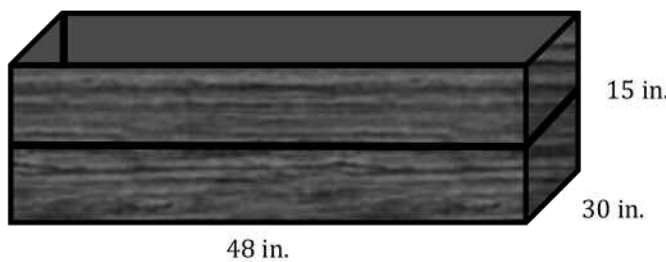
Name _____ Date _____

Lesson 25: Volume and Surface Area

Exit Ticket

Melody is planning a raised bed for her vegetable garden.



a. How many square feet of wood does she need to create the bed?

b. She needs to add soil. Each bag contains $1.5\ \text{ft}^3$. How many bags will she need to fill the vegetable garden?

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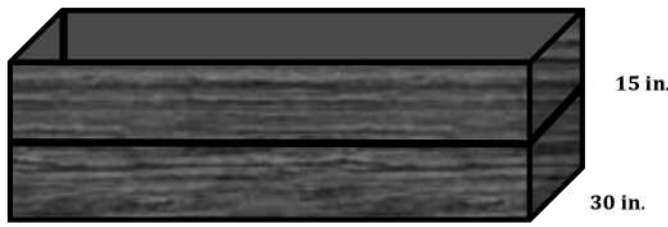

a. **How many square feet of wood does she need to create the bed?**

The dimensions in feet are 4 ft. *by* 1.25 ft. *by* 2.5 ft. *The lateral area is* $2(4 \text{ ft.})(1.25 \text{ ft.}) + 2(2.5 \text{ ft.})(1.25 \text{ ft.}) = 16.25 \text{ ft}^2$.

b. **She needs to add soil. Each bag contains** 1.5 **cubic feet. How many bags will she need to fill the vegetable garden?**

The volume is $4 \text{ ft.} \cdot 1.25 \text{ ft.} \cdot 2.5 \text{ ft.} = 12.5 \text{ ft}^3$. *Divide the total cubic feet by* 1.5 ft^3 *to determine the number of bags.* $12.5 \div 1.5 = 8\frac{1}{3}$ *bags. Melody will need to purchase* $nine$ *bags of soil to fill the garden bed.*

Note that if students fail to recognize the need to round up to nine bags, this should be addressed. Also, if the thickness of the wood were given, then there would be soil left over and possiblely only 8 bags would be needed, depending on the thickness.

1. **The dimensions of several right rectangular fish tanks are listed below. Find the volume in cubic centimeters, the capacity in liters (**$1 \text{ L} = 1000 \text{ cm}^3$**), and the surface area in square centimeters for each tank. What do you observe about the change in volume compared with the change in surface area between the small tank and the extra-large tank?**

Tank Size	Length (cm)	Width (cm)	Height (cm)
Small	24	18	15
Medium	30	21	20
Large	36	24	25
Extra-Large	40	27	30

Tank Size	Volume (cm^3)	Capacity (L)	Surface Area (cm^2)
Small	6,480	6.48	2,124
Medium	12,600	12.6	3,300
Large	21,600	21.6	4,728
Extra-Large	32,400	32.4	6,180

While the volume of the extra-large tank is about five times the volume of the small tank, its surface area is less than three times that of the small tank.

1. The dimensions of several right rectangular fish tanks are listed below. Find the volume in cubic centimeters, the capacity in liters ($1\text{ L} = 1000\text{ cm}^3$), and the surface area in square centimeters for each tank. What do you observe about the change in volume compared with the change in surface area between the small tank and the extra-large tank?

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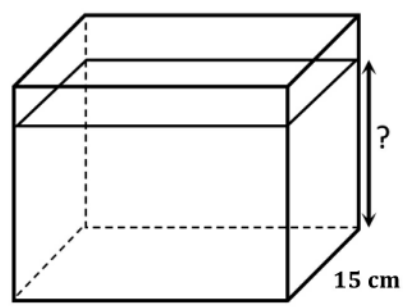
Tank Size	Volume (cm^3)	Capacity (L)	Surface Area (cm^2)
Small			
Medium			
Large			
Extra-Large			

2. A rectangular container 15 cm long by 25 cm wide contains 2.5 L of water.

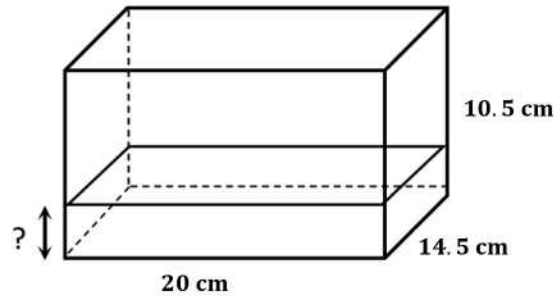


   a. Find the height of the water level in the container. ($1\text{ L} = 1000\text{ cm}^3$)

   b. If the height of the container is 18 cm, how many more liters of water would it take to completely fill the container?

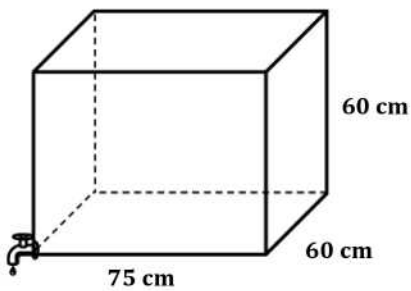
   c. What percentage of the tank is filled when it contains 2.5 L of water?

3. A rectangular container measuring 20 cm by 14.5 cm by 10.5 cm is filled with water to its brim. If 300 cm^3 are drained out of the container, what will be the height of the water level? If necessary, round to the nearest tenth.

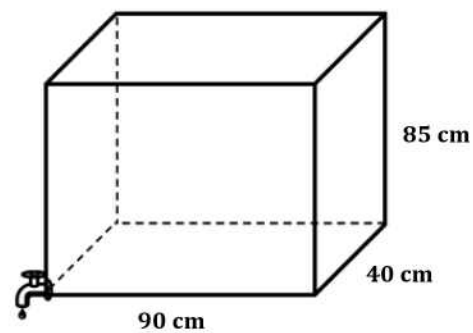


4. Two tanks are shown below. Both are filled to capacity, but the owner decides to drain them. Tank 1 is draining at a rate of 8 liters per minute. Tank 2 is draining at a rate of 10 liters per minute. Which tank empties first?

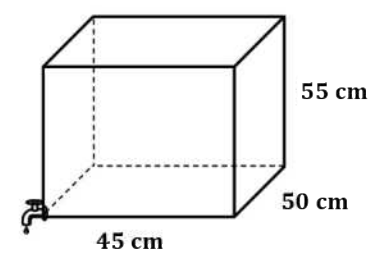
Tank 1

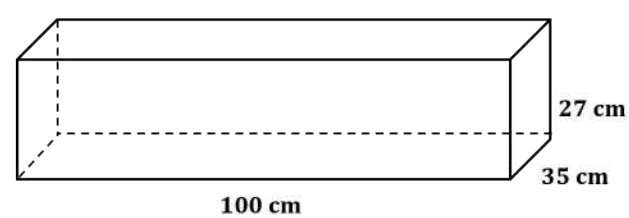


Tank 2

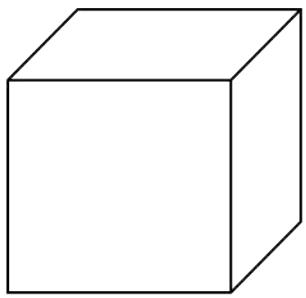


5. Two tanks are shown below. One tank is draining at a rate of 8 liters per minute into the other one, which is empty. After 10 minutes, what will be the height of the water level in the second tank? If necessary, round to the nearest minute.

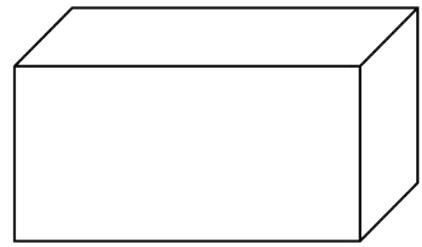




6. Two tanks with equal volumes are shown below. The tops are open. The owner wants to cover one tank with a glass top. The cost of glass is $\$0.05$ per square inch. Which tank would be less expensive to cover? How much less?



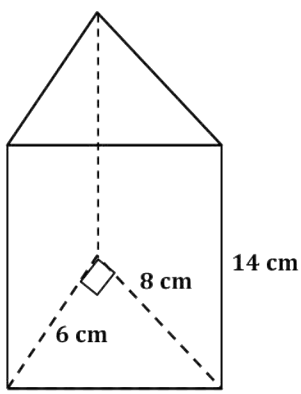
Dimensions: 12 in. long by 8 in. wide by 10 in. high



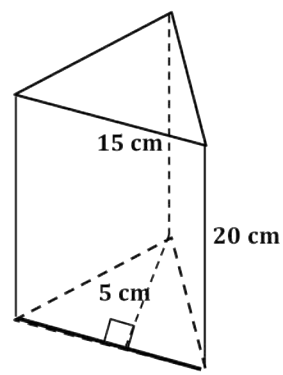
Dimensions: 15 in. long by 8 in. wide by 8 in. high

7. Each prism below is a gift box sold at the craft store.

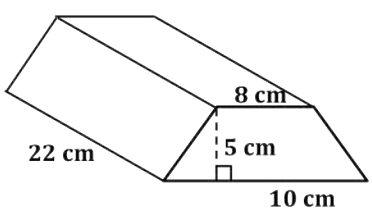
(a)



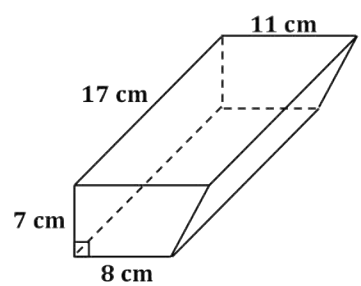
(b)



(c)



(d)



a. What is the volume of each prism?

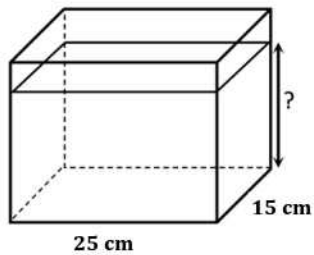
b. Jenny wants to fill each box with jelly beans. If one ounce of jelly beans is approximately $30\ \text{cm}^3$, estimate how many ounces of jelly beans Jenny will need to fill all four boxes? Explain your estimates.

8. Two rectangular tanks are filled at a rate of 0.5 cubic inches per minute. How long will it take each tank to be half-full?

a. Tank 1 Dimensions: 15 in. by 10 in. by 12.5 in.

b. Tank 2 Dimensions: $2\frac{1}{2}$ in. by $3\frac{3}{4}$ in. by $4\frac{3}{8}$ in.

2. A rectangular container 15 cm long by 25 cm wide contains 2.5 L of water.



a. Find the height of the water level in the container. (1 L $= 1000$ cm^3)

2.5 L $= 2,500$ cm^3

To find the height of the water level, divide the volume in cubic centimeters by the area of the base.

$$\frac{2,500 \text{ cm}^3}{25 \text{ cm} \cdot 15 \text{ cm}} = 6\frac{2}{3} \text{ cm}$$

b. If the height of the container is 18 cm, how many more liters of water would it take to completely fill the container?

Volume of tank: $(25 \text{ cm} \times 15 \text{ cm}) \times 18 \text{ cm} = 6,750 \text{ cm}^3$

Capacity of tank: 6.75 L

Difference: $6.75 \text{ L} - 2.5 \text{ L} = 4.25 \text{ L}$

c. What percentage of the tank is filled when it contains 2.5 L of water?

$$\frac{2.5 \text{ L}}{6.75 \text{ L}} = 0.37 = 37\%$$

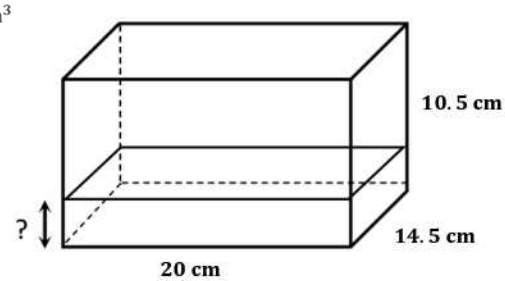
3. A rectangular container measuring 20 cm by 14.5 cm by 10.5 cm is filled with water to its brim. If 300 cm^3 are drained out of the container, what will be the height of the water level? If necessary, round to the nearest tenth.

Volume: $(20 \text{ cm} \times 14.5 \text{ cm}) \times 10.5 \text{ cm} = 3,045 \text{ cm}^3$

Volume after draining: $2,745$ cm^3

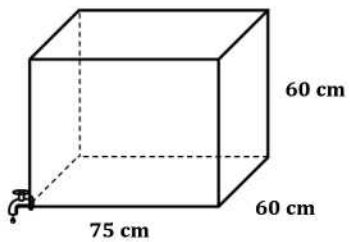
Height (divide the volume by the area of the base):

$$\frac{2745 \text{ cm}^3}{20 \text{ cm} \times 14.5 \text{ cm}} \approx 9.5 \text{ cm}$$

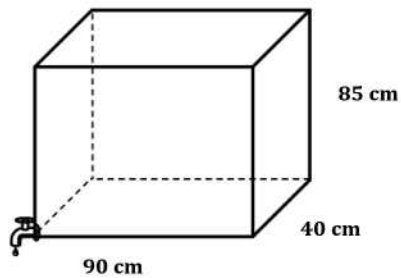


4. **Two tanks are shown below. Both are filled to capacity, but the owner decides to drain them. Tank 1 is draining at a rate of 8 liters per minute. Tank 2 is draining at a rate of 10 liters per minute. Which tank empties first?**

Tank 1



Tank 2



Tank 1 Volume: $75\text{ cm} \times 60\text{ cm} \times 60\text{ cm} = 270{,}000\text{ cm}^3$

Tank 2 Volume: $90\text{ cm} \times 40\text{ cm} \times 85\text{ cm} = 306{,}000\text{ cm}^3$

Tank 1 Capacity: 270 L *Tank 2 Capacity:* 306 L

To find the time to drain each tank, divide the capacity by the rate (liters per minute).

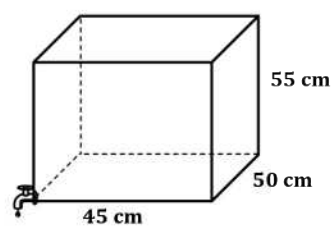
Time to drain tank 1: $\frac{270\text{ L}}{8\frac{\text{L}}{\text{min}}} = 33.75\text{ min}.$ *Time to drain tank 2:* $\frac{306\text{ L}}{10\frac{\text{L}}{\text{min}}} = 30.6\text{ min}.$

Tank 2 empties first.

5. **Two tanks are shown below. One tank is draining at a rate of 8 liters per minute into the other one, which is empty. After 10 minutes, what will be the height of the water level in the second tank? If necessary, round to the nearest minute.**

Volume of the top tank: $45\text{ cm} \times 50\text{ cm} \times 55\text{ cm} = 123{,}750\text{ cm}^3$

Capacity of the top tank: 123.75 L

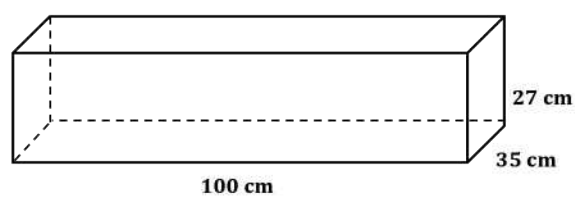


At $8\frac{\text{L}}{\text{min}}$ *for* 10 *minutes,* 80 L *will have drained into the bottom tank after* 10 *minutes.*

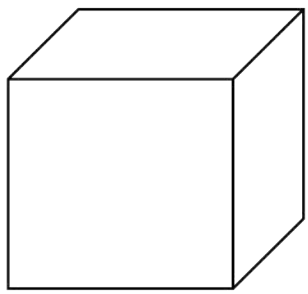
That is $80{,}000\text{ cm}^3$. *To find the height, divide the volume by the area of the base.*

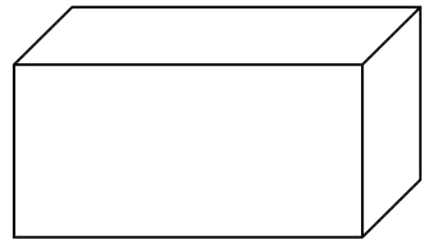
$$\frac{80000\text{ cm}^3}{100\text{ cm} \cdot 35\text{ cm}} \approx 22.9\text{ cm}$$

After 10 *minutes, the height of the water in the bottom tank will be about* 23 cm.



6. Two tanks with equal volumes are shown below. The tops are open. The owner wants to cover one tank with a glass top. The cost of glass is $\$0.05$ per square inch. Which tank would be less expensive to cover? How much less?





Dimensions: 12 in. long by 8 in. wide by 10 in. high

Surface area: 96 in^2

Cost: $0.05 \frac{\$}{\text{in}^2} \cdot 96 \text{ in}^2 = \$4.80$

Dimensions: 15 in. long by 8 in. wide by 8 in. high

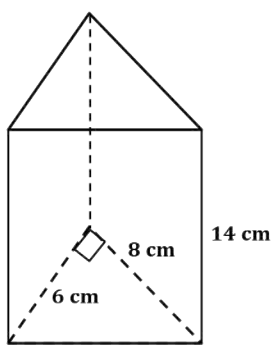
Surface area: 120 in^2

Cost: $0.05 \frac{\$}{\text{in}^2} \cdot 120 \text{ in}^2 = \$6.00$

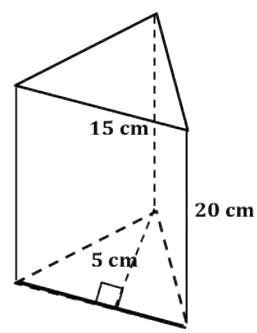
The first tank is less expensive. It is $\$1.20$ cheaper.

7. Each prism below is a gift box sold at the craft store.

(a)



(b)



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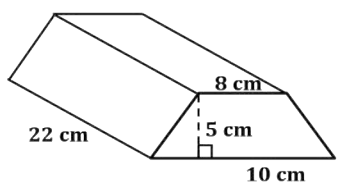

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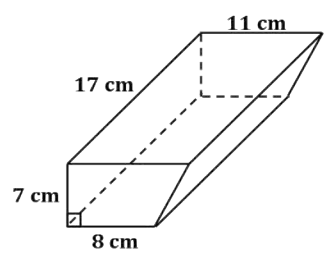

a. What is the volume of each prism?

(a) Volume $= 336 \text{ cm}^3$, (b) Volume $= 750 \text{ cm}^3$, (c) Volume $= 990 \text{ cm}^3$, (d) Volume $= 1130.5 \text{ cm}^3$

b. Jenny wants to fill each box with jelly beans. If one ounce of jelly beans is approximately 30 cm^3, estimate how many ounces of jelly beans Jenny will need to fill all four boxes? Explain your estimates.

Divide each volume in cubic centimeters by 30.

(a) 11.2 ounces (b) 25 ounces (c) 33 ounces (d) 37.7 ounces

Jenny would need a total of 106.9 ounces.

8. **Two rectangular tanks are filled at a rate of 0.5 cubic inches per minute. How long will it take each tank to be half-full?**

   a. **Tank 1 Dimensions: 15 in. by 10 in. by 12.5 in.**

   Volume: $1,875 \text{ in}^3$

   Half of the volume is 937.5 in^3.

   To find the number of minutes, divide the volume by the rate in cubic inches per minute.

   Time: $1,875$ *minutes.*

   b. **Tank 2 Dimensions: $2\frac{1}{2}$ in. by $3\frac{3}{4}$ in. by $4\frac{3}{8}$ in.**

   Volume: $\frac{2625}{64} \text{ in}^3$

   Half of the volume is $\frac{2625}{128} \text{ in}^3$.

   To find the number of minutes, divide the volume by the rate in cubic inches per minute.

   Time: 41 *minutes*