Name: _____
Hour: ____ Date: _____

Chemistry: *Energy and Stoichiometry*

Directions: *Solve each of the following problems. Show your work, including proper units, to earn full credit.*

1. The combustion of propane (C_3H_8) produces 248 kJ of energy per mole of propane burned. How much heat energy will be released when 1 000 dm^3 of propane are burned at STP?

2. Carbon monoxide burns in air to produce carbon dioxide according to the following balanced equation:

$$2\ CO(g) + O_2(g) \rightarrow 2\ CO_2(g) + 566\ kJ$$

How many grams of carbon monoxide are needed to yield 185 kJ of energy?

3. Nitrogen gas combines with oxygen gas according to the following balanced equation:

$$N_2(g) + 2\ O_2(g) + 67.8\ kJ \rightarrow 2\ NO_2(g)$$

Assuming that you have excess nitrogen, how much heat energy must be added to 540 g of oxygen in order to use up all of that oxygen?

4. Ethyl alcohol burns according to the following balanced equation:

$$C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) + 1\ 364\ kJ$$

How many molecules of water are produced if 5 000 kJ of heat energy are released?

Answers: 1. 11 071 kJ 2. 18.3 g CO 3. 572 kJ 4. 6.62×10^{24} molecules H_2O

KEY

Chemistry: *Energy and Stoichiometry*

Directions: *Solve each of the following problems. Show your work, including proper units, to earn full credit.*

1. The combustion of propane (C_3H_8) produces 248 kJ of energy per mole of propane burned. How much heat energy will be released when 1 000 dm^3 of propane are burned at STP?

$$\underset{1000\ dm^3}{\mathbf{C_3H_8}} + \underset{excess}{\mathbf{5\ O_2}} \rightarrow \mathbf{3\ CO_2} + \mathbf{4\ H_2O} + \underset{x\ kJ}{\mathbf{heat}}$$

$$x\ kJ = 1000\ dm^3\ C_3H_8 \left(\frac{1 mol\ C_3H_8}{22.4\ L\ C_3H_8}\right)\left(\frac{248\ kJ}{1 mol\ C_3H_8}\right) = 11{,}071\ kJ$$

2. Carbon monoxide burns in air to produce carbon dioxide according to the following balanced equation:

$$2\ CO(g) + O_2(g) \rightarrow 2\ CO_2(g) + 566\ kJ$$

How many grams of carbon monoxide are needed to yield 185 kJ of energy?

$$\underset{x\ g}{\mathbf{2\ CO}} + \mathbf{O_2} \rightarrow \mathbf{2CO_2} + \underset{185\ kJ}{\mathbf{566\ kJ}}$$

$$x\ g\ Co = 185\ kJ\left(\frac{2 mol\ CO}{566\ kJ}\right)\left(\frac{28\ g\ CO}{1 mol\ CO}\right) = 18.3\ g\ CO$$

3. Nitrogen gas combines with oxygen gas according to the following balanced equation:

$$N_2(g) + 2\ O_2(g) + 67.8\ kJ \rightarrow 2\ NO_2(g)$$

Assuming that you have excess nitrogen, how much heat energy must be added to 540 g of oxygen in order to use up all of that oxygen?

$$\mathbf{N_2} + \underset{540\ g}{2\ O_2} + \underset{x\ kJ}{67.8\ kJ} \rightarrow \mathbf{2\ NO_2}$$

$$x\ kJ = 540\ g\ O_2\left(\frac{1 mol\ O_2}{32\ g\ O_2}\right)\left(\frac{67.8\ kJ}{2 mol\ O_2}\right) = 572\ kJ$$

4. Ethyl alcohol burns according to the following balanced equation:

$$C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) + 1364\ kJ$$

How many molecules of water are produced if 5 000 kJ of heat energy are released?

$$C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + \underset{x\ molecules}{3\ H_2O(g)} + \underset{5000\ kJ}{1364\ kJ}$$

$$x\ molecules\ H_2O = 5000\ kJ\left(\frac{3 mol\ H_2O}{1364\ kJ}\right)\left(\frac{6.02\times10^{23}\ molecules\ H_2O}{1 mol\ H_2O}\right) = 6.62\times10^{24}\ molecules\ H_2O$$

Answers: 1. 11 071 kJ 2. 18.3 g CO 3. 572 kJ 4. 6.62 x 10^{24} molecules H_2O