

## CHM 115 B (Fall 2005)

### Handout for first day of class.

#### Practice Conversion Problems (KEY)

1. Convert a mass of 10.29 g into kg. Report the answer in scientific notation.  
ANSWER: 0.01029 kg (or 1.029x10<sup>-2</sup> kg)

2. Convert a volume of 1.500x10<sup>-4</sup> μL into liters (or litres if you prefer the French spelling).  
ANSWER: 1.500x10<sup>-2</sup> L

3. Derived units involve a combination of two units. Density is a derived unit ( $\frac{g}{cm^3}$ ). Convert the density of mercury (13.55  $\frac{g}{cm^3}$ ) into units of  $\frac{Mg}{m^3}$ . What do you notice about the result?  
ANSWER: 13.55 Mg/m<sup>3</sup>

4. Converting units raised to powers requires raising the conversion factors to powers. Convert 100.0 cm<sup>2</sup> into units of m<sup>2</sup>.  
ANSWER: 0.01000 m<sup>2</sup>

Note: drawing a picture of this may help you visualize why this answer is correct.

5. Convert a temperature of -40.0°F into °C and K.  
ANSWER: -40.0°C

ANSWER: 233.2 K

6. Write each of the following in terms of the SI base unit using scientific notation:

(a) 7.3 mK                      (b) 275 pm                      (c) 19.6 ms                      (d) 45 μm  
(a) 7.3x10<sup>-3</sup> K                      (b) 2.75x10<sup>-10</sup> m                      (c) 1.96x10<sup>-2</sup> s                      (d) 4.5x10<sup>-5</sup> m

7. Ethyl acetate has a characteristic fruity odor and is used as a solvent in paint lacquers and perfumes. An experiment calls for 0.0450 kg of ethyl acetate. If the density of ethyl acetate is 0.902  $\frac{g}{mL}$ , what volume in liters is required? (Density is discussed in Chapter 1 – it is a property of a material that can be used to interconvert mass and volume units for a particular material at a specified temperature.)

ANSWER: 0.0449 L

8. A room measures 10.0 ft x 12.0 ft. x 9.0 ft. Find the volume of the room in liters AND the mass of air it contains (assume the density of dry air at typical ambient conditions is about 1.2 x 10<sup>-3</sup>  $\frac{g}{cm^3}$ )

ANSWER: 3.0x10<sup>4</sup> L and 3.7x10<sup>4</sup> g or 37 kg

9. A carat is the mass unit used for diamonds and other gemstones. 1 carat = 200 mg. If a 1.0 carat diamond costs \$2,000, what is the cost of diamond per pound (note: the pound is really not a mass unit, but . . . on Earth 1 lb = 0.4536 kg).

ANSWER: 4.5x10<sup>6</sup> \$/lb

The following problem will be solved (by student groups, not by the instructor) in class. You may want to give it some thought prior to arriving at class.

One more problem . . .

Scientists often need to make approximations of quantities when they are reading. This is a necessary skill because it is not a wise practice to accept everything you read as truth.

For example, when reading a story on global warming, a scientist might read that 1,000,000 metric tons (1 metric ton = 1,000 kg) of CO<sub>2</sub> (carbon dioxide) are produced by cars each year in the USA. A skeptical scientist might want to do an approximate calculation to see if this number is “about right”.

In order to do this, a number of assumptions would be made and knowledge of gasoline combustion would be employed. Since we have not yet covered all the topics you need to understand to do this, we will tackle part of this problem.

A first step in doing the approximate calculation above might be to estimate the number of gallons of gasoline consumed per year in the USA. Make a list of the assumptions you must make (for example, how many cars there are on the roads in the USA), come up with and list the values you use, and find the answer in the units of gals of gasoline/year.

After your group is done compare your results with a neighboring group and think about the following: (a) do the numbers found by different groups match? (b) how close do the numbers have to be to “match”, (c) if the numbers do not match, what are the major sources of the discrepancy? Be prepared to discuss this in some detail at the end of a 8 minute period of working and comparing!

The two most common methods employed by those of you working in class the other day used some common estimates and then diverged along two different trains of thought:

**Common estimated information included:**

- # of people in the U.S. - about 300 million people (or  $300 \times 10^6$  people, or  $3.00 \times 10^8$  people)
- fraction of the people driving – some said one half (or 50%), you could also simply view this as an estimate of the number of cars in use at any given “average” time

**Method (a) –**

- estimated ave. distance the ave. car is driven in an ave. year – perhaps 12,500 miles
- estimated ave. mileage for ave. gasoline powered car – perhaps 20 miles per gallon

$$\text{ANS.} = \left( \frac{1 \text{ gallon}}{22 \text{ mile}} \right) * \left( \frac{12,500 \text{ mile}}{\text{car}} \right) * \left( 150 \times 10^6 \text{ cars} \right) = 8.5 \times 10^{10} \text{ gallons of gas}$$

**Method (b) –**

- estimated ave. gas consumption per car per week - at 1 tank per week
- estimated ave. volume of ave. tank in ave. gasoline powered vehicle – at 20 gallon per tank

$$\text{ANS.} = \left( \frac{20 \text{ gallon}}{\text{tank}} \right) * \left( \frac{52 \text{ tanks}}{\text{year}} \right) * \left( 150 \times 10^6 \text{ cars} \right) = 1.6 \times 10^{11} \text{ gallons of gas}$$

The percentage difference between these two estimates can be found by expressing the difference ( $7.1 \times 10^{10}$  gallons) between the answers as a percentage of the average of the two answers ( $1.2 \times 10^{11}$  gallons):

$$\% \text{ difference} = 100 * \left( \frac{20 \text{ gallon}}{\text{tank}} \right) = 60 \% \text{ difference is the estimates}$$