Name _____ Date _____

The Volume of a Right Prism

Lawrence poured 27.328 L of water into a right rectangular prism-shaped tank. The base of the tank is 40 cm by 28 cm. When he finished pouring the water, the tank was $\frac{2}{3}$ full. (1 L $= 1000$ cm^3)

a. How deep is the water in the tank?

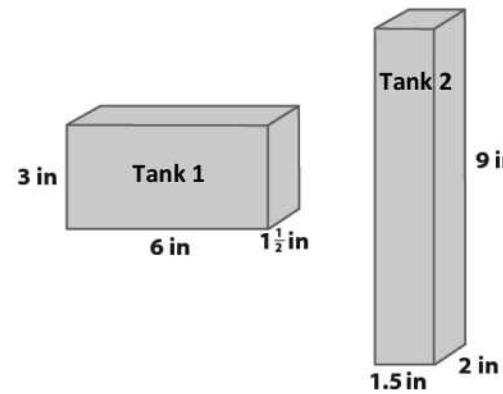
b. How deep is the tank?

c. How many liters of water can the tank hold in total?

1. Mark wants to put some fish and decorative rocks in his new glass fish tank. He measured the outside dimensions of the right rectangular prism and recorded a length of 55 cm, width of 42 cm, and height of 38 cm. He calculates that the tank will hold 87.78 L of water. Why is Mark's calculation of volume incorrect? What is the correct volume? Mark also failed to take into account the fish and decorative rocks he plans to add. How will this affect the volume of water in the tank? Explain.

2. Leondra bought an aquarium that is a right rectangular prism. The inside dimensions of the aquarium are 90 cm long, by 48 cm wide, by 60 cm deep. She plans to put water in the aquarium before purchasing any pet fish. How many liters of water does she need to put in the aquarium so that the water level is 5 cm below the top?

3. The inside space of two different water tanks are shown below. Which tank has a greater capacity? Justify your answer.



4. The inside of a tank is in the shape of a right rectangular prism. The base of that prism is 85 cm by 64 cm. What is the minimum height inside the tank if the volume of the liquid in the tank is 2 L ?

5. An oil tank is the shape of a right rectangular prism. The inside of the tank is 36.5 cm long, 52 cm wide, and 29 cm high. If 45 L of oil have been removed from the tank since it was full, what is the current depth of oil left in the tank?

6. The inside of a right rectangular prism-shaped tank has a base that is 14 cm by 24 cm and a height of 60 cm. The tank is filled to its capacity with water, and then 10.92 L of water is removed. How far did the water level drop?

7. A right rectangular prism-shaped container has inside dimensions of $7\frac{1}{2}$ cm long and $4\frac{3}{5}$ cm wide. The tank is $\frac{3}{5}$ full of vegetable oil. It contains 0.414 L of oil. Find the height of the container.

8. A right rectangular prism with length of 10 in., width of 16 in., and height of 12 in. is $\frac{2}{3}$ filled with water. If the water is emptied into another right rectangular prism with a length of 12 in., a width of 12 in., and height of 9 in., will the second container hold all of the water? Explain why or why not. Determine how far (above or below) the water level would be from the top of the container.

Lawrence poured $27.328\ \text{L}$ of water into a right rectangular prism shaped tank. The base of the tank is $40\ \text{cm}$ by $28\ \text{cm}$. When he finished pouring the water, the tank was $\frac{2}{3}$ full. $(1\ \text{L} = 1000\ \text{cm}^3)$

a. How deep is the water in the tank?

$27.328\ \text{L} = 27328\ \text{cm}^3$

$$V = Bh$$
$$V = (lw)h$$
$$27328\ \text{cm}^3 = (40\ \text{cm} \cdot 28\ \text{cm}) \cdot h$$
$$27328\ \text{cm}^3 = 1120\ \text{cm}^2 \cdot h$$
$$27328\ \text{cm}^3 \cdot \frac{1}{1120\ \text{cm}^2} = 1120\ \text{cm}^2 \cdot \frac{1}{1120\ \text{cm}^2} \cdot h$$
$$\frac{27328}{1120}\ \text{cm} = 1 \cdot h$$
$$24\frac{280}{1120}\ \text{cm} = h$$
$$24\frac{2}{5}\ \text{cm} = h$$

The depth of the water is $24\frac{2}{5}\ \text{cm}$.

b. How deep is the tank?

The depth of the water is $\frac{2}{3}$ *the depth of the tank. Let* d *represent the depth of the tank in centimeters.*

$$24\frac{2}{5}\ \text{cm} = \frac{2}{3} \cdot d$$
$$24\frac{2}{5}\ \text{cm} \cdot \frac{3}{2} = \frac{2}{3} \cdot \frac{3}{2} \cdot d$$
$$36\ \text{cm} + \frac{3}{5}\ \text{cm} = 1d$$
$$36\frac{3}{5}\ \text{cm} = d$$

The depth of the tank is $36\frac{3}{5}\ \text{cm}$.

c. How many liters of water can the tank hold total?

$$V = Bh$$
$$V = (lw)h$$
$$V = (40\ \text{cm} \cdot 28\ \text{cm}) \cdot 36\frac{3}{5}\ \text{cm}$$
$$V = 1120\ \text{cm}^2 \cdot 36\frac{3}{5}\ \text{cm}$$
$$V = 40320\ \text{cm}^3 + 672\ \text{cm}^3$$
$$V = 40992\ \text{cm}^3$$

$40992\ \text{cm}^3 = 40.992\ \text{L}$ *The tank can hold up to* $41.0\ \text{L}$ *of water.*

1. Mark wants to put some fish and decorative rocks in his new glass fish tank. He measured the outside dimensions of the right rectangular prism and recorded a length of 55 cm, width of 42 cm, and height of 38 cm. He calculates that the tank will hold 87.78 L of water. Why is Mark's calculation of volume incorrect? What is the correct volume? Mark also failed to take into account the fish and decorative rocks he plans to add. How will this affect the volume of water in the tank? Explain.

   $V = Bh = (lw)h$

   $V = 55\text{ cm} \cdot 42\text{ cm} \cdot 38\text{ cm}$

   $V = 2310\text{ cm}^2 \cdot 38\text{ cm}$

   $V = 87780\text{ cm}^3$

   $87780\text{ cm}^3 = 87.78\text{ L}$

   Mark measured only the outside dimensions of the fish tank and did not account for the thickness of the sides of the tank. If he fills the tank with 87.78 L of water, the water will overflow the sides. Mark also plans to put fish and rocks in the tank which will force water out of the tank if it is filled to capacity.

2. Leondra bought an aquarium that is a right rectangular prism. The inside dimensions of the aquarium are 90 cm long, by 48 cm wide, by 60 cm deep. She plans to put water in the aquarium before purchasing any pet fish. How many liters of water does she need to put in the aquarium so that the water level is 5 cm below the top?

   If the aquarium is 60 cm deep, then she wants the water to be 55 cm deep. Water takes on the shape of its container, so the water will form a right rectangular prism with a length of 90 cm, a width of 48 cm, and a height of 55 cm.

   $V = Bh = (lw)h$

   $V = (90\text{ cm} \cdot 48\text{ cm}) \cdot 55\text{ cm}$

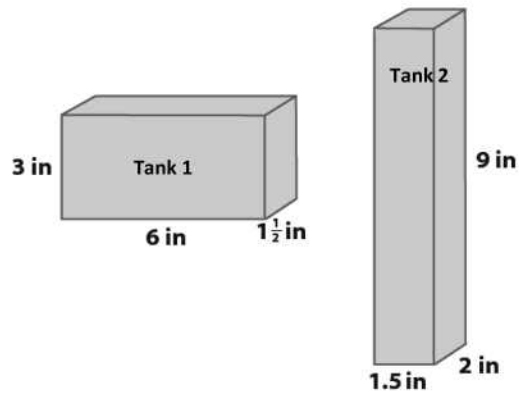
   $V = 4320\text{ cm}^2 \cdot 55\text{ cm}$

   $V = 237600\text{ cm}^3$

   $237600\text{ cm}^3 = 237.6\text{ L}$

   The volume of water needed is 237.6 L.

3. The inside space of two different water tanks are shown below. Which tank has a greater capacity? Justify your answer.



$V_1 = Bh = (lw)h$

$V_1 = \left(6 \text{ in.} \cdot 1\frac{1}{2} \text{ in.}\right) \cdot 3 \text{ in.}$

$V_1 = (6 \text{ in}^2 + 3 \text{ in}^2) \cdot 3 \text{ in}^2$

$V_1 = 9 \text{ in}^2 \cdot 3 \text{ in}^2$

$V_1 = 27 \text{ in}^3$

$V_2 = Bh = (lw)h$

$V_2 = \left(1\frac{1}{2} \text{ in.} \cdot 2 \text{ in.}\right) \cdot 9 \text{ in.}$

$V_2 = (2 \text{ in}^2 + 1 \text{ in}^2) \cdot 9 \text{ in}.$

$V_2 = 3 \text{ in}^2 \cdot 9 \text{ in.}$

$V_2 = 27 \text{ in}^3$

The tanks have the same volume, 27 in^3. Each prism has a face with an area of 18 in^2 (base) and a height that is $1\frac{1}{2}$ in.

4. The inside of a tank is in the shape of a right rectangular prism. The base of that prism is 85 cm by 64 cm. What is the minimum height inside the tank if the volume of the liquid in the tank is $\mathbf{L}$?

$V = Bh = (lw)h$

$$92000 \text{ cm}^3 = (85 \text{ cm} \cdot 64 \text{ cm}) \cdot h$$
$$92000 \text{ cm}^3 = 5440 \text{ cm}^2 \cdot h$$
$$92000 \text{ cm}^3 \cdot \frac{1}{5440 \text{ cm}^2} = 5440 \text{ cm}^2 \cdot \frac{1}{5440 \text{ cm}^2} \cdot h$$
$$\frac{92000}{5440} \text{ cm} = 1 \cdot h$$
$$16\frac{31}{34} \text{ cm} = h$$

The minimum height of the inside of the tank is $16\frac{31}{34}$ cm.

5. An oil tank is the shape of a right rectangular prism. The inside of the tank is 36.5 cm long, 52 cm wide, and 29 cm high. If 45 liters of oil have been removed from the tank since it was full, what is the current depth of oil left in the tank?

$V = Bh = (lw)h$

$V = (36.5 \text{ cm} \cdot 52 \text{ cm}) \cdot 29 \text{ cm}$

$V = 1898 \text{ cm}^2 \cdot 29 \text{ cm}$

$V = 55042 \text{ cm}^3$

The tank has a capacity of 55042 cm^3*, or* 55.042 L*. If* 45 L *of oil have been removed from the tank, then* $55.042 \text{ L} - 45 \text{ L} = 10.042 \text{ L}$ *are left in the tank.*

$V = Bh = (lw)h$

$$\begin{aligned} 10042 \text{ cm}^3 &= (36.5 \text{ cm} \cdot 52 \text{ cm}) \cdot h \\ 10042 \text{ cm}^3 &= 1898 \text{ cm}^2 \cdot h \\ 10042 \text{ cm}^3 \cdot \frac{1}{1898 \text{ cm}^2} &= 1898 \text{ cm}^2 \cdot \frac{1}{1898 \text{ cm}^2} \cdot h \\ \frac{10042}{1898} \text{ cm} &= 1 \cdot h \\ 5.29 \text{ cm} &\approx h \end{aligned}$$

The depth of oil left in the tank is approximately 5.29 cm.

6. The inside of a right rectangular prism-shaped tank has a base that is 14 cm by 24 cm and a height of 60 cm. The tank is filled to its capacity with water, and then 10.92 L of water is removed. How far did the water level drop?

$V = Bh = (lw)h$

$V = (14 \text{ cm} \cdot 24 \text{ cm}) \cdot 60 \text{ cm}$

$V = 336 \text{ cm}^2 \cdot 60 \text{ cm}$

$V = 20160 \text{ cm}^3$

The capacity of the tank is 20160 cm^3 *or* 20.16 L*. When* 10.92 L *or* 10920 cm^3 *of water is removed from the tank, there remains* $20160 \text{ cm}^3 - 10920 \text{ cm}^3 = 9240 \text{ cm}^3$ *of water in the tank.*

$V = Bh = (lw)h$

$$\begin{aligned} 9240 \text{ cm}^3 &= (14 \text{ cm} \cdot 24 \text{ cm}) \cdot h \\ 9240 \text{ cm}^3 &= 336 \text{ cm}^2 \cdot h \\ 9240 \text{ cm}^3 \cdot \frac{1}{336 \text{ cm}^2} &= 336 \text{ cm}^2 \cdot \frac{1}{336 \text{ cm}^2} \cdot h \\ \frac{9240}{336} \text{ cm} &= 1 \cdot h \\ 27\frac{1}{2} \text{ cm} &= h \end{aligned}$$

The depth of the water left in the tank is $27\frac{1}{2}$ cm*. This means that the water level has dropped* $60 \text{ cm} - 27\frac{1}{2} \text{ cm} = 32\frac{1}{2} \text{ cm}$.

7. A right rectangular prism-shaped container has inside dimensions of $7\frac{1}{2}$ cm long and $4\frac{3}{5}$ cm wide. The tank is $\frac{3}{5}$ full of vegetable oil. It contains 0.414 L of oil. Find the height of the container.

$V = Bh = (lw)h$

$$414 \text{ cm}^3 = \left(7\frac{1}{2} \text{ cm} \cdot 4\frac{3}{5} \text{ cm}\right) \cdot h$$
$$414 \text{ cm}^3 = 34\frac{1}{2} \text{ cm}^2 \cdot h$$
$$414 \text{ cm}^3 = \frac{69}{2} \text{ cm}^2 \cdot h$$
$$414 \text{ cm}^3 \cdot \frac{2}{69 \text{ cm}^2} = \frac{69}{2} \text{ cm}^2 \cdot \frac{2}{69 \text{cm}^2} \cdot h$$
$$\frac{828}{69} \text{ cm} = 1 \cdot h$$
$$12 \text{ cm} = h$$

The vegetable oil in the container is 12 cm deep, but this is only $\frac{3}{5}$ of the container's depth. Let d represent the depth of the container in centimeters.

$$12 \text{ cm} = \frac{3}{5} \cdot d$$
$$12 \text{ cm} \cdot \frac{5}{3} = \frac{3}{5} \cdot \frac{5}{3} \cdot d$$
$$\frac{60}{3} \text{ cm} = 1 \cdot d$$
$$20 \text{ cm} = d$$

The depth of the container is 20 cm.

8. A right rectangular prism with length of 10 in., width of 16 in., and height of 12 in. is $\frac{2}{3}$ filled with water. If the water is emptied into another right rectangular prism with a length of 12 in., a width of 12 in., and height of 9 in., will the second container hold all of the water? Explain why or why not. Determine how far (above or below) the water level would be from the top of the container.

$\frac{2}{3} \cdot 12 \text{ in.} = \frac{24}{3} \text{ in.} = 8 \text{ in.}$ *The height of the water in the first prism is* 8 in.

$V = Bh = (lw)h$

$V = (10 \text{ in.} \cdot 16 \text{ in.}) \cdot 8 \text{ in.}$

$V = 160 \text{ in}^2 \cdot 8 \text{ in.}$

$V = 1280 \text{ in}^3$

The volume of water is 1280 in^3.

$V = Bh = (lw)h$

$V = (12 \text{ in.} \cdot 12 \text{ in.}) \cdot 9 \text{ in.}$

$V = 144 \text{ in}^2 \cdot 9 \text{ in.}$

$V = 1296 \text{ in}^3$

The capacity of the second prism is 1296 in^3*, which is greater than the volume of water, so the water will fit in the second prism.*

$V = Bh = (lw)h$ *Let* h *represent the depth of the water in the second prism in inches.*

$1280 \text{ in}^3 = (12 \text{ in.} \cdot 12 \text{ in.}) \cdot h$

$1280 \text{ in}^3 = (144 \text{ in}^2) \cdot h$

$1280 \text{ in}^3 \cdot \frac{1}{144 \text{ in}^2} = 144 \text{ in}^2 \cdot \frac{1}{144 \text{ in}^2} \cdot h$

$\frac{1280}{144} \text{ in.} = 1 \cdot h$

$8\frac{128}{144} \text{ in.} = h$

$8\frac{8}{9} \text{ in.} = h$

The depth of the water in the second prism is $8\frac{8}{9}$ in.

The water level will be $9 \text{ in.} - 8\frac{8}{9} \text{ in.} = \frac{1}{9} \text{ in.}$ *from the top of the second prism.*