GS104 Lab Exercise
Introduction to Scientific Inquiry and Data Analysis

with Science employs the scientific method via qualitative and quantitative observation, the collection of data, hypothesis formulation / testing, and hypothesis modification. This lab exercise provides a basic introduction to quantitative observation and analysis.

Part 1 - Unit Conversion

Using the attached metric and English measurement unit conversion tables, complete the following conversions. SHOW ALL OF YOUR MATH WORK IN THE SPACE PROVIDED.

\[ \text{1 m} = \frac{205\text{ cm}}{(2.05\text{ cm})/1\text{ ft}} = 205\text{ cm}, \quad 2 \times 10^4 \text{ in} = \frac{\text{3.176}}{(2 \times 10^5 \text{ in})} \left( \frac{1\text{ mi}}{12 \times 10^3 \text{ in}} \right) = 3.16 \text{ mi} \]

\[ \text{150 m} = \frac{150\text{ mm}}{(1.50\text{ mm})/1\text{ in}} = 150\text{ mm}, \quad 2 \times 10^8 \text{ ft} = \frac{378,777}{(2 \times 10^9 \text{ ft})} \left( \frac{\text{mi}}{5280 \text{ ft}} \right) = 7.19787 \text{ mi} \]

\[ \text{14 g} = \frac{5400 \text{ mg}}{(5.40 \text{ g})/1\text{ in}} = 5400 \text{ mg}, \quad 126,765,000 \text{ ft} = \frac{38413}{(126.765,000 \text{ ft})} \left( \frac{\text{km}}{3280 \text{ ft}} \right) = 38413 \text{ km} \]

\[ \text{1 km} = \frac{0.006214 \text{ km}}{(1.8 \text{ in})} = 0.0006214 \text{ km}, \quad 72^\circ \text{C} = \frac{1(61.1^\circ \text{ F})}{\text{F}} \left( \frac{1\text{ C}}{5} + \frac{32}{5} \right) = 161.1^\circ \text{ F} \]

\[ \text{214.6 cm} = \frac{42.46 \text{ m}}{(4214.6 \text{ cm})} \left( \frac{1\text{ m}}{100\text{ cm}} \right) = 42.146 \text{ m}, \quad 8^\circ \text{F} = -17^\circ \text{ C} \]

\[ \text{512.5 g} = \frac{0.3215 \text{ kg}}{(321.5 \text{ g})} = 0.3215 \text{ kg}, \quad 0^\circ \text{C} = \frac{32^\circ \text{ F}}{9} = -13.8^\circ \text{ C} \]

\[ \text{1 in} = \frac{2.54 \text{ cm}}{(1 \text{ in})} \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) = 2.54 \text{ cm} \]

\[ \text{1 m} = \frac{3.3 \text{ ft}}{(1 \text{ in})} \left( \frac{3.3 \text{ ft}}{1 \text{ m}} \right) = 3.3 \text{ ft} \]

\[ \text{1 mi} = \frac{1.6093 \text{ km}}{(1 \text{ mi})} = 1.6093 \text{ km} \]

\[ \text{23.4 mi} = \frac{198.6 \text{ km}}{(123.4 \text{ km})} \left( \frac{1\text{ km}}{1\text{ mi}} \right) = 198.6 \text{ km} \]

\[ \text{1054 km} = \frac{768.8 \text{ mi}}{(1234 \text{ km})} \left( \frac{1\text{ km}}{1\text{ mi}} \right) = 768.8 \text{ mi} \]

\[ \text{1054 lb} = \frac{479.1 \text{ kg}}{(2.2 \text{ lb})} = 479.1 \text{ kg} \]

\[ \left( \frac{1054 \text{ lb}}{2.2 \text{ lb}} \right) \left( \frac{1\text{ km}}{1\text{ mi}} \right) = \left( \frac{1\text{ km}}{5280 \text{ ft}} \right) = 15600 \text{ ft} \]

\[ \left( \frac{15600 \text{ ft}}{5280 \text{ ft}} \right) = 2.95 \text{ mi} \]
2. Solving Equations

A. The density of a substance is defined by it's mass divided by it's volume. The equation has the following form:

\[ D = \frac{M}{V} \]

where D is density in gm/cm\(^3\), M = mass in grams, and V is volume in cm\(^3\).

1. You measure the mass of a substance as 2356 gm. It's volume is 534 cm\(^3\), calculate it's density in gm/cm\(^3\). SHOW THE FORMULA AND ALL OF YOUR MATH WORK!

\[ D = \frac{2356 \text{ gm}}{534 \text{ cm}^3} = 4.4 \frac{\text{gm}}{\text{cm}^3} \]

2. The density of a substance is 9.8 gm/cm\(^3\). If you had a volume of 3.8 cm\(^3\) of the substance, what would be the corresponding mass in grams? Hint: Rearrange the density equation to solve for mass. SHOW THE FORMULA AND ALL OF YOUR MATH WORK!

\[ m = VD = (3.8 \text{ cm}^3)(9.8 \frac{\text{gm}}{\text{cm}^3}) = 37.2 \text{ gm} \]

3. The density of a substance is 2.5 gm/cm\(^3\) and you possess 15.3 grams of that material. What will be the corresponding volume in cm\(^3\)? Hint: Rearrange the density equation to solve for mass. SHOW THE FORMULA AND ALL OF YOUR MATH WORK!

\[ V = \frac{m}{D} = \frac{15.3 \text{ gm}}{2.5 \frac{\text{gm}}{\text{cm}^3}} = 6.1 \text{ cm}^3 \]

4. The velocity of moving objects (for example your car while driving) is measure as a rate of motion, according to the following equation:

\[ V = \frac{d}{t} \]

where V is velocity (m/sec), d is distance (m), and t is time (sec).

4. You drive your car between two cities that are 123 miles apart. It takes you 4 hours to get there. Calculate your average velocity in mi/hr. SHOW THE FORMULA AND ALL OF YOUR MATH WORK!

\[ V = \frac{d}{t} = \frac{123 \text{ mi}}{4 \text{ hr}} = 30.75 \frac{\text{mi}}{\text{hr}} \]

5. Using the velocity you calculated in 4 above, what was your velocity in m/sec? Hint: you will have to use a distance and time conversion factor. SHOW THE FORMULA AND ALL OF YOUR MATH WORK!

\[ \left( \frac{30.75 \frac{\text{mi}}{\text{hr}}}{\frac{1 \text{ mi}}{1609.34 \text{ m}}} \right) \left( \frac{1 \text{ m}}{3.33 \text{ ft}} \right) \left( \frac{1 \text{ hr}}{3600 \text{ s}} \right) = 13.7 \frac{\text{m}}{\text{s}} \]

6. You are driving a car at a velocity of 10 m/sec for a distance of 12 km. How long did it take you to get there? Answer in hours. SHOW THE FORMULA AND ALL OF YOUR MATH WORK!

\[ V = \frac{d}{t} \]

\[ \left( 12 \text{ km} \right) \left( \frac{1000 \text{ m}}{1 \text{ km}} \right) = 12000 \text{ m} \quad 12000 \left( \frac{1 \text{ hr}}{3600 \text{ s}} \right) = 3.33 \text{ hr} \]

\[ \frac{d}{V} = \left( \frac{12 \text{ km}}{10 \frac{\text{m}}{\text{s}}} \right) \Rightarrow t = \frac{d}{V} = \frac{12000 \text{ m}}{10 \frac{\text{m}}{\text{s}}} = 1200 \text{ s} \]

\[ 2 \frac{d}{V} = 1200 \text{ s} \]

\[ t = \frac{d}{V} = \frac{12000 \text{ m}}{10 \frac{\text{m}}{\text{s}}} = 1200 \text{ s} \]