1. State the number of significant figures in each of the following numbers.

a. 6.4157 m____5_____

b. $4.57700\times10^{-5}$ s _____6_____

c. 0.0003445 g _____4_____

d. 0.0122 km _____3_____

e. 15 books _____∞_____

2. Perform the following calculations (work in this problem need not be shown). **Give your answer with the correct number of significant figures.**

a. $(14.5\times123)-2.20\times10^{1}$ _____$1.76\times10^{3}$_____

b. (55.6 - 22.5) × (12.3 ÷ 0.56) ____$7.3\times10^{2}$_____

c. $1201 + 1.3\times10^{3} + 1\times10^{2}$ ____$2.6\times10^{3}$_____

d. $\dfrac{4(15.6)^{3}(3.1415)}{3}$ (4 and 3 are exact) ____$1.59\times10^{4}$_____

e. $2.334\times10^{4} \div 5.668\times10^{3}$ _____4.118_____

3. Convert the following. **SHOW ALL WORK FOR FULL CREDIT.** (Conversion factors are on the last page.)

a. The volume of the Houston Astrodome is $8.235\times10^{8}$ ft$^3$. What is this volume in L?

$$?\ \text{L} = 8.235\times10^{8}\ \text{ft}^3 \times \left(\frac{12\ \text{in}}{1\ \text{ft}}\right)^3 \times \left(\frac{2.540\ \text{cm}}{1\ \text{in}}\right)^3 \times \frac{1\ \text{mL}}{1\ \text{cm}^3} \times \frac{10^{-3}\ \text{L}}{1\ \text{mL}} = 2.332\times10^{10}\ \text{L}$$

b. The temperature on the moon in daylight is about 265 °F. What is this temperature in K?

$$\left(265\ ^\circ\text{F} - 32\ ^\circ\text{F}\right)\left(\frac{5\ \text{K}}{9\ ^\circ\text{F}}\right) + 273.15\ \text{K} = 403\ \text{K}$$

c. The average sedan has a fuel capacity of 17 gal. What is the volume in mL?

$$?\ \text{mL} = 17\ \text{gal} \times \frac{4\ \text{qt}}{1\ \text{gal}} \times \frac{0.9463\ \text{L}}{1\ \text{qt}} \times \frac{1\ \text{mL}}{10^{-3}\ \text{L}} = 6.4\times10^{4}\ \text{mL}$$

d. A NASCAR race car travels around the track at 132.9 kilometers per hour. What is this speed in feet per second?

$$?\frac{ft}{s} = \frac{132.9\ \text{km}}{\text{h}} \times \frac{1\ \text{h}}{3600\ \text{s}} \times \frac{1\ \text{mi}}{1.609\ \text{km}} \times \frac{5280\ \text{ft}}{1\ \text{mi}} = 121.1\ \text{ft s}^{-1}$$

4. What is the density of a substance (in g/mL) if it has a mass of 1.367 lb. and a volume of 3.2 gal?

$$?\frac{\text{g}}{\text{mL}} = \frac{1.367\ \text{lb}}{3.2\ \text{gal}} \times \frac{1\ \text{gal}}{4\ \text{qt}} \times \frac{1\ \text{qt}}{0.9463\ \text{L}} \times \frac{10^{-3}\ \text{L}}{1\ \text{mL}} \times \frac{453.6\ \text{g}}{1\ \text{lb}} = 0.051\ \text{g/mL}$$

5. A sample of a compound containing only C, H, and S was burned in oxygen, and 6.60 g of $CO_2$, 5.41 g of $H_2O$, and 9.61 g of $SO_2$ were obtained. What is the empirical formula of the compound?

$$6.60\text{ g } CO_2 \times \frac{1\text{ mol } CO_2}{44.0098\text{ g } CO_2} \times \frac{1\text{ mol C}}{1\text{ mol } CO_2} = 0.149965\text{ mol C} / 0.149965\text{ mol} = 1$$

$$5.41\text{ g } H_2O \times \frac{1\text{ mol } H_2O}{18.0153\text{ g } H_2O} \times \frac{2\text{ mol H}}{1\text{ mol } H_2O} = 0.6006006\text{ mol H} / 0.149965\text{ mol} = 4$$

$$9.61\text{ g } SO_2 \times \frac{1\text{ mol } SO_2}{64.064\text{ g } SO_2} \times \frac{1\text{ mol S}}{1\text{ mol } SO_2} = 0.15006\text{ mol S} / 0.149965\text{ mol} = 1$$

The empirical formula is $CH_4S$.

6. Calculate the ***mass of water produced*** when 25.00 g of liquid butanol ($C_3H_7OH$) reacts with 70.00 g of oxygen gas. The products are gaseous carbon dioxide and liquid water. Include phase labels in your balanced chemical equation.

$2\ C_3H_7OH\ (l) + 9\ O_2\ (g) \rightarrow 6\ CO_2\ (g) + 8\ H_2O\ (l)$

$$25.00\text{ g } C_3H_7OH \times \frac{1\text{ mol } C_3H_7OH}{60.0950\text{ g } C_3H_7OH} \times \frac{8\text{ mol } H_2O}{2\text{ mol } C_3H_7OH} \times \frac{18.0153\text{ g } H_2O}{1\text{ mol } H_2O} = 29.98\text{ g } H_2O$$

$$70.00\text{ g } O_2 \times \frac{1\text{ mol } O_2}{31.9988\text{ g } O_2} \times \frac{8\text{ mol } H_2O}{9\text{ mol } O_2} \times \frac{18.0153\text{ g } H_2O}{1\text{ mol } H_2O} = 35.03\text{ g } H_2O$$

29.98 g of water are produced.

7. ***Balance*** the following chemical equations:

a. _____ $TiO_2$ + _____ C + ___2__ $Cl_2$ → _____ $TiCl_4$ + _____ $CO_2$

b.__4__ $NH_3$ + __3___ $O_2$ → ___2__ $N_2$ + __6____ $H_2O$

8. 24.55 g of Barium Nitrate reacts with Cesium Phosphate to produce Cesium Nitrate and solid Barium Phosphate. Calculate the ***mass of Barium Phosphate*** produced if there is an 87.66 % yield.

$$3\ Ba(NO_3)_2 + 2\ Cs_3PO_4 \rightarrow 6\ CsNO_3 + Ba_3(PO_4)_2$$

$$24.55\text{ g } Ba(NO_3)_2 \times \frac{1\text{ mol } Ba(NO_3)_2}{261.35\text{ g } Ba(NO_3)_2} \times \frac{1\text{ mol } Ba_3(PO_4)_2}{3\text{ mol } Ba(NO_3)_2} \times \frac{601.96\text{ g } Ba_3(PO_4)_2}{1\text{ mol } Ba_3(PO_4)_2} \times \frac{87.66\text{ g } Ba_3(PO_4)_2\text{ actual}}{100\text{ g } Ba_3(PO_4)_2\text{ theoretical}} = 16.52\text{ g } Ba_3(PO_4)_2$$

9. Calculate the following:

a. The number of oxygen atoms in 100.00 g of Iron(III) Oxalate.

$$100.00\text{ g } Fe_2(C_2O_4)_3 \times \frac{1\text{ mol } Fe_2(C_2O_4)_3}{375.747\text{ g } Fe_2(C_2O_4)_3} \times \frac{12\text{ mol O}}{1\text{ mol } Fe_2(C_2O_4)_3} \times \frac{6.0221\times10^{23}\text{ at O}}{1\text{ mol O}}$$

$$= 1.9232\times10^{24}\text{ atom of O}$$

c. Calculate the ***number of atoms*** in a cube of Aluminum that has an edge length of 5.00 cm and a density of 2.70 g $mL^{-1}$. Volume of a cube = (edge length)$^3$

$$(5.00\text{ cm})^3 \times \frac{1\text{ mL}}{1\text{ cm}^3} \times \frac{2.70\text{ g Al}}{1\text{ mL}} \times \frac{1\text{ mol Al}}{26.981538\text{ g Al}} \times \frac{6.0221\times10^{23}\text{at Al}}{1\text{ mol Al}} = 7.53\times10^{24}\text{ at Al}$$

**Conversion Factors**

| | | |
|---|---|---|
| 1 qt = 0.9463 L | 1 lb. = 453.6 g | 1 mi = 5280 feet |
| 1.609 km = 1 mi | 2 pt = 1 qt | 1 gal = 4 qt |
| 2 c = 1 pt | 8 fl. oz. = 1 c | 8 furlongs = 1 mi |