Midterm 1 - Units and Real World Numbers

Math 1030 - Dylan Zwick's Class

Fall 2007

Name: Solutions

Conversion Factors

1 year = 365 days
1 day = 24 hours
1 hour = 60 minutes
1 minute = 60 seconds
1 dram = 3 scruples
1 scruple = 20 grains
1 grain = 0.0648 grams
1 kilogram = 2.2046 pounds
1 dollar = 115.367 yen

Constants

Diameter of Carbon Atom = 1×10^{-10} meters
Earth-Sun Distance = 1.49578×10^{11} meters
Mass of Carbon = 12.000 grams per mole.
1 mole = 6.022×10^{23} atoms.

1. **Unit Conversions** (10 points)

(a) How many minutes are there in two years? (2 points)

$$2 \text{ years} \left(\frac{365 \text{ days}}{\text{year}}\right)\left(\frac{24 \text{ hours}}{\text{day}}\right)\left(\frac{60 \text{ min}}{\text{hour}}\right)$$

$$= \boxed{1,051,200 \text{ minutes}}$$

(b) How many drams are in a kilogram? (3 points)

$$(1 \text{ kilogram})\left(\frac{1000 g}{1 kg}\right)\left(\frac{1 \text{ grain}}{.0648 g}\right)\left(\frac{1 \text{ scruple}}{20 \text{ grains}}\right)\left(\frac{1 \text{ dram}}{3 \text{ scruple}}\right)$$

$$\simeq \boxed{257 \text{ drams}}$$

(c) How many carbon atoms, laid end to end, would it take to get from the Earth to the Sun? And how much would all these atoms weight? (5 points)

$$\frac{\text{Earth-Sun distance}}{\text{diameter of C atom}} = \#\text{ of atoms}$$

$$= \frac{1.49578 \times 10^{11} m}{1 \times 10^{-10} m} = 1.49578 \times 10^{21} \text{ C atoms}$$

to 1 significant digit = $\boxed{1 \times 10^{21} \text{ C atoms}}$

$$\text{Mass} = \frac{12 g}{(6.022 \times 10^{23} \text{ C atoms})} \times (1.49578 \times 10^{21} \text{ C atoms})$$

$$= .0298 g = \boxed{3 \times 10^{-2} g}$$

to one significant digit

2. **Compound Unit Problem** (10 points)

(a) If you have a 100 watt light bulb turned on for 10 hours per day, how much energy (in kilowatt-hours) does this use in a 30 day month? (5 points)

$$(100 \text{ watts})\left(\frac{1 \text{ kW}}{1000 \text{ W}}\right)\left(\frac{10 \text{ hours}}{\text{day}}\right)\left(\frac{30 \text{ days}}{\text{month}}\right)(1 \text{ month})$$

$$= \boxed{30 \text{ kilowatt-hours}}$$

(b) If electricity is 9 cents per kilowatt-hour, how much does the electricity cost to power the light bulb for that month? (5 points)

$$\left(\frac{9¢}{\text{kW}\cdot\text{h}}\right) \times (30 \text{ kW}\cdot\text{h})$$

$$= 270¢ = \boxed{\$2.70}$$

3. **Currency Conversion Problem** (5 points)

You plan to travel to Japan and you are practicing how to deal with different measurement systems. Consider the following situation: Suppose pears at a store in Japan are priced at 950 yen per kilogram. What is the price of these pears in US dollars per pound? (5 points)

$$\left(\frac{950 \text{ yen}}{\text{kg}}\right)\left(\frac{\$1}{115.367 \text{ yen}}\right)\left(\frac{1 \text{ kg}}{2.2046 \text{ pounds}}\right)$$

$$\approx \boxed{\$3.74/\text{pound}}$$

4. **Percentages** (10 points)

(a) The annual number of deaths from cardiovascular disease in the United States decreased from 1,008,000 in 1970 to 910,600 in 2004. Find the absolute change, and the relative change as a percentage. (4 points)

Absolute: $910,600 - 1,008,000 = \boxed{-97,400}$

Relative:

$$\frac{910,600 - 1,008,000}{1,008,000} \times 100\% = \boxed{-9.66\%}$$

(b) A friend paid a total bill of \$21.83 at a restaraunt and said she left an 18% tip. What was the original total of the restaraunt bill, before the tip? (3 points)

Original $= x$

$$x + x(.18) = \$21.83$$

$$\Rightarrow x(1 + .18) = \$21.83$$

$$\Rightarrow x = \frac{\$21.83}{1.18} = \boxed{\$18.50}$$

(c) The federal reserve announces that it is changing interest rates from 4% to 4.25%. By what relative percentage did interest rates incrase? (3 points)

Example - A change from 3% to 6% is a 100% relative increase.

$$\frac{4.25\% - 4\%}{4\%} \times 100\% = \boxed{6.25\%} \text{ increase}$$

5. **Scientific Notation** (10 points)

Perform the following calculations, and express your answers in scientific notation:

(a) $2.5 \times 10^{12} - 1.7 \times 10^{12}$ (2 points)

$2.5 \times 10^{12} - 1.7 \times 10^{12} = .8 \times 10^{12} = \boxed{8 \times 10^{11}}$

(b) $(3.1 \times 10^5) * (2.7 \times 10^2)$ (2 points)

$(3.1 \times 10^5) \times (2.7 \times 10^2) = 8.37 \times 10^7$

$= \boxed{8.4 \times 10^7}$

(c) $\frac{1.6 \times 10^{-5}}{7.5 \times 10^3}$ (2 points)

$\frac{1.6 \times 10^{-5}}{7.5 \times 10^3} = .213 \times 10^{-8} = \boxed{2.1 \times 10^{-9}}$

(d) $2.42 \times 10^4 + 7.1 \times 10^3$ (2 points)

$2.42 \times 10^4 + 7.1 \times 10^3$

$= 2.42 \times 10^4 + .71 \times 10^4 = \boxed{3.13 \times 10^4}$

(e) Express $6,590,000,000$ in scientific notation. (2 points)

$\boxed{6.59 \times 10^9}$

6. **Uncertainty** (5 points)

(a) Express the following solutions using the correct number of significant digits.

i. $3.41in + 2.6in$ (2 points)

$6.0\,in$

ii. $\frac{5.47892 \times 10^2}{4.57 \times 10^{-1}}$ (2 points)

1.20×10^3

(b) If a scale has its base weight off by 2 lbs, so it weights everybody at 2 lbs greater than their actual weight, is this an example of a random error or a systematic error? (1 point)

Systematic