

Additional Problems for Dimensional Analysis

Geology 1P

Mr. Traeger

Name: Key

Period: _____

Date: _____

Work the following problems using dimensional analysis/factor label method. Use the conversion table below. **You absolutely must show your work!** Feel free to express your answers in scientific notation. You will need to in some cases!

Helpful Conversion Factors	
1 inch (in.)	2.54 centimeters (cm)
1 mile (mi.)	1.6 kilometers (km)
1 liter (l)	0.264 gallons (g)
1 fluid ounce (oz.)	29.57 milliliters (mL)
1 pound (lb.)	0.45 kilograms (kg)
1 gallon (g)	3.79 Liters (L)
1 short ton (2,000 lbs.)	907.2 kilograms (kg)
1 meter (m)	3.28 feet (ft.)
1 mile (mi.)	5,280 feet (ft.)
60 seconds (sec.)	1 minute (min.)
60 minutes (min.)	1 hour (hr.)
24 hours (hr.)	1 day
365.25 days	1 year

1. You're going 44 meters/second. How fast are you going in miles/hour?

$$\frac{44 \cancel{\text{ m}}}{\cancel{\text{ s}}} \times \frac{1 \cancel{\text{ km}}}{1000 \cancel{\text{ m}}} \times \frac{1 \text{ mile}}{1.6 \cancel{\text{ km}}} \times \frac{60 \cancel{\text{ s}}}{1 \cancel{\text{ min}}} \times \frac{60 \cancel{\text{ min}}}{1 \text{ hr}} = \frac{(44 \times 1 \times 1 \times 60 \times 60)}{(1000 \times 1.6)} = \frac{158400}{1600} = 99 \frac{\text{mi}}{\text{hr}} = 9.9 \times 10^1 \frac{\text{mi}}{\text{hr}}$$

2. How many liters are there in a bottle that holds 128 ounces of milk?

$$\frac{128 \cancel{\text{ oz}}}{1} \times \frac{29.57 \cancel{\text{ mL}}}{1 \cancel{\text{ oz}}} \times \frac{0.001 \text{ L}}{1 \cancel{\text{ mL}}} = \frac{(128 \times 29.57 \times 0.001)}{(1 \times 1 \times 1)} = 3.79 \text{ L} = 3.79 \times 10^0 \text{ L}$$

3. How many seconds are in one year?

$$\frac{1 \cancel{\text{ yr}}}{1} \times \frac{365.25 \cancel{\text{ days}}}{1 \cancel{\text{ yr}}} \times \frac{24 \cancel{\text{ hr}}}{1 \cancel{\text{ day}}} \times \frac{60 \cancel{\text{ min}}}{1 \cancel{\text{ hr}}} \times \frac{60 \cancel{\text{ sec}}}{1 \cancel{\text{ min}}} = \frac{(1 \times 365.25 \times 24 \times 60 \times 60)}{1} = 31,557,600 \text{ sec} = 3.2 \times 10^7 \text{ sec}$$

4. If there are approximately 6 trillion (6×10^{12}) miles in one light year, how far away is a star that is 430 light years? Express your answer in kilometers.

$$\frac{430 \cancel{\text{ ly}}}{1} \times \frac{6 \times 10^{12} \cancel{\text{ mi}}}{1 \cancel{\text{ ly}}} \times \frac{1.6 \cancel{\text{ km}}}{1 \cancel{\text{ mi}}} = \frac{(430 \times 6 \times 10^{12} \times 1.6)}{(1 \times 1 \times 1)} = 4.128 \times 10^{15} \text{ km}$$

5. The Earth (here in La Cañada) rotates at a rate of about 1,000 miles/hour. How fast is this in micrometers/second?

$$\frac{1000 \cancel{\text{ mi}}}{1 \cancel{\text{ hr}}} \times \frac{1.6 \cancel{\text{ km}}}{1 \cancel{\text{ mi}}} \times \frac{1000 \cancel{\text{ m}}}{1 \cancel{\text{ km}}} \times \frac{1 \cancel{\text{ }\mu\text{m}}}{0.000001 \cancel{\text{ m}}} \times \frac{1 \cancel{\text{ hr}}}{60 \cancel{\text{ min}}} \times \frac{1 \cancel{\text{ min}}}{60 \cancel{\text{ sec}}} = \frac{(1000 \times 1.6 \times 1000 \times 1 \times 1 \times 1)}{(1 \times 1 \times 1 \times 0.000001 \times 60 \times 60)} = \frac{1600,000}{0.0036} = 4.4 \times 10^8 \frac{\mu\text{m}}{\text{sec}}$$

Even More Problems for Dimensional Analysis

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Work the following problems using dimensional analysis/factor label method. **You absolutely must show your work!** Use the conversion tables given on the previous page. The answers are given. **Show how we get these answers using the factor label method and express your answer in scientific notation.**

1. Mount Everest, the tallest mountain in the world, is 29,035 feet above sea level. How tall is Mt. Everest in millimeters? Correct answer is 8,849,868 mm.

$$\frac{29035 \cancel{\text{ft}}}{1} \times \frac{1 \cancel{\text{m}}}{3.28 \cancel{\text{ft}}} \times \frac{1 \text{ mm}}{0.001 \cancel{\text{m}}} = \frac{(29035 \times 1 \times 1)}{(1 \times 3.28 \times 0.001)} = \frac{29035}{0.00328} = 8,852,134.15 \text{ mm} = 8.9 \times 10^6 \text{ mm}$$

2. A typical soda pop drink has a volume of 355 mL. How many gallons is this? Correct answer is 0.09378108 gal.

$$\frac{355 \cancel{\text{mL}}}{1} \times \frac{0.001 \cancel{\text{L}}}{1 \cancel{\text{mL}}} \times \frac{1 \text{ gal}}{3.79 \cancel{\text{L}}} = \frac{(355 \times 0.001 \times 1)}{(1 \times 1 \times 3.79)} = \frac{0.355}{3.79} = 0.09366755 \text{ gal} = 9.4 \times 10^{-2} \text{ gal}$$

3. A Nimitz class aircraft carrier displaces about 104,112 short tons of water? How many grams of water does a Nimitz class aircraft carrier displace? Correct answer is 94,448,820,000 g.

$$\frac{104112 \cancel{\text{ST}}}{1} \times \frac{907.2 \cancel{\text{kg}}}{1 \cancel{\text{ST}}} \times \frac{1000 \text{ g}}{1 \cancel{\text{kg}}} = \frac{(104112 \times 907.2 \times 1000)}{(1 \times 1 \times 1)} = 9.4 \times 10^{10} \text{ g} = 94,450,410,000 \text{ g}$$

4. If there are approximately 6 trillion (6×10^{12}) miles in one light year, how far away is a star that is 4.3 light years? Express your answer in centimeters. Correct answer is 4,068,027,000,000,000 cm.

$$\frac{4.3 \cancel{\text{ly}}}{1} \times \frac{6 \times 10^{12} \cancel{\text{mi}}}{1 \cancel{\text{ly}}} \times \frac{1.6 \cancel{\text{km}}}{1 \cancel{\text{mi}}} \times \frac{1000 \cancel{\text{m}}}{1 \cancel{\text{km}}} \times \frac{1 \text{ cm}}{0.01 \cancel{\text{m}}} = \frac{(4.3 \times 6 \times 10^{12} \times 1.6 \times 1000 \times 1)}{(1 \times 1 \times 1 \times 1 \times 0.01)} = 4.128 \times 10^{16} = 4.128 \times 10^{18} \text{ cm} = 4,068,027,000,000,000 \text{ cm}$$

5. Los Angeles is moving towards San Francisco at a rate of about 5 centimeters/year? Yes, it really is due to plate tectonics! How fast is this in miles/hour? Correct answer is 0.0000000036

$$\frac{5 \cancel{\text{cm}}}{1 \cancel{\text{yr}}} \times \frac{0.01 \cancel{\text{m}}}{1 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{km}}}{1000 \cancel{\text{m}}} \times \frac{1 \text{ mi}}{1.6 \cancel{\text{km}}} \times \frac{1 \cancel{\text{yr}}}{365.25 \cancel{\text{day}}} \times \frac{1 \text{ day}}{24 \cancel{\text{hr}}} = \frac{(5 \times 0.01 \times 1 \times 1 \times 1 \times 1 \times 1)}{(1 \times 1 \times 1000 \times 1.6 \times 365.25 \times 24)} = 0.05 = 3.6 \times 10^{-9} \frac{\text{mi}}{\text{hr}} = 0.0000000036 \frac{\text{mi}}{\text{hr}}$$