DENSITY, MASS AND VOLUME

Definitions

Mass (m):
the mass of an object is the amount of matter it contains. (SI units: kg)

Volume (v):
the volume of an object is the amount of space the object takes up. (SI units: m^3)

Density (ρ):
the density of an object is defined as its mass per unit volume.

Formula:

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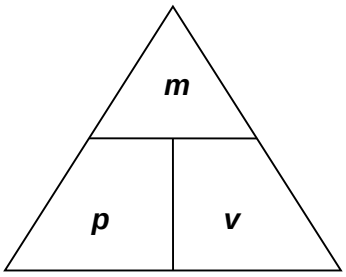
$$density = \frac{mass}{volume}$$

$$p = \frac{m}{v}$$

Units: *kg/m^3 or g/cm^3*



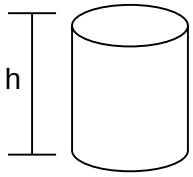
HINT: You can use a triangle to figure out how to calculate any component of density. If you want to work out the mass, put your finger over the m. Hence we can state mass = density x volume

Density is an example of a derived S.I. quantity. Notice the units of density are made up or two basic units.

In order to determine the density of material, we need to find the mass which can be easily determined accurately by using the scale. If the object is a regular shape object we can determine the volume by using the appropriate formula. However, if the object has an irregular shape we can determine its volume by measuring the amount of water displaced in a measuring cylinder.

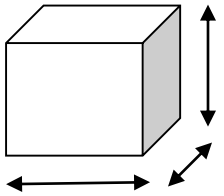
Volume of Regular Objects

Cylinder



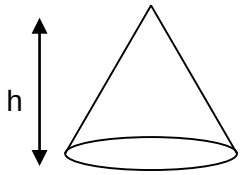
Volume = $\pi r^2 h$

Cube/Cuboid



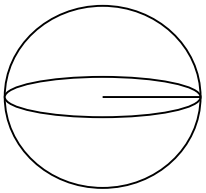
Volume = height x length × width V = hlw

Cone



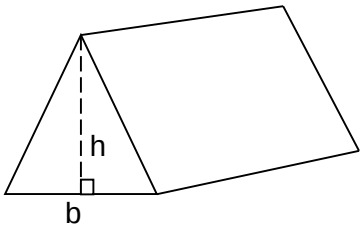
Volume = $\frac{1}{3}\pi r^2 h$

Sphere



Volume = $4/3\ \pi\ r^2$

Prism



Volume of prism = cross sectional area of triangle × length
where area of triangle = ½× base × height

Volume of Liquids

To find the volume of a liquid, we can either use a measuring cylinder, burette or pipette. When reading the volume from these instruments; you should read the bottom of the curved *meniscus* and make sure your eye is on the same horizontal as the *meniscus*. If you are using a measuring cylinder, it should be on a flat level surface.

Examples of Density

1) A piece of metal has a mass of 140g and a volume of 20cm^3. Calculate the density of the metal.

$m = 140g \qquad v = 20cm^3$

$$p = \frac{m}{v}$$

$$= \frac{140}{20}$$

$$= 7g/cm^3$$

2) A body has a density of 0.25g/cm^3. If the mass is 120g, calculate the body's volume.

$p = 0.25g/cm^3 \qquad m = 120g$

$$v = \frac{m}{p}$$

$$= \frac{120}{0.25}$$

$$= 480\ cm^3$$

3) Calculate the mass of a solid gold coin of volume 2.1cm^3, given that the density of the gold coin is 19g/ cm^3.

$p = 19g/cm^3 \qquad v = 2.1cm^3$

$$m = 19g/cm^3 \times 2.1cm^3$$

$$=39.9g$$

4) The density of a container is 780 kg/m^3, if the mass of the container is 15600g, calculate the volume of the container.

$p = 780\ kg/m^3 \qquad m = 15600g = 15.6\ kg$

$$v = \frac{m}{p}$$

$$= \frac{15.6}{780}$$

$$=0.02\ m^3$$