I. Objectives

1. Define the units commonly used in this class.
2. Perform calculations using time, distance, mass, temperature and related units

II. Introduction

Read the entire lab and identify which conversion factors will be required **before** beginning the lab.

The ability to convert among time, distance, mass, volume and temperature units enables Earth scientists to compare, contrast and communicate quantitatively. Throughout the semester you will be required to make these kinds of conversions so it is important that you understand how they are done and that you are able to do them yourself. None of the conversions require more than a working knowledge of arithmetic, scientific notation and a calculator.

The process of converting one time, distance, or mass unit to another time, distance, or mass unit is the same no matter which units are required. Simply find a "chain" of conversion factors needed to change the existing units to the desired units and multiply the conversion factors together, "cancelling" units. This process is called dimensional analysis. Remember that for typical rate-type problems:

amount = rate x time

III. Materials

Calculator

IV. Sample Calculations

1. How many acres are in a square area that is 1000 m on a side?

$$(1000\,m)^2 x \frac{km^2}{10^6 m^2}\ x\ \frac{247\ ac}{km^2} = 247\ ac$$

2. Convert 40^{o}C to ^{o}F and ^{o}K.

$$^oF = \frac{9}{5}(^oC) + 32^oF = \frac{9}{5}(40^oC) + 32^oF = 104^oF$$

$$K = ^oC + 273^oC = 40^oC + 273^oC = 313^oK$$

Answer: 40^{o}C = 104^{o}F = 313^{o}K

3. Convert 212 ^{o}F to ^{o}C and K.

$$^{o}C = \frac{5}{9}(^{o}F\text{-}32\ ^{o}F) = \frac{5}{9}(212\ ^{o}F - 32\ ^{o}F) = 100\ ^{o}F$$

4. Convert the speed of sound, 343 *m/s* to *km/hr*.

$$\frac{343\,m}{1\,s} x \frac{1\,km}{1{,}000\,m} x \frac{60\,s}{1\,\text{min}} x \frac{60\,\text{min}}{1\,hr}$$

Answer: 343 m/s = 1234.8 *km/hr* or 1.235 x 10^3 *km/hr*

5. The average density of the Earth is 5,520 kg/m^3. Convert it to g/cm^3.

$$\frac{5{,}520\,kg}{1\,m^3} x \frac{1{,}000\,g}{1\,kg} x \left(\frac{1\,m}{100\,cm}\right)^3 = 5.52\ \text{g/cm}^3$$

Answer: 5,520 kg/m^3 = 5.52 g/cm^3

6. How many seconds are in one year?

$$\text{Solar Day: } \left(24\,hr\ x \frac{60\,\text{min}}{1\,hr} x \frac{60\,\text{sec}}{\text{min}}\right) = 86{,}400\ \text{sec}$$

Answer: 1 day = 86,400 sec

7. If a sea floor spreading rate is 2.5 cm/yr, calculate how many kilometers of sea floor are created over 1 million years?

$$2.5\ \text{cm/yr x}\left(\frac{1\,m}{100\,cm} x \frac{1\,km}{1000\,m} x \frac{10^6\,yr}{My}\right) = 25\ \text{km/My}$$

Answer: 2.5 cm/yr = 25 km/My

8. Convert 1 million gallons to acre-feet (af)

$$1{,}000{,}000\ gal\ x\ \frac{1\ af}{325{,}851\ gal} = 3.07\ af$$

V. Prelab Definitions

1. second
2. day
3. meter
4. kilometer
5. square meter
6. acre
7. hectare
8. cubic meter
9. liter
10. gallon
11. acre-feet
12. gram
13. kilogram
14. force
15. pounds

16. density

17. pressure

18. speed/velocity

19. temperature

20. Celsius

21. Kelvin

22. Fahrenheit

23. concentration

24. energy

25. joule

26. calorie

27. power

28. watt

VI. Lab Procedure

Perform each of the following calculations. Be sure your answers include the correct units. **You must show your work to receive credit!** Do not include more than three significant figures unless the underlying data values justify greater accuracy. Be sure that your answers make sense.

1. How many seconds are in 1 week?

2. Given that the average density of the Earth is 5.52 g/cm^3 and the mean radius is 6370 km, find the mass of the Earth in kilograms.

3. How long, in minutes, does it take an earthquake surface wave to travel around the world if the wave's average speed is 6 km/sec? Assume the Earth's circumference is 40,000 km.

4. Water emerging from sea floor hydrothermal vents may be as hot as 750 ^{o}F. Convert this to both ^{o}C and K.

5. Given that the Colorado River Basin covers 637,000 km^2 and that the average rainfall is approximately 12 inches (1 ft) per year, calculate how many Maf this represents.

6. If 1 calorie is required to heat 1 gram of water 1 ^{o}C, how much energy, in joules, is required to heat the top 100 cm of a pond with a surface area of 1 hectare?

7. Why is it important to use the correct units in your calculations?

Lab courtesy of Dr. Jim Washburne