Activity 2 – Dimensional Analysis

Goals

- Develop conversion factors from common equalities.
- Use conversion factors to convert between different units of measure.
- Apply the concept of dimensional analysis to string together conversion factors forming mathematical expressions.

Concepts to Review

Conversion factors
Dimensional analysis
Units of measure
Mathematical operations with significant figures
Scientific notation
Calculator use

Introduction

The following problems involve converting from one unit to another. If the unit of measure changes, the number in front of the unit will also change. All of these calculations require two things: defined relationships between different units and some method to convert one into another. *Dimensional analysis* involves setting up the problem in such a way as to cancel the unwanted units with only the desired units remaining. A consistent method of problem solving including unit cancellation is invaluable in succeeding in this course.

Concepts to Review: English units, Metric units, Conversion factor, temperature (scales, conversions between scales), Exact vs. Measured Numbers, Significant figures in Calculations involving Measurements, Density vs. Specific Gravity.

Use your text to find other common equalities (Table 1.3) and the relationships needed to convert temperatures. Also look for similar problems to help you learn how to successfully set up these problems.

Required Materials

Scientific calculator, selection of commercial products

Activity 2 – Dimensional Analysis Worksheet

Name_____

Section_____ **Date**_____

Exercise – Measured and Exact Numbers

Look at the commercial products in lab or at your home and create conversion factors (ratios) for fluid ounces to liters or milliliters. To do this, read the amounts present in both English units (fluid ounces, pints, quarts, pounds, ounces, etc.) and then divide one value by the other, keeping the units.

Product	*English Measurement*	*Metric Measurement*	*Conversion Factors*
Coca Cola	12 fl oz	355 mL	$\frac{355\text{ mL}}{12\text{ fl oz}}$ or $\frac{12\text{ fl oz}}{355\text{ mL}}$

Questions and Problems – Dimensional Analysis

For all of the following calculations, show all your work. If you need more space than is provided, you may do your work on separate pages but be sure to attach these when you are done. Write your correct answers in the space provided. If you only provide the answers without showing your work, you will not be given full credit. All answers should be clearly identified (boxed off), written in scientific notation if the values are less than 1 or greater than 1000, and all should have the correct number of significant figures.

1. How many seconds are in exactly one day to five significant figures?

2. Seventeen apples weigh 3.25 pounds. They cost 59 cents for 1 pound. What is the cost of 8.95×10^3 apples?

3. The distance from Santa Cruz to Santa Barbara is about 280 miles. If a car gets 23.6 miles per gallon, and the price of gas is 32 cents per liter, how much will it cost for gas to drive from Santa Cruz to Santa Barbara?

4. It is found that 5 pears weigh an average of 1.9 pounds. A box of pears cost $7.94. The price per pound is 55 cents. How many pears are in exactly 7 boxes?

5. During surgery a patient receives 5.0-pts of plasma. (1 quart = 2 pints, 1 liter = 1.057 qt)

    a. How many milliliters of plasma were given?

    b. How many dL were given?

6. How many cubic meters of soil are needed to fill a flower box that is 3.5 feet long, 8 inches wide and 1 foot deep?

7. Body temperatures above 41.1^{o}C can lead to convulsions, especially in children.

    a. What is this temperature in ^{o}F?

    b. What is this temperature in K?

8. The daily dose of ampicillin for the treatment of an ear infection is 115 mg ampicillin per kg of body weight. The pill is dispensed in 500. mg tablets. How many tablets should be given daily for a 75 pound child? An IV pump delivers medication at a constant rate of 24 mg/hr. How long does it take to deliver 9.0×10^{1} mg?

9. The volume of blood plasma in adults is 3.1 L. The density of blood plasma is 1.03 g/cc. How many pounds of blood plasma are there in the average adult body? (Hint: You can use the density as a conversion factor.)

10. Which is the higher temperature, 18 ^{o}F or -1.0 ^{o}C?

11. A bottle of Cabernet Sauvignon is labeled as having an alcohol content of 12.5% by volume.

    a. Write the percentage of the alcohol in the wine as a conversion factor.

    b. If an individual were to consume 320. mL of the wine, how many fluid ounces of pure alcohol would the individual have ingested? (1 pint = 16 ounces; 8 pints = 1 gal)

12. Urine is a water-based solution containing a variety of dissolved solids. The specific gravity of a urine sample of a young wrestler is 1.045, which is outside the normal range of 1.003 – 1.030. (The specific gravity of a substance is its density divided by the density of water at $4^{O}C$, at which the assumption stated below is accurate.)

    a. What is the density (d) of the urine sample? (Assume that $d(H_2O) = 1.00$ g/mL)

    b. Is it more likely that the wrestler is dehydrated or that he recently drank a large amount of water? *You will use words for this answer, no calculations necessary*. (Hint: Review the definition of density)