



Mass, Volume and Density

Physical Properties of Matter

What is matter?

- Matter is what the universe is made of.
- Matter is anything that has mass and volume.
- Examples include just about everything (any solid, liquid or gas).
- Example of things that are not matter include electricity, sound and light.

What is the difference between mass and volume?

■ Mass- how much matter is present	■ Volume- how much space something takes up
■ Measured in kg, g and mg	■ Measured in mL, L and cm^3

Which weighs more a ton of bricks or a ton of feathers?
Neither, they both have the same mass. However, the feathers will have a much higher volume.

The difference between mass and weight.

- Weight is the force of gravity pulling down on the mass of an object.
- Weight = mass x gravity and 99.99999% of the time gravity is a constant (9.8 m/s²)
- A normal scale will divide for you and give you your mass
- However there are differences

- Weight is a force, it pulls in a definite direction.
- Weight is measured in Newtons (N)
- Weight changes with altitude. On the moon you would weigh 1/6 of what you do on Earth.
- Mass is inertia (resistance to change in motion) it has no direction.
- Mass is measured in kilograms (kg).
- Mass never changes, unless you remove or add matter to the object.

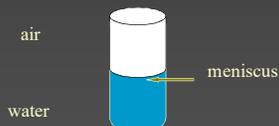
How to measure volume.

If it is a cubic solid, measure length, width and height and multiply them.



$$l \times w \times h = v$$

If it is a liquid, pour it in a graduated cylinder and read from the meniscus (the low point of the curve).



ALWAYS PUT YOUR HEAD AT THE SAME LEVEL AS THE MENISCUS

Measuring an irregular solid

- first pour water into a graduated cylinder large enough to hold the solid, and read its volume.
- then place the solid into the water being careful not to spill any water.
- read the new volume.
- subtract the new volume from the old for the volume of the solid.

How to measure mass

- If it is a “nonmessy” solid, weigh it on a scale.
- If it is a liquid or messy (a powder, greasy etc.) get a weighing tray or beaker.
- weigh the empty weighing tray or beaker and record its mass.
- add the object to the weighing tray or beaker and weigh it and subtract the mass of the empty beaker.

Scale Rules

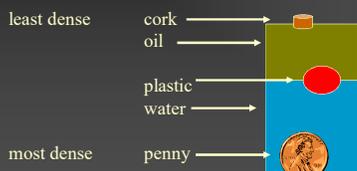
- Gently place objects on scale.
- Make sure the scale is clean. (wipe off excess powder when done)
- Make absolutely certain before you use it it reads 0.00 g
- It if doesn't press ON/ZERO
- If you press ON/ZERO after you place your weighing tray on the scale, you don't have to subtract the mass.

Density

- Density is a ratio of mass to volume of an object.
- $D = m / v$ (density = mass / volume)
- Density is measured in g/mL (grams per milliliter).
- Density of a pure compound or element is a constant
- Gold is always 19.3 g/mL, pure water is always 1.0 g/mL

Quick density test

- less dense objects float in more dense objects.



Interesting point...

- Density of water is 1 g/mL
- The density of steel is 7.9 g/mL
- What is the density of an aircraft carrier loaded with jets, crew, and guns?
- If it hasn't been sunk it is less than 1 g/mL
- Boats have a hollow hull (big space for air to collect) to decrease their density.
- Air has a density of .0013 g/mL
