Mr. Forrest/ Integrated Science Name: _____ Paper # _____

The Metric System and Measurement

Introduction

The metric system is the world standard for measurement. Not only is it used by scientists throughout the world, but most nations have adopted it as their standard of measurement. All of the measurements done in this course will use the metric system.

The table below shows the standard unit of length, weight, volume, and temperature in the metric system. It also shows the English equivalent.

	Metric	**English**
Length	meter	39.37 inches
Weight	gram	0.03527 ounces
Volume	liter	1.0567 quarts
Temperature	degree (Centigrade)	1.8 degrees Fahrenheit

Meters, grams, and liters (see the table above) form the basis for larger or smaller units.
The units are named using these prefixes:

Giga = 1,000,000,000 (billion)

Mega = 1,000,000 (million)

Kilo = 1000 (thousand)

Deci = 1/10 (tenth)

Centi = 1/100 (hundredth)

Milli = 1/1,000 (thousandth)

Micro = 1/1,000,000

Nano = 1/1,000,000,000

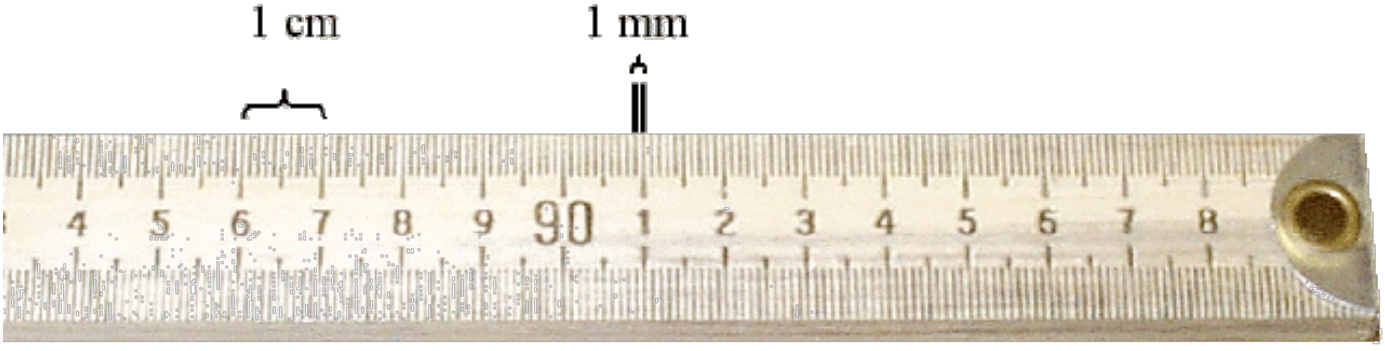
The STANDARD units (from which all other units can be derived) in the SI (metric) system are:
Mass: kilogram
Length: meter
Time: second

The table below shows how meters are related to five other measures of length.

Unit	**Length**
kilometer (km)	1,000 m (1 X 10^{3} m)
meter (m)	1 m
centimeter (cm)	0.01 m (1 X 10^{-2} m)
millimeter (mm)	0.001 m (1 X 10^{-3} m)
micrometer (µm)	0.000001 m (1 X 10^{-6} m)
nanometer (nm)	0.000000001 m (1 X 10^{-9} m)
gigameter (Gm)	1,000,000,000 m (1 x 10^{9} m)

Notice that each of the units in the table above are related to meters by a multiple of 10.

The photograph below shows the end of a meter stick. The 90 cm mark can be seen in the center of the photograph. One meter = 100 cm. Notice that each centimeter is divided into 10 mm.



The tables below show similar units based on grams (mass) and liters (volume).

Unit	Mass
metric ton (t)	1,000 kg or 1,000,000 g (1×10^6 g)
Kilogram (kg)	1,000 g (1×10^3 g)
gram (g)	1 gram
milligram (mg)	0.001 g (1×10^{-3} g)
microgram (µg)	0.000001 g (1×10^{-6} g)
nanogram (ng)	0.000000001 g (1×10^{-9} g)

Unit	Volume
kiloliter (kl)	1,000 liters (1×10^3 l)
liter (l)	1 liter
milliliter (mL)	0.001 liter (1×10^{-3} l), $1 cm^3$
microliter (ul)	0.000001 liter (1×10^{-6} l)

Notice in the table above that one milliliter (mL) equals one cubic centimeter (1 mL = 1 cc or cm^3).

Metric Conversions

Exponents (Scientific notation)

The table below shows how numbers can be written using exponents. For example, a second way to write the number 1,000 is 1×10^3.

$100 = 1 \times 10^2$ $1000 = 1 \times 10^3$ $0.01 = 1 \times 10^{-2}$ $0.001 = 1 \times 10^{-3}$

Examples

$256 = 2.56 \times 10^2$

$3287 = 3.287 \times 10^3$

$0.055 = 5.5 \times 10^{-2}$

Exponents are useful when writing numbers that are very large or very small. For example, the number 1,930,000,000,000,000,000 is easier to write as 1.93×10^{18}. It's very helpful to know how your own calculator will do this.

Decimal Point

Metric conversions are done by moving the decimal point. When converting a large unit such as meters to a smaller unit such as millimeters, the decimal point is moved to the right. When converting smaller units to larger units, the decimal point is moved to the left. You must subtract the exponents in order to determine how many places to move the decimal point.

When converting to a larger metric unit (move decimal point to the left)

When converting to a smaller metric unit (move decimal point to the right)

Examples

Convert 2.6 cm to mm.

This problem is solved by subtracting the exponents. The exponent for cm is -2; the exponent for mm is -3. Subtract the two numbers: -2 - (-3) = +1. Therefore, to convert 2.6 cm to mm, you must move the decimal point 1 place to the right.
2.6 cm = 26 mm (this should make sense since you should have a bigger number if you are measuring in a smaller unit!

Convert 57 um to cm.

The exponent for µm is -6. The exponent for cm is -2. You must subtract these two numbers to determine how many places to move the decimal point. -6 - (-2) = -4. The negative sign indicates that you must move the decimal point 4 places to the left.
So, 57 µm = 0.0057 cm