Chapter 3-Volume

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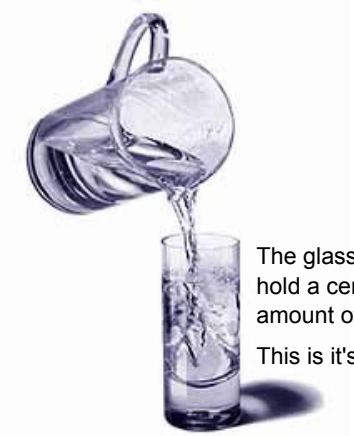
Volume is the measure of how much space is inside of a 3D Shape. It is how much the shape holds: Capacity



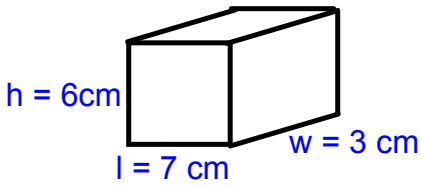
The glass can only hold a certain amount of water.

This is it's Capacity

To measure volume you must use the right formula for its shape.

Basic 3D Volumes

Rectangle Prism



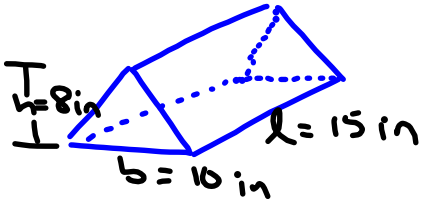
$V = l \times w \times h$

$= 7cm \times 3cm \times 6cm$

$= 126\ cm^3$

NOTE: volume is always cubed

Triangle Prism



(Area of the Base) x height

$V = 1/2\ (bxh) \times l$

$= 1/2(10 \times 8) \times 15$

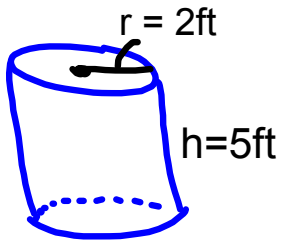
$= (40) \times 15$

$= 600\ in^3$

Cylinder

remember the more difficult Surface Area formula

$SA = 2\pi r^2 + 2\pi rh$



The Volume formula is much easier:

$V = \pi r^2 h$

$V = \pi (2)^2 (5)$

$V = \pi (4)(5)$

$V = \pi \times 20$

$V = 62.8\ ft^3$

3.2 Units of Volume & Capacity

Volume often deals with liquids so we need to know liquid Measures.

In the metric system

gallon 4 L

basic unit litre

ML (1/1000 of L)

In the old Imperial system

teaspoon (5 ml)

tablespoon (15ml)

Fluid Ounce

* Cup (8 ounce, 250mL)

pint (2 cups, 500mi)

quart (2 pints, 1 L)

gallon (4 quarts,)

Unit Conversions with the Imperial System

Bigger to Smaller (multiply)	cups	x8 →	fluid ounces
	gallons	×4 →	quarts
	pints	x2 →	cups
	quart	x2 →	pint
	gallons	×8 →	pints
Smaller to Bigger (divide)	cup	÷ 16 →	gallon
	pint	÷ 8 →	gallon
	cup	÷ 4 →	quarts

Section 3.2 Extra Practice

1. Match the best unit to measure each item.

a)

capacity of a travel-size shampoo bottle	ounce
capacity of a gas tank	cup
volume of a teapot	quart
volume of a family-size orange juice container	gallon

b)

capacity of a water dispenser	cm^3
volume of a pot of water	mL
volume of a bottle of perfume	L

2. Covert each measurement.

a) 1 gallon = ☐ quarts

b) 4 gallons = ☐ quarts

c) 12 gallons = ☐ quarts

d) 1 cup = ☐ fl oz

e) 4 cups = ☐ fl oz

f) $\frac{1}{4}$ cup = ☐ fl oz

g) 1 fl oz = ☐ cups

h) 4 fl oz = ☐ cups

i) 20 fl oz = ☐ cups

j) 1 qt = ☐ cups

k) 4 qt = ☐ cups

l) $\frac{1}{4}$ qt = ☐ cups

m) 1 qt = ☐ fl oz

n) 4 qt = ☐ fl oz

o) 1 gallon = ☐ fl oz

3. Mr. Taylor purchases orange juice in 4-L containers for the school breakfast program. The school uses 200-mL glasses. How many glasses of orange juice can one container fill?

4. The capacity of a coffee pot is 9 cups.

$9 \times 8oz = 70oz$

a) If the capacity of a small cup is 8 oz, how many small coffees can be poured from one pot of coffee? How many ounces remain in the pot?

b) If the capacity of a medium cup is 10 oz, how many medium coffees can be poured from one pot of coffee? How many ounces remain in the pot?

c) If the capacity of a large cup is 14 oz, how many large coffees can be poured from one pot of coffee? How many ounces remain in the pot?

d) If the capacity of an extra-large cup is 20 oz, how many extra-large coffees can be poured from one pot of coffee? How many ounces remain in the pot?

5. Windshield cleaner fluid is often sold in containers that have a capacity of 3.78 L.

Suppose you use half the contents of a container to fill the windshield cleaner tank in your car.

a) What is the capacity of the tank?

b) What is the volume of the fluid remaining in the container?

Word Problem Example:

Sam is preparing for a BBQ for his company social and needs to order the steaks. He plans to serve an 8oz steak to each of his guests and plans to have 40 people at the event (with 5 extra as spoilage/dropins). How many pounds of meat should be ordered at the butcher.
NOTE: 1 pound = 16 ounces

solution....

Step 1 - find out the total amount number of ounces of meat needed

Step 2 - Convert to Pounds

Volume of Cones.

A cone has $\frac{1}{3}$ the volume of the cylinder with the same height and base.

$$V_{cylinder} = \pi r^2 h$$

$$V_{cone} = \frac{\pi r^2 h}{3} \quad (\pi r^2 h) \div 3$$

Pyramids

Any pyramid is also $\frac{1}{3}$ of its prism so, get the prism's Volume and divide by 3.

$$V_{square\ prism} = l \times w \times h$$

$$V_{square\ pyramid} = \frac{l \times w \times h}{3}$$

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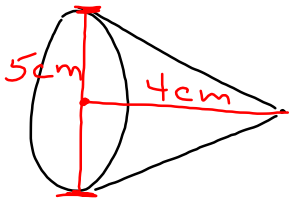
$$V_{cone} = \frac{\pi r^2 h}{3}$$

$$V_{square\ pyramid} = \frac{l \times w \times h}{3}$$

$$V_{Triangle\ Pyramid} = \frac{\left(\frac{b \times h}{2} \times l\right)}{3}$$



When working with formulas....

always

1. identify the formula to use

   ... in this case, the volume of a cone

$$V = \frac{\pi r^2 h}{3}$$

2. fill in the formula carefully

$$= \frac{\pi (2.5)^2 (4)}{3}$$

3. work out the calculations in careful steps

$$= \frac{(2.5) \times (2.5) \times (3.14) \times (4)}{3}$$

$$= \frac{78.5}{3} = 26.2 \text{ cm}^3$$

When working with formulas....

always

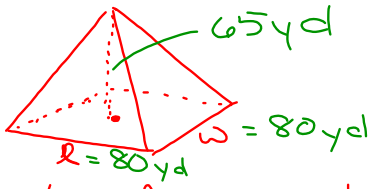
1. identify the formula to use

   .. in this case, a rectangular pyramid

2. fill in the formula carefully

3. work out the calculations

   in careful steps



$$V = \frac{l \times w \times h}{3}$$

$$= \frac{(80)(80)(65)}{3}$$

$$= \frac{416{,}000}{3}$$

$$= 138666.7\ yd^3$$

Volume of Composite Shapes

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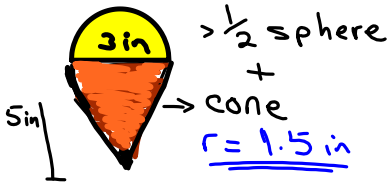
Composite shapes are a combination of 2 or more basic objects. (basics → cube, triangle prism, sphere...)

To get the volume of a composite shape... break it down! Then add the parts.

Identify the shapes



Work the Formulas

sphere + cone

$$V = \frac{1}{2}\left(\frac{4\pi r^3}{3}\right) + \frac{\pi r^2 h}{3}$$

$$V = \frac{2\pi(1.5)^3}{3} + \frac{\pi(1.5)^2(5)}{3}$$

$$= \frac{2\pi(3.375)}{3} + \frac{\pi(2.25)(5)}{3}$$

$$= \frac{21.2}{3} + \frac{35.34}{3}$$

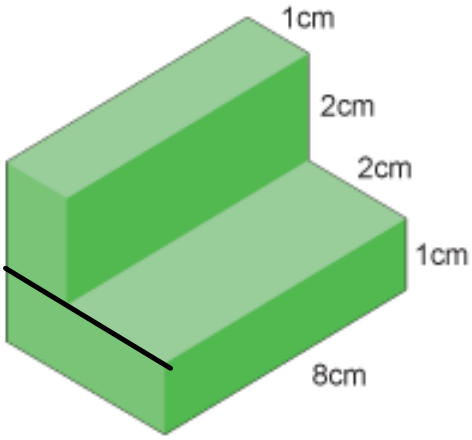
$$= 7.1 + 11.8$$

$$= 18.9 \text{ in}^3$$

When working with composite shapes....

always

1. identify the parts that make the object, and how they are put together



2. Get the formulas to use together
3. Carefully fill in the formulas

4. Work out the calculations in careful steps
5. DON'T FORGET THE UNITS

Top Rect Prism	+	Lower Rect Prism
l x w x h	+	l x w x h
(1) x (8) x (2)	+	(3) x (8) x (1)
16	+	24

40 cm^3