NAME:

Metric System Worksheet

Any quantitative observation is a measurement and must always have a unit for each numerical value, otherwise that number is meaningless (i.e.: Dr. Laux is 1650 tall………what does that tell you??!!??)

There are two common unit systems in use today, and without a universal unit system interaction between scientists would be impossible (imagine if each country had their own set of units!).

1) The English System stems from historical necessities in Europe and is primarily only used by the United States today, and by many engineers. For example, the foot may have been defined by the actual length of a king’s foot at the time!

2) The metric system is used by most of the rest of the world and is the primary system used by scientists. In 1960, an international system based on the metric system was created and are called SI units (French for Systeme Internationale).

Some common units from each system are given in the Table below. Note that units of temperature and time are universal.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>English Units</th>
<th>Metric Units</th>
<th>Fundamental SI unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>mass</td>
<td>lb, tons, oz</td>
<td>g, kg, cg</td>
<td>kg</td>
</tr>
<tr>
<td>volume</td>
<td>fl. oz., gal, cm³</td>
<td>L, mL</td>
<td>m³</td>
</tr>
<tr>
<td>length</td>
<td>mile, yd, ft, in</td>
<td>m, cm, km</td>
<td>m</td>
</tr>
<tr>
<td>time</td>
<td>sec, yr, min, hr</td>
<td>same</td>
<td>sec</td>
</tr>
<tr>
<td>temperature</td>
<td>K, °F, °C, °R</td>
<td>same</td>
<td>K</td>
</tr>
</tbody>
</table>

Converting from English to SI units is a necessary skill in science and follows the rules for dimensional analysis (unit conversion). Even basic unit conversion mistakes can be costly or even deadly (i.e.: The Mars probe that crashed on the surface in the late 1990’s due to someone who forgot to convert from one system of units to the other). As long as the conversion factor between the units is known, it is simple to convert them (i.e.: 2.54 cm = 1 in or 453.59 g = 1 lb).

Converting units within the metric system is much easier since they are all related by powers of 10. Prefixes are used to denote particular factors of 10, as shown below for common prefixes in this class:

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Representation</th>
<th>Prefix</th>
<th>Symbol</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>giga</td>
<td>G</td>
<td>10⁹ (one billion)</td>
<td>centi</td>
<td>c</td>
<td>10⁻² (a hundredth)</td>
</tr>
<tr>
<td>Mega</td>
<td>M</td>
<td>10⁶ (one million)</td>
<td>milli</td>
<td>m</td>
<td>10⁻³ (a thousandth)</td>
</tr>
<tr>
<td>kilo</td>
<td>k</td>
<td>10³ (one thousand)</td>
<td>micro</td>
<td>μ</td>
<td>10⁻⁶ (a millionth)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>nano</td>
<td>n</td>
<td>10⁻⁹ (a billionth)</td>
</tr>
</tbody>
</table>

For example, to convert from meters to centimeter, just multiply by 100, since there are 100 cm in a meter. The rules for dimensional analysis apply since the prefixes in the metric system are just conversion factors.

\[
2.56 \text{ m} \left( \frac{100 \text{ cm}}{1 \text{ m}} \right) = 256 \text{ cm}
\]
**Problems:**

Perform the following metric system conversions. Be sure to show all conversion factors! Watch sig. figs.!

1) $0.50 \text{ m} = \underline{\hspace{1cm}} \text{ mm}$
2) $2.00 \text{ km} = \underline{\hspace{1cm}} \text{ m}$
3) $0.400 \text{ L} = \underline{\hspace{1cm}} \text{ mL}$
4) $1.00 \text{ g} = \underline{\hspace{1cm}} \text{ kg}$
5) $1.00 \text{ cm} = \underline{\hspace{1cm}} \text{ m}$
6) $8.00 \text{ mm} = \underline{\hspace{1cm}} \text{ cm}$
7) $22.4 \text{ L} = \underline{\hspace{1cm}} \text{ mL}$
8) $5.00 \text{ g} = \underline{\hspace{1cm}} \text{ kg}$
9) $4.245 \text{ L} = \underline{\hspace{1cm}} \text{ mL}$
10) $345 \text{ g} = \underline{\hspace{1cm}} \text{ kg}$
11) $10.0 \text{ nm} = \underline{\hspace{1cm}} \text{ m}$
12) $3.22 \text{ Gg} = \underline{\hspace{1cm}} \text{ kg}$
13) $3.001 \text{ cg} = \underline{\hspace{1cm}} \text{ mg}$
14) $1.2 \text{ m} = \underline{\hspace{1cm}} \mu\text{m}$
15) $455 \text{ nm} = \underline{\hspace{1cm}} \text{ m}$

Perform the following conversions between the English and metric systems. Be sure to show all work!

1) $10.0 \text{ cm} = \underline{\hspace{1cm}} \text{ in}$
2) $15.0 \text{ lb} = \underline{\hspace{1cm}} \text{ kg}$
3) $1.00 \text{ yd} = \underline{\hspace{1cm}} \text{ cm}$
4) $16.9 \text{ fl. oz} = \underline{\hspace{1cm}} \text{ L}$
5) $1.00 \text{ qt} = \underline{\hspace{1cm}} \text{ L}$
6) $6.00 \text{ in} = \underline{\hspace{1cm}} \text{ cm}$
7) $0.800 \text{ kg} = \underline{\hspace{1cm}} \text{ oz}$
8) $1.83 \text{ kg} = \underline{\hspace{1cm}} \text{ lb}$
9) $25.00 \text{ mL} = \underline{\hspace{1cm}} \text{ qt}$
10) $1.40 \text{ m}^3 = \underline{\hspace{1cm}} \text{ mL}$