Notes for Metrics, Standard Units, Indirect Measurements

Bellwork: Dimensional Analysis; slope

Metrics:

p. 10 Standard units – units that have been agreed upon (standards)

We have standards so that we can calibrate measurements

In ancient times some measurements were variable (1 cubit = 1 forearm, but whose arm?). With commerce came standard. In German I saw poles and weights kept at the town hall that were the "standards". Everyone in town would come to those standards to measure their goods.

Q: What if we didn't have standards? What if the standard for weight was different at each grocery store?

Length – meter; mass – kg; time – sec (there are 5 more)

They have things that they equal (see p. 11 in book)

Prefixes: allow us to convert between large and small units easily.

Try this: convert 3.2 ft to inches: 3.2 ft x 12 in = ? inches

Try this: convert 3.2 meters to centimeters = 3.2 x 100 = 320 cm

(notice that all I had to do was move the decimal – so much easier)

Here are the most common prefixes (and a good way to remember them):

kilo- Hecta - deka- meter (stand unit) deci-, centi-, milli-,

King Henry Died Monday Drinking Chocolate Milk

We know these prefixes:

Centi (century, cents, percent) – means hundred 100 cm = 1 m

Milli (millennium) – means thousand 1000 mm = 1 m

Common Conversion Factors: (and they work for different standard units [liters, grams]).

100 cm = 1 m $1 \times 10^{-2}$ m = 1 cm = 0.01 m

1000 mm = 1 m $1 \times 10^{-3}$ m = 1 mm = 0.001 m

1 km = 1000 m $1 \times 10^{3}$ m = 1 km = 1000 m

Other important prefixes:

VERY SMALL: nano- ($10^{-9}$), micro-($10^{-6}$),

VERY BIG: mega-(x $10^{6}$), giga-(x $10^{9}$), tera-(x $10^{12}$)

You can either convert by moving the decimal OR by doing a conversion.

Conversion Factors:

$1 \times 10^{-6}$ m = 1 micrometer = 0.000001 m (one millionth)

$1 \times 10^{-9}$ m = 1 nm = 0.000000001 m (one billionth)
$1 \times 10^{6}$ m = 1 Mm = 1,000,000 m (mega is for million)
$1 \times 10^{9}$ m = 1 Gm = 1,000,000,000 (Giga is for billion)
$1 \times 10^{9}$ m = 1 Gm = 1,000,000,000 (Giga is for billion)

How big are they? As a person doing science it is VERY important that you actually have a rough idea of how big things are. Otherwise you are just talking numbers, not reality.

m – just bigger than a yard; 3.3 ft (a 10 ft pole is a 3 meter pole)
centimeter - a little smaller than the width of your little finger
mm – (width of a pencil lead, or a fingernail)
km = 0.6 miles (just longer than a half mile)
g - mass of 2 or 3 small paperclips or mass of a dollar bill
kg = 2.2 pounds
L – just larger than a quart
mL – appr. volume of 3 pennies.

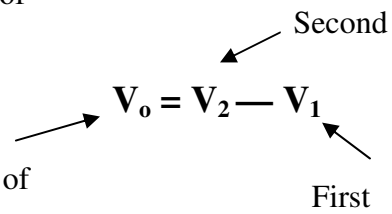
Practice:

| | | | |
|---|---|---|---|
| 0.03 km to cm | 2000 mL to L | 258 cm to m | 0.04 m to mm |
| 0.00049 cm to micrometers | | 5.2 km to meters | 4 m to cm |
| 3,500 g to kg | 49868 kg to Mg | 9.8 nm to m | |

Indirect Methods of measurement –

Displacement method:
The volume of some objects is easy to find, like a cube or a cylinder. The volume of some irregular objects, like a rock, would be hard to calculate. If you put the object in water and measure the volume change, you have found the volume of the object.

Displacement
Method of




Measuring something too BIG to measure:
Measure a small part then multiply by the large part.
Ex.

Measuring something too small to measure:

Measure a large number of objects then divide by the number of objects part.

Ex.

If time: Play Metric Game

Lab: Discovering Metrics

How big is it? Roughly how big is it: mL/ liter/ g/ kg/ mm/ cm/ km

Length: inches/ feet/ centimeters/ meters

Student table; width of room; length of pencil

Volume: milliliters vs. Liters vs. gallons

How many cups in a liter?

How many ml in a cup?

How many liters in a gallon?

Mass: grams vs. kilograms vs. pounds

How many grams in a pound?