UNIT CONVERSION
AST 113 @ MESA COMMUNITY COLLEGE

NAME: _____   **DATE**: _____

INTRODUCTION

This lab exercise reviews a method for converting from one unit of measure to another.

EQUIPMENT
A scientific calculator.

MEASUREMENT AND UNITS OF MEASURE

All physical quantities (distance, mass, time, length, speed, etc.) have *units of measure* associated with them. A measurement without a unit of measure has no meaning. For example, you measure a distance and record a value of 30. Another student reads your measurement and asks: 30 what? 30 meters? 30 kilometers? 30 light-years?

The unit of measure is just as important as the number!

The same quantity can be expressed using more than one unit of measure. For example, a person's height could be expressed as "5 feet, 10 inches" or "70 inches" or "178 centimeters" or "1.78 meters". These all represent the <u>same height</u> using different units of measure.

Metric units of measure are now a global standard. The meter (distance), the second (time), and the gram (mass) are the most commonly used basic units. In addition, each metric unit can be combined with a prefix that changes the size of the basic unit.

The most commonly used prefixes are shown below. The examples in the table below all use the prefixes with the basic unit of the meter, but the prefixes work the same way with any basic unit.

Prefix	Letter	Factor	In terms of meters…	One meter equals…
nano-	n	10^{-9}	1 nanometer = 10^{-9} meter	1 meter = 10^{+9} nanometers
micro-	μ	10^{-6}	1 micrometer = 10^{-6} meter	1 meter = 10^{+6} micrometers
milli-	m	10^{-3}	1 millimeter = 10^{-3} meter	1 meter = 10^{+3} millimeters
centi-	c	10^{-2}	1 centimeter = 10^{-2} meter	1 meter = 10^{+2} centimeters
kilo-	k	10^{+3}	1 kilometer = 10^{+3} meters	1 meter = 10^{-3} kilometer
mega-	M	10^{+6}	1 megameter = 10^{+6} meters	1 meter = 10^{-6} megameter
giga-	G	10^{+9}	1 gigameter = 10^{+9} meters	1 meter = 10^{-9} gigameter

Notice that the nano, micro, and milli prefixes are each different by a factor of 10^3. Similarly, the kilo, mega, and giga prefixes are also different by a factor of 10^3. Centi- does not fit this pattern.

A quantity expressed with one metric unit can be converted to any other unit of measure. For example, consider converting 1273 centimeters to meters. First we need to know the relationship between centimeters and meters: 1 centimeter $= 10^{-2}$ meter.

We can now multiply the original quantity (1273 centimeters) by the conversion relationship. The *most important* part of setting up the problem is that the original unit (centimeters) <u>cancels</u> the same unit (centimeters) in the conversion relationship. If the relationship had been reversed (*centimeters* on top and *meters* on bottom), then *centimeters* would not cancel out.

$$1273 \text{ centimeters} \times \frac{10^{-2}\,\text{meter}}{1 \text{ centimeter}}$$

So $1273 \times 10^{-2} \div 1$ equals 12.73. The quantity now has units of meters: 1273 cm = 12.73 m.

Things to remember:
- A. Arrange the fraction so the original units *cancel* leaving only the new unit.
- B. Multiply together the numbers on top and divide by each number on the bottom.
- C. Converting to a *smaller* unit (e.g. kilometers to meters) makes the number *larger*.
- D. Converting to a *larger* unit (e.g. milliseconds to seconds) makes the number *smaller*.

Perform the following unit conversions. Show your work, including the conversion you use. Write your answer in scientific notation.

1) 93,500 centimeters to meters

2) 7.41×10^{12} nanoseconds to seconds

3) 2.7×10^5 meters to kilometers

4) 4.88×10^{-4} seconds to microseconds

5) 0.0000000282 grams to milligrams