Name _____ **Honors Chemistry** **__/___/___**

1. Gaseous ammonia reacts with solid copper(II) oxide to produce nitrogen gas, copper metal and water vapor. 18.1 grams of ammonia gas is reacted with 95.4 grams of copper(II) oxide.
(a) Write the balance chemical equation (4 points)
(b) Identify the limiting reactant. Support your answer with calculations. (4 points)
(c) What mass of the excess reagent remains? (4 points)
(d) Calculate the expected mass of copper to be produced. (4 points)
(e) If 68.3 grams of copper are actually produced, what is the percent yield? (4 points)
Show Work:

Answers:

(a)

(b)

(c)

(d)

(e)

Energy Stoichiometry

Energy stoichiometry is a way to relate the amount of energy absorbed or released in a reaction to another factor stoichometrically related. A strong understanding of dimensional analysis helps. In an energy stoichiometry problem you will be given a chemical equation with thermodynamic data included. You will be given a variable in a word problem and be asked to solve for another variable. You will always need to make a relationship between moles of a substance and the heat absorbed or released. Always pay attention to the sign of the thermodynamic data. If a reaction is exothermic, it will always be exothermic, and vise-versa.

Example 1: When suffering from a fever, your body temperature rises from 37ºC to 40.ºC, using 787 kJ of energy. Assume your body burns only glucose to raise your temperature. How many grams of glucose ($C_6H_{12}O_6$) are consumed?

$C_6H_{12}O_6$ (s) + 6 O_2 (g) → 6 H_2O (l) + 6 CO_2 (g) $\Delta H° = -2870$ kJ

$$\frac{-787 \text{ kJ}}{} \times \frac{1 \text{ mole } C_6H_{12}O_6}{-2870 \text{ kJ}} \times \frac{180 \text{ grams } C_6H_{12}O_6}{1 \text{ mole } C_6H_{12}O_6} = \mathbf{49.4 \text{ grams } C_6H_{12}O_6}$$

Example 2: Gasohol contains ethanol, C_2H_5OH (l), which reacts with oxygen when burned to produce CO_2 (g) and H_2O (g). Calculate the amount of energy given off as 500.0 grams of ethanol are burned.

C_2H_5OH (l) + 3 O_2 (g) → 2 CO_2 (g) + 3 H_2O (g) $\Delta H° = -1368$ kJ

$$\frac{500.0 \text{ g } C_2H_5OH}{} \times \frac{1 \text{ mole } C_2H_5OH}{46.08 \text{ g } C_2H_5OH} \times \frac{-1368 \text{ kJ}}{1 \text{ mole } C_2H_5OH} = \mathbf{-1.4840 \text{ kJ}}$$

Homework: Solve each of following energy stoiciometry problems. Show all work.

1. Calculate the amount of heat absorbed when 5.66 grams of carbon disulfide form from the synthesis of C (s) and S (s).
   $C\ (s) + 2\ S\ (s) \rightarrow CS_2\ (l) \quad \Delta H° = +89.3\ kJ$

2. How many grams of methane (CH_4) are needed to produce 2100. kJ of energy?
   $CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l) \quad \Delta H° = -890.4\ kJ$

3. How much heat is given off when 1106 grams of phosphorus trichloride are formed?
   $2P + 3Cl_2 \rightarrow 2PCl_3 \qquad \Delta H° = -574\ kJ$

4. How many grams of magnesium oxide are produced when 350 kJ of energy is released?
   $2Mg\ (s) + O_2\ (g) \rightarrow 2MgO\ (s) \quad \Delta H° = -1204\ kJ$

5. How much energy is required to break down 300.0 grams of phosphorus pentachloride?
   $PCl_5 \rightarrow PCl_3 + Cl_2 \qquad \Delta H° = -87.9\ kJ$

6. How many grams of water vapor are released in the production of 3000. kilocalories of energy?
   $2H_2(g) + O_2(g) \rightarrow 2H_2O\ (g) \qquad \Delta H° = -484\ kJ$

7. How much energy is released in the break down of 999 grams of iron(III) oxide?
   $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2 \qquad \Delta H° = -26.3\ kJ$

8. How many grams of propane (C_3H_8) would to be used to generate the 55.5 kJ of energy?
   $C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 4\ H_2O\ (l) + 3\ CO_2\ (g) \qquad \Delta H° = -2220\ kJ$

9. How many kJ of energy are needed to produce 2.0 kilograms of glucose?
   $6\ H_2O\ (l) + 6\ CO_2\ (g) \rightarrow C_6H_{12}O_6\ (s) + 6\ O_2\ (g) \qquad \Delta H° = 2870\ kJ$

10. How many kJ of energy are released when 560. liters of sulfur dioxide react with excess oxygen at STP?
    $2SO_2\ (g) + O_2\ (g) \rightarrow 2SO_3\ (g) \qquad \Delta H° = -197.8\ kJ$