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GS104 Lab Exercise
Introduction to Scientific Inquiry and Data Analysis

gs104sp2001:quantex.wpd

Introduction

Earth 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.

2.05 m = 205 cm $(2.05\,m)\left(\frac{100\,cm}{1\,m}\right) = 205\,cm$

1.50 m = 1500 mm $(1.50\,m)\left(\frac{1000\,mm}{1\,m}\right) = 1500\,mm$

5.4 g = 5400 mg $(5.4\,g)\left(\frac{1000\,mg}{1\,g}\right) = 5400\,mg$

6.8 m = 0.0068 km $(6.8\,m)\left(\frac{1\,km}{1000\,m}\right) = 0.0068\,km$

4214.6 cm = 42.146 m $(4214.6\,cm)\left(\frac{1\,m}{100\,cm}\right) = 42.146\,m$

321.5 g = 0.3215 kg $(321.5\,g)\left(\frac{1\,kg}{1000\,g}\right) = 0.3215\,kg$

1 in = 2.54 cm $(1\,in)\left(\frac{2.54\,cm}{1\,in}\right) = 2.54\,cm$

1 m = 3.3 ft $(1\,m)\left(\frac{3.3\,ft}{1\,m}\right) = 3.3\,ft$

1 mi = 1.6093 km $(1\,mi)\left(\frac{1.6093\,km}{1\,mi}\right) = 1.6093\,km$

123.4 mi = 198.6 km $(123.4\,mi)\left(\frac{1.6093\,km}{1\,mi}\right) = 198.6\,km$

1234 km = 766.8 mi $(1234\,km)\left(\frac{1\,mi}{1.6093\,km}\right) = 766.8\,mi$

1054 lb = 479.1 kg $(1054\,lb)\left(\frac{1\,kg}{2.2\,lb}\right) = 479.1\,kg$

2 x 10^5 in = 3.16 mi $(2\times10^5\,in)\left(\frac{1\,ft}{12\,in}\right)\left(\frac{1\,mi}{5280\,ft}\right) = 3.16\,mi$

2 x 10^9 ft = 378,787 mi $(2\times10^9\,ft)\left(\frac{1\,mi}{5280\,ft}\right) = 378,787\,mi$

126,765,000 ft = 38413 km $(126,765,000\,ft)\left(\frac{1\,km}{3300\,ft}\right) = 38413\,km$

72° C = 161.6 °F $T_F = \frac{9}{5}T_C + 32° = \frac{9}{5}(72) + 32 = 161.6\,°F$

8° F = -13.3 °C $T_C = \frac{5}{9}T_F - 32° = \frac{5}{9}(8 - 32) = -13.3\,°C$

0°C = 32 °F freezing

212°F = 100 °C boiling

5.7 x 10^45 sec = 1.8×10^{38} years $(5.7\times10^{45}\,sec)\left(\frac{1\,hr}{3600\,sec}\right)\left(\frac{1\,day}{24\,hr}\right)\left(\frac{1\,yr}{365.25\,d}\right) = 1.8\times10^{38}\,yr$

9.8 x 10^20 days = 2.7×10^{18} years $(9.8\times10^{20}\,days)\left(\frac{1\,yr}{365\,days}\right) = 2.7\times10^{18}\,yr$

2.0 x 10^31 in = 5.08×10^{30} km $(2.0\times10^{31}\,in)\left(\frac{2.54\,cm}{1\,in}\right)\left(\frac{1\,m}{100\,cm}\right)\left(\frac{1\,km}{1000\,m}\right) =$

If 1 inch equals 2000 ft on a map; points A and B are 7.8 inches apart on the map. How far apart are points A and B on the ground in feet? Now how about in miles?

$(7.8\,in)\left(\frac{2000\,ft}{1\,in}\right) = 15600\,ft.$

$(15600\,ft)\left(\frac{1\,mi}{5280\,ft}\right) = 2.95\,mi$

Part 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:

$$D = M / V$$

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!

$$D = \frac{2356\,gm}{534\,cm^3} = 4.4\,\frac{gm}{cm^3}$$

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!

$V \times D = \frac{m}{V} \times V$ $\quad m = VD = (3.8\,cm^3)\left(9.8\,\frac{gm}{cm^3}\right) = 37.2\,gm$

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

$\frac{1}{D} \times V = \frac{m}{V} \times V \times \frac{1}{D} \Rightarrow V = \frac{m}{D} = \frac{15.3\,g}{2.5\,g/cm^3} = 6.1\,cm^3$

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

$$V = d / t$$

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!

$V = \frac{d}{t} = \frac{123\,mi}{4\,hr} = 30.75\,\frac{mi}{hr}$

5. Using the velocity you caculated 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!

$\left(30.75\,\frac{mi}{hr}\right)\left(\frac{5280\,ft}{1\,mi}\right)\left(\frac{1\,m}{3.3\,ft}\right)\left(\frac{1\,hr}{3600\,s}\right) = 13.7\,\frac{m}{s}$

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!

$V = \frac{d}{t}$ $\quad (12\,km)\left(\frac{1000\,m}{1\,km}\right) = 12000\,m$ $\quad 1200\,s\left(\frac{1\,hr}{3600\,s}\right) = 0.33\,hr$

$V \cdot t = \frac{d}{t} \cdot t$

$t \cdot V = d \cdot \frac{1}{V} \Rightarrow t = \frac{d}{V}$

2 $\quad t = \frac{d}{V} = \frac{12000\,m}{10\,\frac{m}{s}} = 1200\,s$