Units, Math and Conversions

Name_____ Period_____

In this class we will perform all measurements and calculations in the metric system. This activity is designed to help you understand the major metric prefixes and the relationships between them. In addition it will also provide you with the tools to convert from any unit English or metric to any other unit.

Answer the following questions about the metric and English systems of measurement using the on-line **Dictionary of Units at**
http://www.unc.edu/~rowlett/units/index.html

Explain the history of each of the following units that are used today. What is their origin?

1) I bet you thought a meter measured some special stick of a particular length. What does it really measure??????

2) How about a kilogram? What is it really a measurement of?

3) What about a second? What is it really a measurement of?

4) How about a Newton?

5) A Slug???

6) Estimate how many Fortnights this class will be before it ends the end of May.

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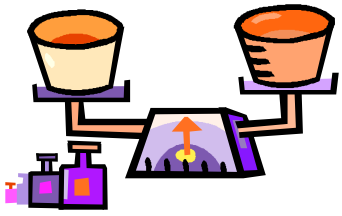

Measurement Activities: Relationships between metric units

Relationships with milli

Using the 100 ml graduated cylinder, measure the number of ml that will fit in one liter. Fill in the following relationship.

⇒ _____ ml = _____ L

Using a meter stick, determine the number of millimeters that are in 1 cm. Fill in the relationship below.

_____ mm = _____ cm

How many mm would be in an entire meter? Fill in the relationship below.

⇒ _____ mm = _____ m

Using the two relationships above that are highlighted with arrows, how many mg would be equal to 1 g?

_____ mg = _____ g

Questions:

1) Two liters (2 L) is equal to how many ml? _____

2) Five meters (5 m) is equal to how many mm?_____

3) Compare your answer in **question 1** to the original 2 L. Did your answer produce a number that is smaller or larger than the original number of 2?
   _____

4) Compare your answer in **question 2** to the original 5 meters. Did your answer produce a number that is smaller or larger than the original number of 5?
   _____

Summary: If you move from a larger unit to a smaller unit the value of the number will get _____ (larger/smaller).

☆ **Rule:** if the **UNIT GETS SMALLER…… NUMBER GETS _____.**

What happens if you go the other way?

5) 5000 mg is equal to how many grams? _____

6) 7000 ml is equal to how many liters?? _____

7) Compare your answer in question 5 to the original 5000 mg. Did your answer produce a number that is smaller or larger than the original number of 5000? _____

☆ **Rule:** if the **UNIT GETS LARGER…….NUMBER GETS _____.**

8) There are lots of metric prefixes but the must important to understand are the relationships between **milli**, **centi** and **kilo**. Using your essential facts booklet, fill in the blanks for each of the following.

a. _____mg = _____g
b. _____km = _____m
c. _____m = _____cm
d. _____ml = _____L
e. _____m = _____mm
f. _____ kL= _____L

9)
A. Which is the larger unit: L or ml? _____
B. If you need to convert from ml to liters, would the number with your answer get larger or smaller? _____

10)
A. Which is the larger unit: grams or kilograms? _____
B. If you need to convert from kg to grams, would the number with your answer get larger or smaller? _____

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A Little Math Review

Solve each of the following:

a) $\frac{(7)(2)}{(7)}$ =

b) $\frac{2x}{2}$ =

c) $\frac{7y}{y}$ =

d) $\frac{10xyz}{5}$ =

e) $\frac{5}{5x}$ =

f) $\frac{50xg}{25g}$ =

g) $\frac{(10mg)(5g)}{(50mg)}$ =

h) $\frac{(5km)(20m)}{(10km)}$ =

i) $\frac{(5x)(4x)}{10}$ =

j) $\frac{(2m)(2m)(2m)}{3}$ =

k) $\frac{(4cm)(4cm)}{8m}$ =

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Rearrange the equation using algebra rules and solve it for the indicated variable.

a) Solve for x

$10 = 5x$

b) Solve for y

$12 = y - 10$

c) Solve for n

$12 = \frac{n}{2}$

d) Solve for n

$12 = \frac{n}{d}$

e) Solve for d

$27 = \frac{d}{t}$

f) Solve for d

$v = \frac{d}{t}$

g) Solve for a

$F = ma$

h) Solve for F

$W = Fd$

i) Solve for t (tough one!)

$v = \frac{d}{t}$

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Conversions

Using Dimensional Analysis to Always Get It Right

Dimensional analysis is just a fancy name for a method of calculating that

1. uses numbers in the form of fractions.
2. enables us to convert from one type of unit measurement to another.

It is something you will encounter heavily in this class and can also be useful in your daily lives outside class (cooking, work, etc). This worksheet is intended to help you get comfortable with manipulating numbers in terms of their units (i.e. dimensional analysis). In this worksheet you will encounter some definitions or terms that you may or may not have seen before. These are terms we will be using in the class, so please get to know them. These terms are identified by putting them in **bold** font.

What is a Unit?

A **unit** is something that gives definition to a numerical value, quantity, or measurement. Let us consider "1 mile". The **unit** involved here is the "mile". Without the **unit**, you would not know what the 1 is measuring. Now you know it is length because mile is a **unit** used to measure length. Different measurements often times have multiple possible **units** associated with them. For example:

Measurement: Some Possible Units

Length: Meters, centimeters, feet, inches, miles, kilometers
Mass: Kilograms, grams, slugs
Time: Hours, minutes, seconds, days, months
Volume: Cups, teaspoons, liters, milliliters, gallons, quarts
Currency: Dollars, cents, dimes

Turning Numbers (or quantities) into fractions based on their conversion factors

If a quantity does not appear as a fraction, it is possible to put it in a fraction form. Doing this sometimes makes solving **dimensional analysis** problems easier. Remember that numbers and **units** that appear above the fraction line are in the "**numerator**" and numbers and units that appear below the fraction line are in the "**denominator**". Let's start with a couple conversions you are familiar with.. How about:

- **eggs**: Eggs are sold in dozens rather than individually so
  12 eggs = 1 dozen. (**conversion factor**)

This quantity is not in the form of a fraction. To put it in fraction form, we put the number and **unit** from one side of the **conversion factor** in the **numerator**, and simply put the other number and **unit** from the **conversion factor** in the **denominator**. To make it a fraction there are two ways to look at it:

$$\frac{12\ eggs}{1\ dozen} \quad \textbf{or} \quad \frac{1\ dozen}{12\ eggs}$$

Example: If you own a chicken farm and your chickens produce 530 eggs each day, how may dozen eggs are produced?

Setup of the problem:
Step 1: Write down the number and units given in the problem

Example: 530 eggs

Step 2: Place a times (x) sign and a fraction next to the original number.

Example: (530 eggs) x _____

Step 3: Using the fractional conversion factors that relate the two units

$$\frac{12\ eggs}{1\ dozen} \quad \textbf{or} \quad \frac{1\ dozen}{12\ eggs}$$

Select the one that has **the unit that you want to get rid of in the denominator**. In this case

$$\frac{1\ dozen}{12\ eggs}$$

is the correct choice because we have **530 eggs in the numerator** of our math problem. Therefore our setup will look like:

Example: $(530\ eggs)x\frac{1\ dozen}{12\ eggs}$

Canceling Units
If a **unit** appears in the **numerator** and the same **unit** appears in the **denominator**, it can be **cancelled** or removed. This **unit** can be in the **numerator** and **denominator** of the same fraction or in two different fractions being **multiplied** together.

$$(530\ \cancel{eggs})x\frac{1\ dozen}{12\ \cancel{eggs}}$$

Now it's just math, grab your calculator and let the setup tell you what to do. Any number in the numerator you multiply by and any number in the denominator you divide by. In this case, take 530, multiply by 1 and then divide by 12.

$$(530\ \cancel{eggs})x\frac{1\ dozen}{12\ \cancel{eggs}} = 44.2 \text{ dozen}$$

This process can be repeated multiple times in order to convert to any unit.

Dimensional Analysis Practice Worksheet

There are 10 practice problems in this worksheet. Each problem involves changing a quantity (the **given** quantity) from one type of **unit** to another in a step by step manner. All 10 problems indicate how many **conversion factors** you will need to use in order to get to the final answer. Problems one through five indicate the **units** involved in each step. For problems six through ten you will have to determine the **units** involved in each step yourself.

1) Convert 56 mg to grams

$$56\ \text{mg} \times \frac{\text{g}}{\text{mg}} = \text{g}$$

2) Convert 240 km to m

$$240\ \text{km} \times \frac{\text{m}}{\text{km}} = \text{m}$$

3) Convert 2 in to m (1 in = 2.54 cm)

$$2\ \text{in} \times \frac{\text{cm}}{\text{in}} \times \frac{\text{m}}{\text{cm}} = \text{m}$$

4) Convert 500 ft to m (1 m = 3.28 ft)

$$500\ \text{ft} \times \frac{\text{m}}{\text{ft}} = \text{m}$$

5) Convert 3 weeks to minutes

☆ $$3\ \text{week} \times \frac{\text{day}}{\text{wk}} \times \frac{\text{hours}}{\text{day}} \times \frac{\text{min}}{\text{hr}} = \text{min}$$

6) Convert 50 kg to g

$$50\text{kg} \times \_\_\_\_\_ = \text{g}$$

7) Convert 8500 mm to km

$$8500\ \text{mm} \times \_\_\_\_\_ \times \_\_\_\_\_ =$$

8) Convert 50 ml to cups (1 L = 4.226 cups)

$$50\ \text{ml} \times \_\_\_\_\_ \times \_\_\_\_\_ =$$

9) Convert 3 yards to inches

$$3\ \text{yd} \times \_\_\_\_\_ \times \_\_\_\_\_ =$$

10) 124 miles to cm (1 mi = 5280 ft)

☆ $$124\ \text{miles} \times \_\_\_\_\_ \times \_\_\_\_\_ \times \_\_\_\_\_ =$$

Room measurements

Task 1: Measure the height of the door in cm.

Convert your measurement to meters.

Task 2: Measure the height of a computer station in mm.

Convert your measurement to meters.

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Task 3 (hallway): There are two pieces of tape marked on the wall in the hallway. The two pieces of tape are 30 meters apart. Using a stopwatch determine the speed you normally walk at in m/s. $\left(v = \frac{d}{t} \right)$

Task 4: Measure the area of the classroom in a metric unit you think makes the most sense for an object of this size. (Hint: **area = length x width**)

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