Stoichiometry Name _____

1. The human body needs at least 1.03 x 10^{-2} mol O_2 every minute. If all of this oxygen is used for the cellular respiration reaction that breaks down glucose, how many grams of glucose does the human body consume each minute?

$$C_6H_{12}O_6(s) + 6\ O_2(g) \text{ -----> } 6\ CO_2(g) + 6\ H_2O(l)$$

2. *In the space shuttle, the CO_2 that the crew exhales is removed from the air by a reaction within canisters of lithium hydroxide. On average, each astronaut exhales about 20.0 mol of CO_2 daily. What volume of water will be produced when this amount of CO_2 reacts with an excess of LiOH? (Hint: the density of water is about 1.oo g/mL.)*

$$CO_2(g) + 2\ LiOH(s) \text{ ------> } Li_2CO_3(aq) + H_2O$$

3. *Carbon monoxide can be combined with hydrogen to produce methanol, CH_3OH. Methanol is used as an industrial solvent, as a reactant in synthesis, and as a clean-burning fuel for some racing cars. If you had 152.5 kg CO and 24.50 kg H_2, how many kilograms of CH_3OH could be produced?*

4. *One step in making para-aminobenzoic acid, PABA, an ingredient in some suntan lotions, involves replacing one of the hydrogen atoms in a toluene molecule with an -NO_2 group, directly opposite the -CH_3 group. Calculate the percent yield if 550 g of toluene added to an excess of nitric acid provides 305 g of the nitrotoluene product.*

5. *A more efficient way to prepare the molecule that was used to produce PABA for suntan lotions involves a slightly different starting material, known as isopropyl-benzene. This reaction usually has a 91.2% yield. How many grams of the product, para-nitro-isopropylbenzene, can you expect if 775 g of isopropylbenzene react with an excess of nitric acid?*

6. ***Air-bag design depends on stoichiometric precision.***

$$2\ NaN_3(s) \ \text{-----}> \ 2\ Na(s) + 3\ N_2(g)$$

$$6\ Na(s) + Fe_2O_3(s) \ \text{-----}> \ 3\ Na_2O(s) + 2\ Fe$$

Assume that 65.1 L of N_2 gas are needed to inflate an air bag to the proper size. How many grams of NaN_3 must be included in the gas generant to generate this amount of N_2? (Hint: the density of N_2 gas at this temperature is about 0.916 g/L).

How much Fe_2O_3 must be added to the gas generant for this amount of NaN_3?

7. ***Engine efficiency depends on the reactant proportions***

gasoline + air -----> carbon dioxide + water + energy

$$2\ C_8H_{18(g)} + 25\ O_{2(g)} \ \text{-----}> \ 16\ CO_{2(g)} + 18\ H_2O_{(g)} + 10{,}900\ kJ$$

How many liters of air must react with 1.000 L of isooctane in order for combustion to occur completely? At 20 degrees Celcius, the density of isooctane is 0.6916 g/mL, and the density of oxygen is 1.331 g/L. (Hint: remember to use the percentage of oxygen in air.)

8. ***Car designers use stoichiometry to control pollution***

$$NO_2(g) \xrightarrow{\text{ultraviolet radiation}} NO(g) + O(g)$$

$$O_2(g) + O(g) \ \text{----------}> \ O_3(g)$$