh** or **V = l w h** for all rectangular prisms.
Let's Practice! Determine the volume of each prism.

1.)



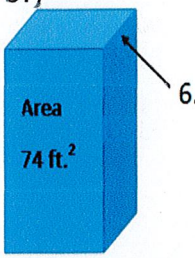
V = l x w x h
V = (25 in.)(3 in.)(7 in.)
V = (75 in^2)(7 in)
V = 525 in^3

2.)



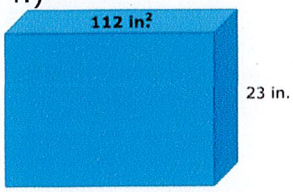
V = l x w x h
V = (4.5 cm)(3.2 cm)(4.2 cm)
V = 60.48 cm^3

3.)



This example gives the area of a side and the length of the height that connects the bases.
This prism has just been turned on its side.
V = Bh
V = (74 $ft.^2$)(6.3 ft.)
V = 466.2 $ft.^3$

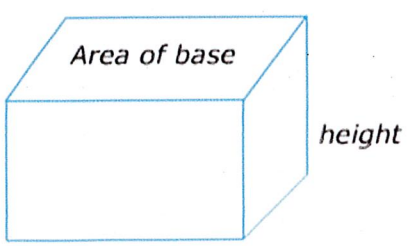
4.)

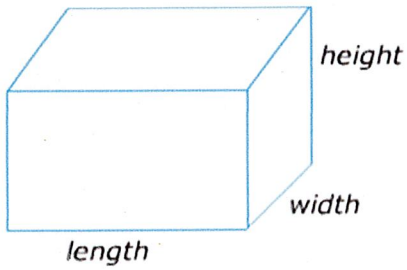


V = Bh
V = (112 $in.^2$)(23 in.)
V = 2576 $in.^3$

Let's Review

The volume of a prism is the space that fills it. You can determine the volume of a rectangular prism by either multiplying the area of the base times the height or by multiplying the length, width and height.





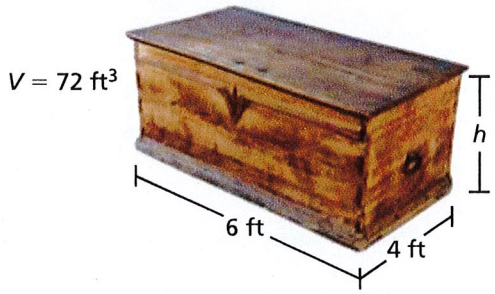
Examples with missing factors.

p. 3

Using Volumes of Prisms ~~and Cylinders~~

EXAMPLE 4 Modeling with Mathematics

You are building a rectangular chest. You want the length to be 6 feet, the width to be 4 feet, and the volume to be 72 cubic feet. What should the height be?



SOLUTION

1. **Understand the Problem** You know the dimensions of the base of a rectangular prism and the volume. You are asked to find the height.
2. **Make a Plan** Write the formula for the volume of a rectangular prism, substitute known values, and solve for the height h.
3. **Solve the Problem** The area of a base is $B = 6(4) = 24$ ft² and the volume is $V = 72$ ft³.

$V = Bh$	Formula for volume of a prism
$72 = 24h$	Substitute.
$3 = h$	Divide each side by 24.

▶ The height of the chest should be 3 feet.

4. **Look Back** Check your answer.

$V = Bh = 24(3) = 72$ ✓

Ex. 4: (l × w) Volume = base area × height

$V = Bh$

$72\text{ ft}^3 = 24\text{ ft}^2 \times h$

$72 \div 24 = h$

$3 = h$

3 feet should be the height.

missing factor becomes a division problem

$Bh = B \times h$

$24h = 24 \times h$

EXAMPLE 5 Solving a Real-Life Problem

You are building a 6-foot-tall dresser. You want the volume to be 36 cubic feet. What should the area of the base be? Give a possible length and width.

SOLUTION

$V = Bh$	Formula for volume of a prism
$36 = B \cdot 6$	Substitute.
$6 = B$	Divide each side by 6.

▶ The area of the base should be 6 square feet. The length could be 3 feet and the width could be 2 feet.

$B \cdot 6 = B \times 6$

Ex. 5:

$V = Bh$

$36\text{ ft}^3 = B \times 6\text{ ft}$

$36 \div 6 = B$

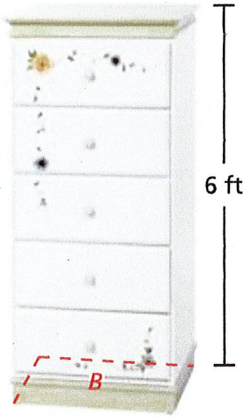
$6\text{ ft}^2 = B$

So either

length = 2 ft
width = 3 ft

or

length = 3 ft
width = 2 ft



$V = 36$ ft³

Monitoring Progress

Help in English and Spanish at *BigIdeasMath.com*

4. **WHAT IF?** In Example 4, you want the length to be 5 meters, the width to be 3 meters, and the volume to be 60 cubic meters. What should the height be?

Ans: H = 4m

5. **WHAT IF?** In Example 5, you want the height to be 5 meters and the volume to be 75 cubic meters. What should the area of the base be? Give a possible length and width.

Ans: w = 5m, l = 3m or w = 3m, l = 5m

Volume or rectangular prisms (customary units)

Grade 5 Word Problems Worksheets

Read and answer each question:

1. A cube is a rectangular prism with the same measurement for length, width and height. If a cube is 4 inches tall, what is its volume?

2. A desk is 1.5 feet wide and 5 feet long. It is 3 feet above the floor. What is the volume of space under the desk?

3. A drawer is 5 feet wide, 4 feet deep and 2 feet tall. What is the volume of the drawer?

4. A block that is 2 inches wide, 3 inches long, and 2 inches tall. What is the volume of a tower that is built by 3 blocks?

5. The closet is 6 feet wide, 5 feet deep and 8 feet tall. In the closet, there is a suitcase that is 2 feet wide, 3 feet long and 4 feet tall. How much room is left in the closet?

Answers for p.4

1. $4 \times 4 \times 4 = 64$
   The volume of the cube is 64 cubic inches.

2. $3 \times 1.5 \times 5 = 22.5$
   The volume of space under the desk is 22.5 cubic feet.

3. $6 \times 4 \times 2 = 40$
   The volume of the drawer is 40 cubic feet.

4. $2 \times 3 \times 2 \times 3 = 36$
   The volume of a tower built by 3 blocks is 36 cubic inches

5. $6 \times 5 \times 8 - 2 \times 3 \times 4 = 240 - 24 = 216$
   The room left in the closet is 216 cubic feet.

OBJECTIVE

Understand that volume is additive. Find the volume of composite solid figures when not all dimensions are given and/or they must be decomposed.

Measurement and Data

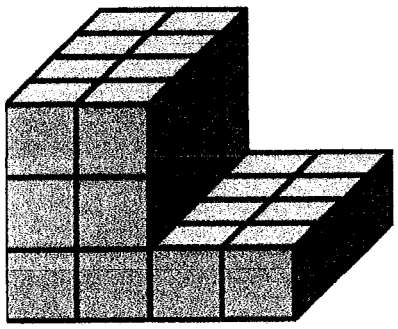
- **5.MD.C.5.C —**

  Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

Problem 1

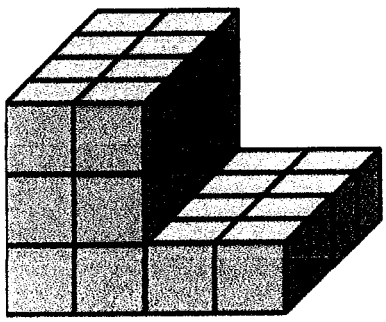
John was finding the volume of this figure. He decided to break it apart into two separate rectangular prisms. John found the volume of the solid below using this expression: (4 x 4 x 1) + (2 x 4 x 2).

Decompose the figure into two rectangular prisms and shade them in different colors to show one way John might have thought about it.



Phillis also broke this solid into two rectangular prisms, but she did it differently than John. She found the volume of the solid below using this expression: (2 x 4 x 3) + (2 x 4 x 1).

Decompose the figure into two rectangular prisms and shade them in different colors to show one way Phillis might have thought about it.



Guiding Questions

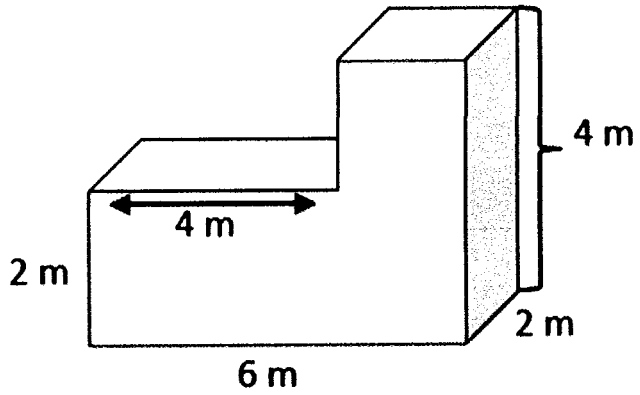
- How does each term in John's expression relate to the measurements in the figure?
- How does each term in Phillis's expression relate to the measurements in the figure?
- If John and Phillis used their equations to find the total volume, would they get the same answer?

Notes

You will need two differently colored markers or crayons for this task.

Problem 2

Find the volume of the following figure.

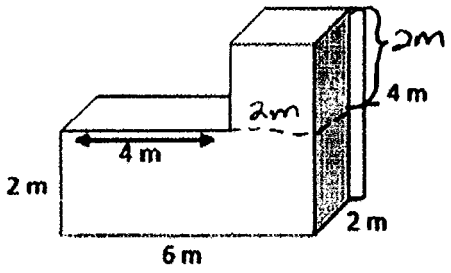


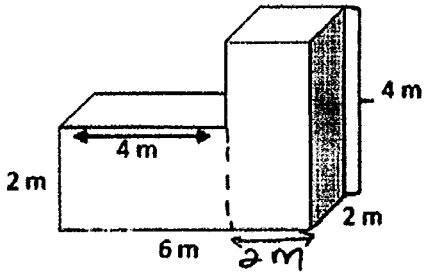
Guiding Questions

- How can we find the volume of this figure?
- How might we break the figure up into rectangular prisms? Is there more than one possible way to do so?
- Let's choose one of the possible ways to decompose the figure. Do we have all the information we need to find the volume of each rectangular prism? How can we use the information we're given to find any unlabeled dimensions? How will those dimensions be used to find the volume?
- If we decomposed it the other way, what would you expect to get as the volume? Check your prediction.

Notes

The two decompositions can be represented the following way:



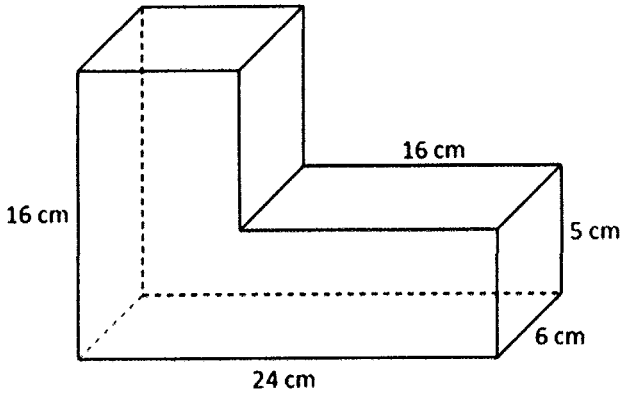


DISCUSSION OF PROBLEM SET

- Compare your approach to solving #2. How is your thinking similar to #1? How is it different?
- Look at #2. What were the two ways you could decompose the figure? Which one was easier for you to compute with?
- What advice would you give to a friend who was having trouble picturing the dimensions on a composite figure? What helps you to figure out missing dimensions?

STUDENT EXAMPLE:

The students at your school have been asked by a local pet store to design a new aquarium. One group of students designed the aquarium below. How much water, in cubic centimeters, will the following fish tank hold?

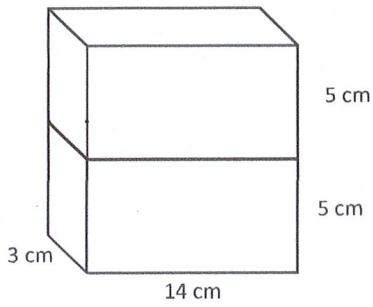


Think: What is one way I can create two rectangular prisms, find their volumes and add up the two volumes together for the total cubic centimeters?

Name _____ Date _____

1. Find the total volume of the figures, and record your solution strategy.

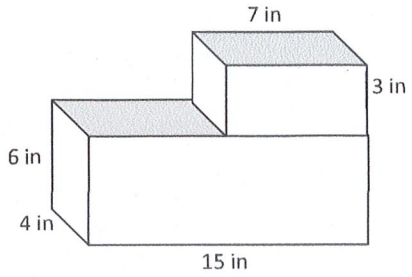
a.



Volume: _____

Solution Strategy:

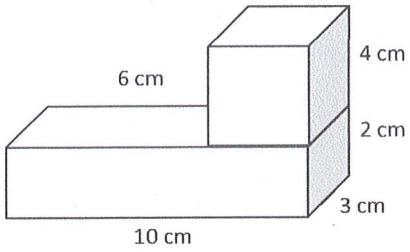
b.



Volume: _____

Solution Strategy:

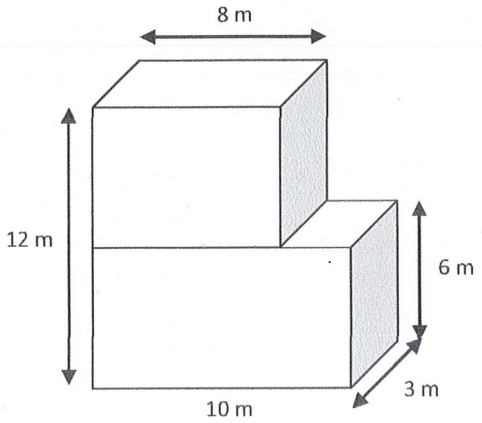
c.



Volume: _____

Solution Strategy:

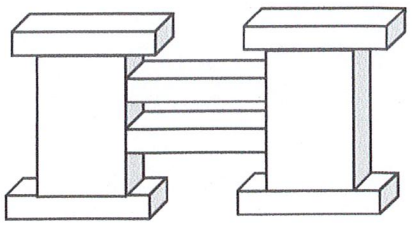
d.



Volume: _____

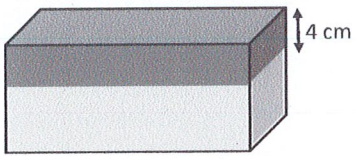
Solution Strategy:

2. A sculpture (pictured below) is made of two sizes of rectangular prisms. One size measures 13 in by 8 in by 2 in. The other size measures 9 in by 8 in by 18 in. What is the total volume of the sculpture?



3. The combined volume of two identical cubes is 128 cubic centimeters. What is the side length of each cube?

4. A rectangular tank with a base area of 24 cm^2 is filled with water and oil to a depth of 9 cm. The oil and water separate into two layers when the oil rises to the top. If the thickness of the oil layer is 4 cm, what is the volume of the water?



5. Two rectangular prisms have a combined volume of 432 cubic feet. Prism A has half the volume of Prism B.

   a. What is the volume of Prism A? Prism B?

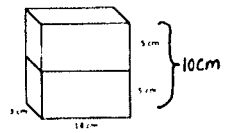
   b. If Prism A has a base area of 24 ft^2, what is the height of Prism A?

   c. If Prism B's base is $\frac{2}{3}$ the area of Prism A's base, what is the height of Prism B?

Name Michelle Date

1. Find the total volume of the figures and record your solution strategy.

a

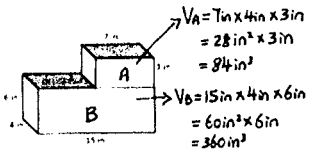


Volume $V = 14cm \times 3cm \times 10cm = 420cm^3$

Solution Strategy

I combined the 2 heights to get 10cm. Then I just used the formula for volume.

b



$V_A = 7in \times 4in \times 3in$
$= 28in^2 \times 3in$
$= 84in^3$

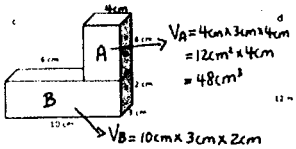
$V_B = 15in \times 4in \times 6in$
$= 60in^2 \times 6in$
$= 360in^3$

Volume $84in^3 + 360in^3 = 444in^3$

Solution Strategy

Prism A & B have the same width, so I used the Volume formula & then added the 2 volumes to find the total.

c



$V_A = 4cm \times 3cm \times 4cm$
$= 12cm^2 \times 4cm$
$= 48cm^3$

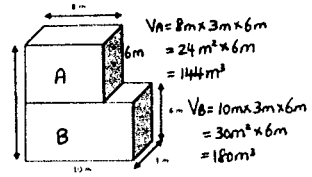
$V_B = 10cm \times 3cm \times 2cm$
$= 30cm^2 \times 2cm$
$= 60cm^3$

Volume $48cm^3 + 60cm^3 = 108cm^3$

Solution Strategy

10cm − 6cm shows that the length of A is 4cm. Then I found the volume of A & B and added them together.

d



$V_A = 8m \times 3m \times 6m$
$= 24m^2 \times 6m$
$= 144m^3$

$V_B = 10m \times 3m \times 6m$
$= 30m^2 \times 6m$
$= 180m^3$

Volume $144m^3 + 180m^3 = 324m^3$

Solution Strategy

12m − 6m shows that the height of A is 6m. Again, I found the volume of each Prism then added them together.

2. A sculpture (pictured below) is made of two sizes of rectangular prisms. One size measures 13 in by 8 in by 2 in. The other size measures 9 in by 8 in by 18 in. What is the total volume of the sculpture?

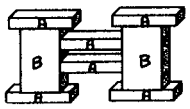
$Volume_A = 13in \times 8in \times 2in$
$= 208in^3$

$208in^3 \times 6 = 1,248in^3$

$Volume_B = 9in \times 8in \times 18in$
$= 72in^2 \times 18in$
$= 1,296in^3$

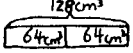
$1,296in^3 \times 2 = 2,592in^3$

$1,248 + 2,592 = 3,840$



The total volume of the sculpture is $3,840in^3$.

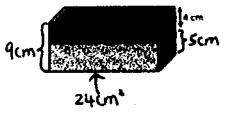
3. The combined volume of two identical cubes is 128 cubic centimeters. What is the side length of each cube?



$4cm \times 4cm \times 4cm = 64cm^3$

Each side length on each cube is 4cm.

4. A rectangular tank with a base area of 24 cm^2 is filled with water and oil to a depth of 9 cm. The oil and water separate into two layers when the oil rises to the top. If the thickness of the oil layer is 4 cm, what is the volume of the water?

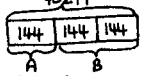


$24cm^2 \times 5cm = 120cm^3$

The volume of the water is $120cm^3$.

5. Two rectangular prisms have a combined volume of 432 cubic feet. Prism A has half the volume of Prism B.

a. What is the volume of Prism A? Prism B?



The volume of Prism A is $144ft^3$.
The volume of Prism B is $288ft^3$.

b. If Prism A has a base area of 24 ft^2, what is the height of Prism A?

$144 \div 12 = 12$, so $144 \div 24 = 6$. The height of prism A is 6ft.

c. If Prism B's base is $\frac{2}{3}$ the area of Prism A's base, what is the height of Prism B?

$\frac{2}{3} \times 24 = \frac{2 \times 24}{3} = 16$

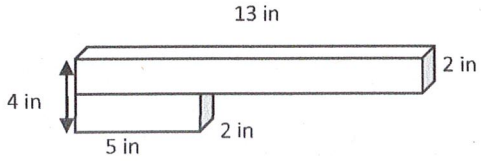
$288ft^3 \div 16ft^2 = 18ft$

The height of prism B is 18ft.

Name _____ Date _____

1. Find the total volume of the figures, and record your solution strategy.

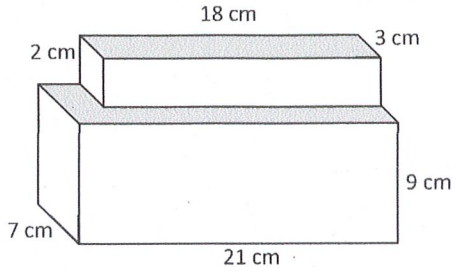
a.



Volume: _____

Solution Strategy:

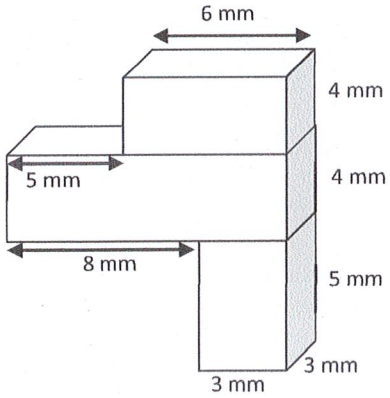
b.



Volume: _____

Solution Strategy:

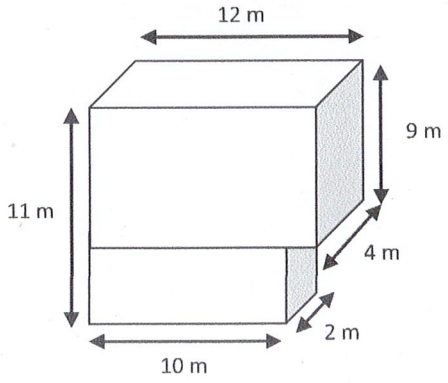
c.



Volume: _____

Solution Strategy:

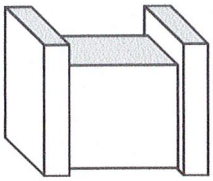
d.



Volume: _____

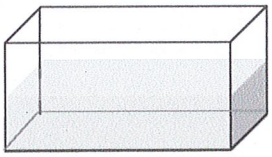
Solution Strategy:

2. The figure below is made of two sizes of rectangular prisms. One type of prism measures 3 inches by 6 inches by 14 inches. The other type measures 15 inches by 5 inches by 10 inches. What is the total volume of this figure?



3. The combined volume of two identical cubes is 250 cubic centimeters. What is the measure of one cube's edge?

4. A fish tank has a base area of 45 cm^2 and is filled with water to a depth of 12 cm. If the height of the tank is 25 cm, how much more water will be needed to fill the tank to the brim?



5. Three rectangular prisms have a combined volume of 518 cubic feet. Prism A has one-third the volume of Prism B, and Prisms B and C have equal volume. What is the volume of each prism?

Name _____ Date _____

Wren makes some rectangular display boxes.

1. Wren's first display box is 6 inches long, 9 inches wide, and 4 inches high. What is the volume of the display box? Explain your work using a diagram.

2. Wren wants to put some artwork into three shadow boxes. She knows they all need a volume of 60 cubic inches, but she wants them all to be different. Show three different ways Wren can make these boxes by drawing diagrams and labeling the measurements.

Shadow Box A	Shadow Box B
Shadow Box C	

3. Wren wants to build a box to organize her scrapbook supplies. She has a stencil set that is 12 inches wide that needs to lay flat in the bottom of the box. The supply box must also be no taller than 2 inches. Name one way she could build a supply box with a volume of 72 cubic inches.

4. After all of this organizing, Wren decides she also needs more storage for her soccer equipment. Her current storage box measures 1 foot long by 2 feet wide by 2 feet high. She realizes she needs to replace it with a box with 12 cubic feet of storage, so she doubles the width.

   a. Will she achieve her goal if she does this? Why or why not?

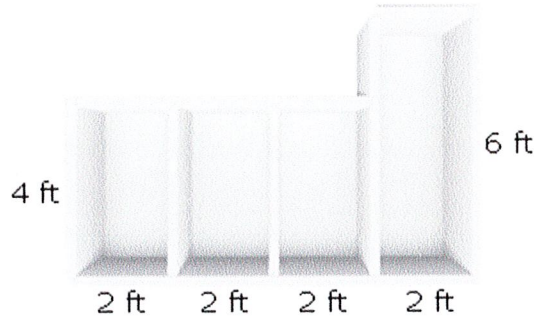
   b. If she wants to keep the height the same, what could the other dimensions be for a 12-cubic-foot storage box?

   c. If she uses the dimensions in part (b), what is the area of the new storage box's floor?

   d. How has the area of the bottom in her new storage box changed? Explain how you know.

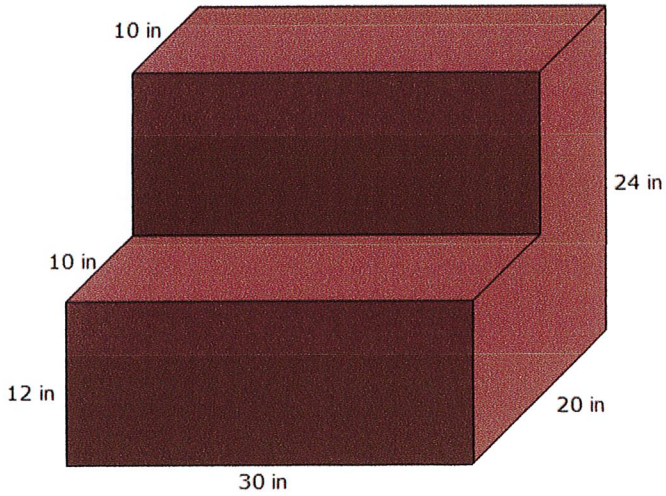
Generation Date: **04/20/2020**
Generated By: **Katie Moore**

1. Mike wants to purchase a wall unit, but he needs to determine the volume before buying it. If the wall unit is 3 feet deep, what is the volume of this wall unit?



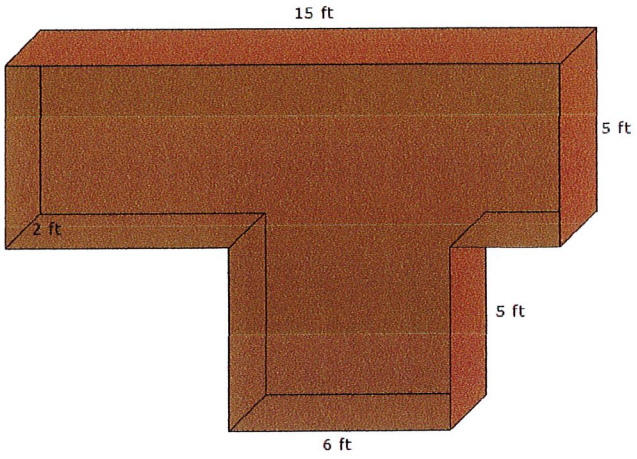
- **A.** 108 cubic feet
- **B.** 72 cubic feet
- **C.** 36 cubic feet
- **D.** 192 cubic feet

2. George is planning to make two rectangular prism-shaped stairs for his front door using solid wood. What is the volume of the wood required to make the stairs?



- **A.** 12,000 cubic inches
- **B.** 14,400 cubic inches
- **C.** 11,400 cubic inches
- **D.** 10,800 cubic inches

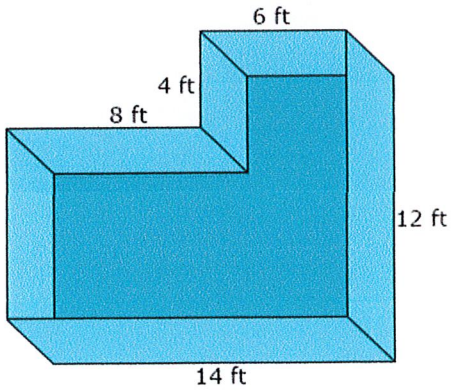
3. The owner of an electronics shop wants to measure the volume of his display case. The display case consists of two rectangular prism-shaped pieces. What is the volume of the display case?



- ○ **A.** 210 cubic feet
- ○ **B.** 240 cubic feet
- ○ **C.** 62 cubic feet
- ○ **D.** 150 cubic feet

---

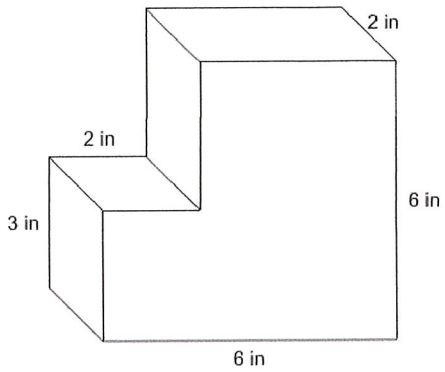
4. Louis built a swimming pool. The depth of the swimming pool is 5 feet. What is the volume of water that it will take to fill the swimming pool?



- ○ **A.** 136 cubic feet
- ○ **B.** 440 cubic feet
- ○ **C.** 680 cubic feet
- ○ **D.** 720 cubic feet

---

5. The solid shown below is made by combining two rectangular prisms. What is the volume of the solid?



Note: Image not drawn to scale.

- **A.** 216 cubic inches
- **B.** 60 cubic inches
- **C.** 120 cubic inches
- **D.** 48 cubic inches

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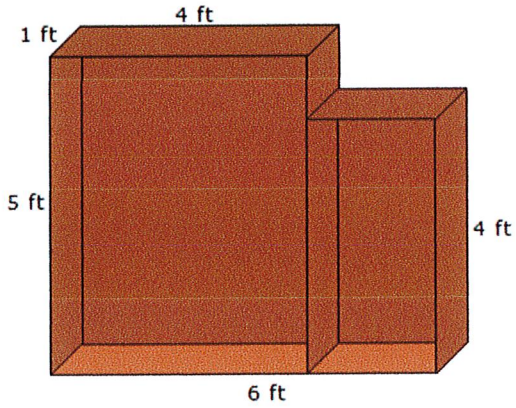
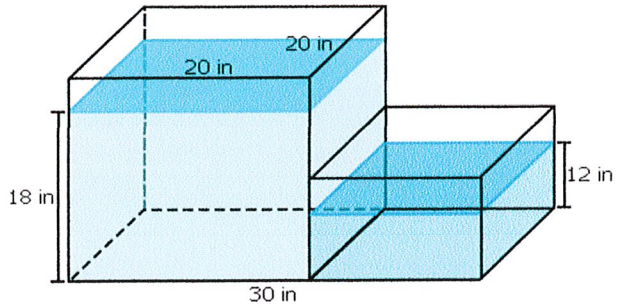
6. Liz has a bookshelf in the shape of two rectangular prisms. What is the volume of the bookshelf?



- **A.** 46 cubic feet
- **B.** 28 cubic feet
- **C.** 44 cubic feet
- **D.** 19 cubic feet

---

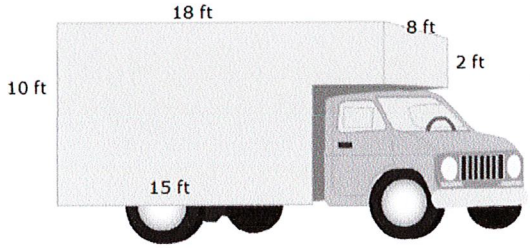
7. Jane has an aquarium made up of two rectangular prism-shaped containers, as shown in the figure below. What is the volume of water in the aquarium?



- **A.** 7,500 cubic inches
- **B.** 18,000 cubic inches
- **C.** 10,800 cubic inches
- **D.** 9,600 cubic inches

---

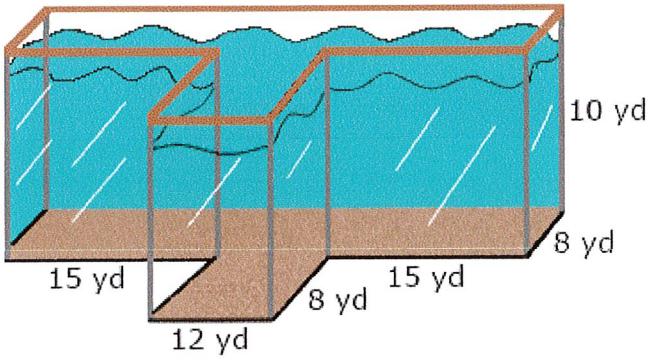
8. A moving company wants to buy a new type of truck and needs to know the volume of the storage compartment before they can decide if they should purchase the truck. What is the volume of the storage compartment?



- **A.** 1,248 cubic feet
- **B.** 1,238 cubic feet
- **C.** 1,224 cubic feet
- **D.** 1,244 cubic feet

---

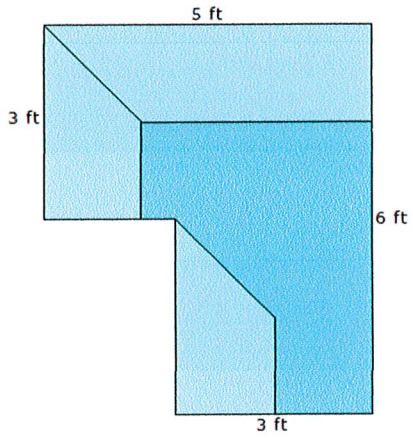
9. A local aquarium purchased a new turtle tank for their giant turtle exhibit. What is the volume of the turtle tank?



- **A.** 5,520 cubic yards
- **B.** 6,120 cubic yards
- **C.** 3,360 cubic yards
- **D.** 4,320 cubic yards

---

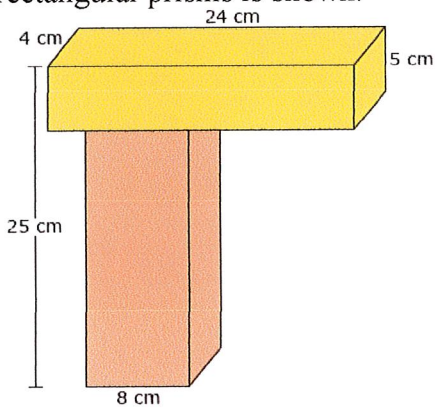
10. Ben built an underground storage tank to store water in his garden. The depth of the storage tank is 3 feet. What is the volume of Ben's storage tank?



- **A.** 117 cubic feet
- **B.** 72 cubic feet
- **C.** 46 cubic feet
- **D.** 99 cubic feet

---

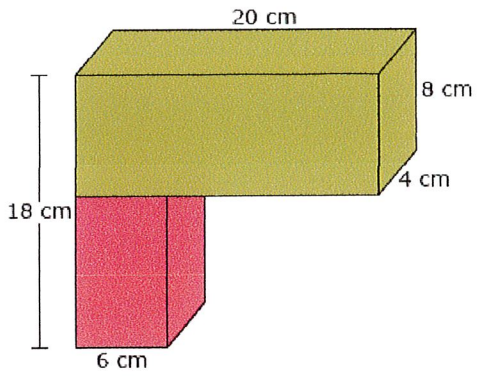
11. A solid figure made of two rectangular prisms is shown.



Which expression can be used to find the volume, in cubic centimeters, of the solid figure?

- **A.** $(24 \times 4 \times 5) + (8 \times 4 \times 25)$
- **B.** $(16 \times 4 \times 5) + (8 \times 4 \times 20)$
- **C.** $(24 \times 4 \times 5) + (8 \times 4 \times 20)$
- **D.** $(16 \times 4 \times 5) + (8 \times 4 \times 25)$

12. A solid figure made of two rectangular prisms is shown.



Which expression can be used to find the volume, in cubic centimeters, of the solid figure?

- ○ **A.** $(20 \times 4 \times 8) + (6 \times 4 \times 18)$
- ○ **B.** $(14 \times 4 \times 8) + (6 \times 4 \times 18)$
- ○ **C.** $(20 \times 4 \times 8) + (6 \times 4 \times 10)$
- ○ **D.** $(14 \times 4 \times 8) + (6 \times 4 \times 10)$

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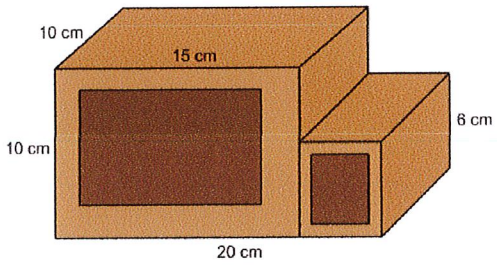
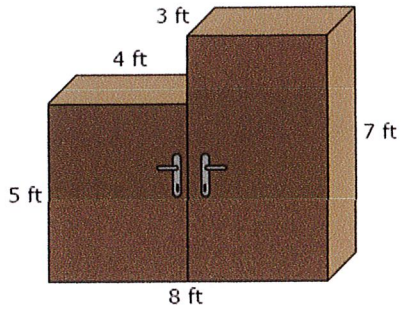
13. Beth has a paperweight in the shape of two rectangular prisms. What is the volume of the paperweight?



- ○ **A.** 1,500 cubic centimeters
- ○ **B.** 1,750 cubic centimeters
- ○ **C.** 1,250 cubic centimeters
- ○ **D.** 1,800 cubic centimeters

---

14. Jackson has a wardrobe with two compartments shaped like rectangular prisms. What is the volume of his wardrobe?



○ **A.** 288 cubic feet

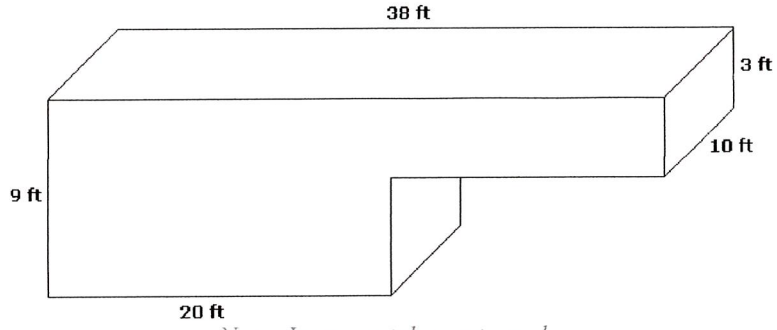
○ **B.** 48 cubic feet

○ **C.** 168 cubic feet

○ **D.** 144 cubic feet

---

15. The solid shown below is made by combining two rectangular prisms. What is the total volume of the solid?



Note: Image not drawn to scale.

○ **A.** 800 cubic feet

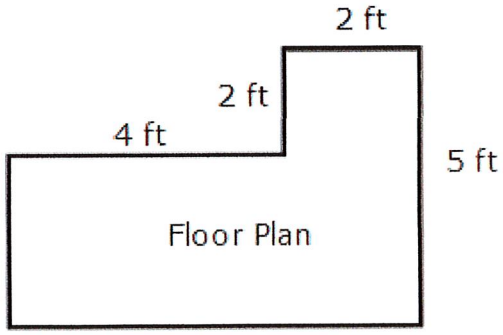
○ **B.** 2,340 cubic feet

○ **C.** 900 cubic feet

○ **D.** 1,800 cubic feet

---

16. Marci needs to rent a storage unit. She needs to determine the volume of the storage unit to decide if the storage unit is big enough to hold her things. If the storage unit is 8 feet high, what is the volume of the storage unit?



○ **A.** 192 cubic feet

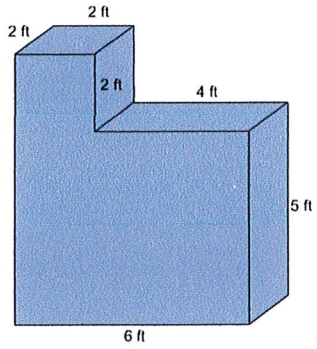
○ **B.** 136 cubic feet

○ **C.** 176 cubic feet

○ **D.** 144 cubic feet

---

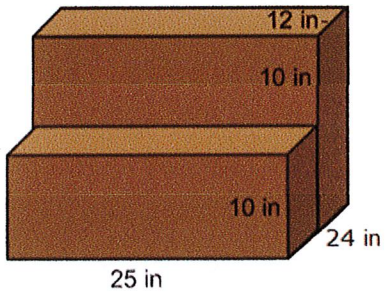
17. Henry wants to estimate the cost of filling his water tank. First, he needs to find the volume of the water tank in order to fill it. What is the volume of the water tank?



- **A.** 68 cubic feet
- **B.** 56 cubic feet
- **C.** 112 cubic feet
- **D.** 48 cubic feet

---

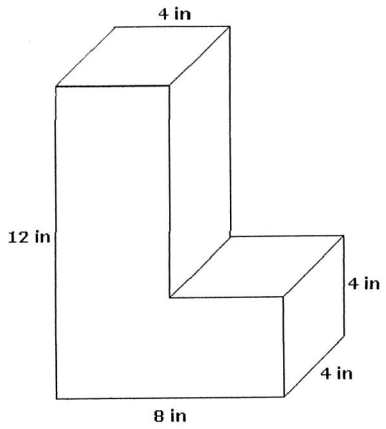
18. A construction company makes cement stairs from a wooden mold. The construction company must calculate the volume of the mold to determine how much cement they need to create the stairs. What is the volume of the wooden mold?



- **A.** 6,000 cubic inches
- **B.** 7,000 cubic inches
- **C.** 9,000 cubic inches
- **D.** 8,000 cubic inches

---

19. The solid shown below is made by combining two rectangular prisms. What is the total volume of the solid?

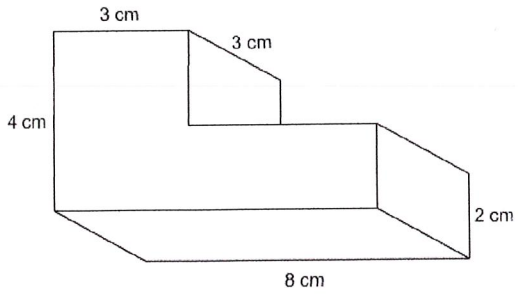


Note: Image not drawn to scale.

- **A.** 276 cubic inches
- **B.** 300 cubic inches
- **C.** 256 cubic inches
- **D.** 280 cubic inches

---

20. The solid shown below is made by combining two rectangular prisms. What is the volume of the solid?



Note: Image not drawn to scale.

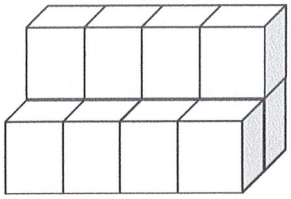
- **A.** 84 cubic centimeters
- **B.** 66 cubic centimeters
- **C.** 132 cubic centimeters
- **D.** 52 cubic centimeters

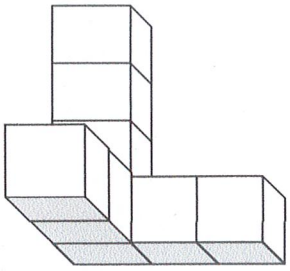
Answers

1. A
2. D
3. A
4. C
5. B
6. B
7. D
8. A
9. D
10. B
11. C
12. C
13. D
14. D
15. B
16. C
17. A
18. C
19. C
20. B

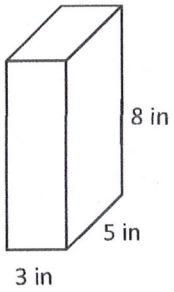
Name _____ Date _____

1. Tell the volume of each solid figure made of 1-inch cubes. Specify the correct unit of measure.

a. 

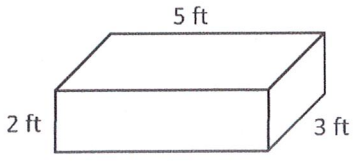
b. 

2. Jack found the volume of the prism pictured to the right by multiplying 5 × 8 and then adding 40 + 40 + 40 = 120. He says the volume is 120 cubic inches.

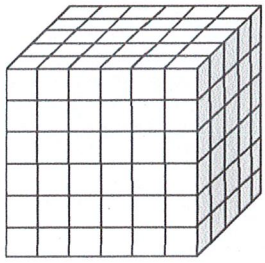


a. Jill says he did it wrong. He should have multiplied the bottom first (3 × 5) and then multiplied by the height. Explain to Jill why Jack's method works and is equivalent to her method.

b. Use Jack's method to find the volume of this right rectangular prism.

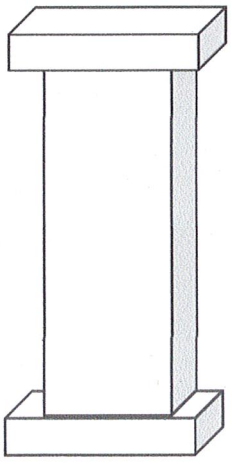


3. If the figure below is made of cubes with 2 cm side lengths, what is its volume? Explain your thinking.

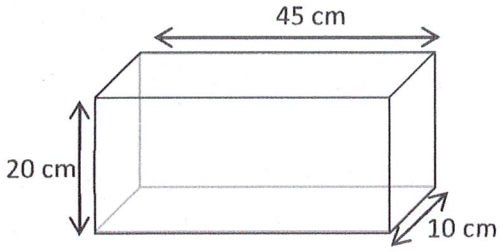


4. The volume of a rectangular prism is 840 in^3. If the area of the base is 60 in^2, find its height. Draw and label a model to show your thinking.

5. The following structure is composed of two right rectangular prisms that each measure 12 inches by 10 inches by 5 inches and one right rectangular prism that measures 10 inches by 8 inches by 36 inches. What is the total volume of the structure? Explain your thinking.

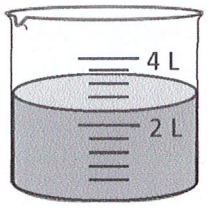


6. a. Find the volume of the rectangular fish tank. Explain your thinking.

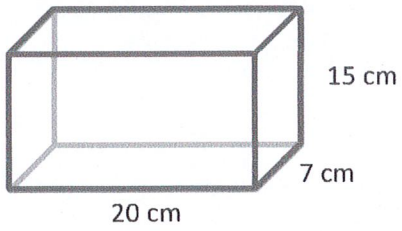


b. If the fish tank is completely filled with water and then 900 cubic centimeters are poured out, how high will the water be? Give your answer in centimeters, and show your work.

7. Juliet wants to know if the chicken broth in this beaker will fit into this rectangular food storage container. Explain how you would figure it out without pouring the contents in. If it will fit, how much more broth could the storage container hold? If it will not fit, how much broth will be left over? (Remember: 1 cm^3 = 1 mL.)



Beaker



Storage Container