Section 3.6 – Determining Capacity and Solving Problems

- **Volume** is the quantity of space that a 3D object fills
  - It can have units in many different forms $(cm, m, kg, L, etc.)$

- **Capacity** is when we describes the contents of a container and how much it can hold.
  - It has units that describe quantities $(g, kg, mL, L, etc.)$

- For the sake of this section we will talk in metric units representing liquid $(mL \ and \ L)$

Conversions Again

- There are some particular conversions that are important when working with capacity
- They are:

$1mL = 1cm^3$	$1m^3 = 1000L$
$1L = 1000cm^3$	$1cm^3 = 1000mm^3$
$1L = 1000mL$	$1L \ weighs \ 1kg$

Example 1: The a juice box has dimensions $38mm \ x \ 118mm \ x \ 52mm$. It says it holds $200mL$ of juice. Is this an accurate statement?

Solution 1:

First we calculate the volume in mm^3

$38 \cdot 118 \cdot 52 = \mathbf{233\ 168 mm^3}$

With cm^3 it is a direct conversion to mL

$233.2cm^3 = \mathbf{233.2 mL}$

What could be a reason for the discrepancy in the capacity calculated and the amount of juice advertised?

The thickness of the packaging!!

Setting up your conversion ratio:

Consider the units you have. Then find the ratio including those units and the units you want.

In this case we have mm^3 we will need to get to cm^3 before we can make the final conversion to mL.

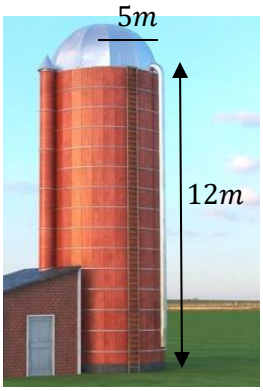
When you have the desired ratio, set it up so the units you want to cancel are on the bottom.

Millimeters cancel

$$233\ 168 \cancel{mm^3} \cdot \frac{1cm^3}{1000\cancel{mm^3}}$$

$$\frac{233\ 168}{1000} cm^3 = \mathbf{233.2 cm^3}$$

Example 2: Fernando works on a farm. There is a massive silo on the farm that needs to be filled with feed before the winter. The silo is in the shape of a cylinder with a spherical roof. What is the capacity, in $Litres$, of the top half-sphere? The cylinder? The total silo?



Solution 2:

Volume of the Sphere

$\frac{4}{3}\pi r^3 \rightarrow \frac{4}{3}\pi(5)^3 \rightarrow \mathbf{523.6m^3}$

So Half the Sphere is:

$$523.6m^3 \div 2 = 261.8m^3$$

Volume of the Cylinder:

$\pi r^2 \cdot h \rightarrow \pi(5)^2 \cdot 12 \rightarrow \mathbf{942.5m^3}$

Total Volume

$$\mathbf{942.5 + 523.6 = 1466.1m^3}$$

Capacity

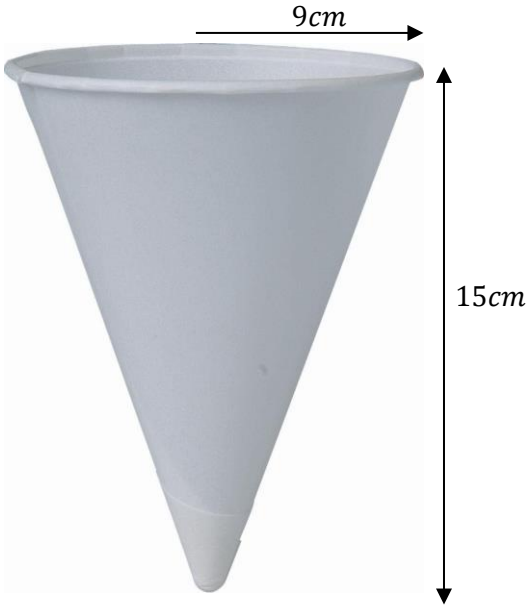
Recall: $1m^3 = 1000L$

$$1466.1m^3 \cdot \frac{1000L}{1m^3} =$$

$$\mathbf{1\,466\,100\ Litres}$$

Example 3: What is the capacity, in mL, of a cone shaped cup with radius $9cm$ and height of $15cm$?

Solution 3:



Volume of the Cone:

$\frac{1}{3}\pi r^2 \cdot h \rightarrow \frac{1}{3}\pi(9)^2 \cdot 15 \rightarrow 1272.3cm^3$

Capacity

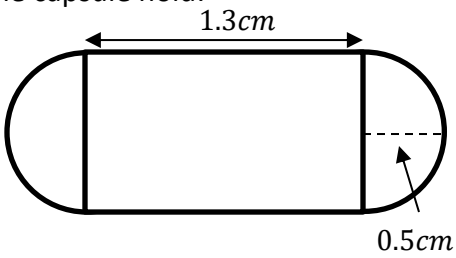
Recall: $1cm^3 = 1mL$

$$1272.3cm^3 = 1272.3mL$$

Section 3.6 – Practice Problems

1. Annika is selling drinks for a Leadership Fundraiser. The compostable eco-friendly cups she is using are in the shape of a cone. They have a diameter of $5.6cm$ and a height of $8.5cm$. Determine the capacity of the cups in mL.

2. A new Covid-19 vaccine is being delivered by cylindrical capsule medication with sphere tops as shown in the diagram. How much medication can the capsule hold:



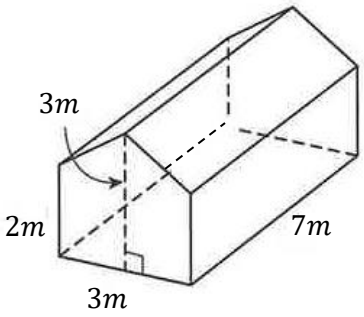
   a) Determine volume to the nearest cubic centimeter

   b) What is the capacity of the capsule in mL?

3. A spherical gas storage tank has an inner radius of $10m$. Determine its capacity to the nearest litre. How much does the gas weigh in tonnes ($1tonne = 1000kg$)?

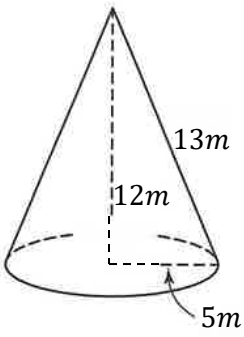
4. A rectangular tuna tin has a capacity of $180mL$. If it has a height of $3cm$ and the width is $7.5cm$, how big is the length of the tin?

5. Determine the capacity of the barn below in $Litres$.



6. What is the capacity, in millilitres, of a sphere with a radius of $38mm$.

7. What is the capacity of this massive cone in mL?



Section 3.6 – Answer Key

1. $69.7mL$
2. $a)\ 1.5cm^3 \quad b)\ 1.5mL$
3. $4\ 188\ 790.2L; 4188.8\ tonnes$
4. $l = 8cm$
5. $52500L$
6. $229.8mL$
7. $314\ 159\ 265.4mL$