WS 11.0 1 calorie = 4.184 Joules Name:_____ p.____

1. Reaction for the combustion of methane in a bunsen burner:

a. What is the formula for methane: CH_4

b. Write a balanced rxn for the combustion of methane, including subscripts.

c. Draw the Lewis Dot structures of all reactant and product molecules.

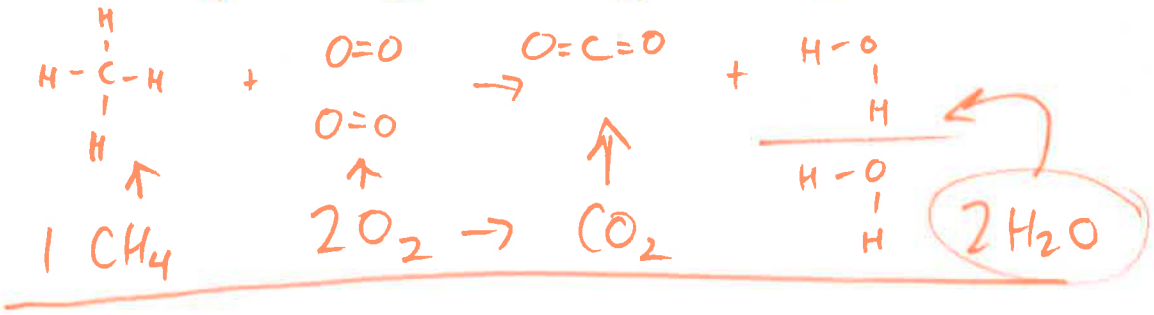
d. This rxn releases 802 kiloJoules of energy per mole of methane burned. Write the heat term into the equation on the correct side.

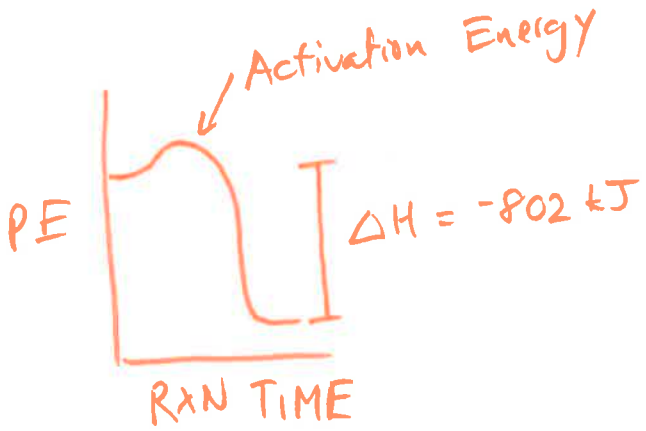
e. Is this reaction exothermic or endothermic? exo

f. Sketch an energy diagram for this reaction and label it.

g. What is ΔH for this reaction? ΔH_{rxn} = -802 kJ

Rxn: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + 802\ kJ$





2. Demo: Examples of endothermic/exothermic reactions:

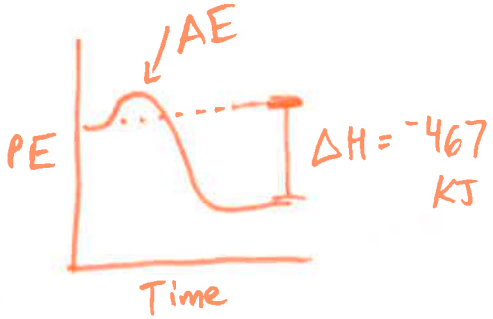
a. $Mg_{(s)} + 2\ HCl_{(aq)} \text{ -------> } MgCl_{2(aq)} + H_{2(g)} + 467\ kJ$

Is the above reaction exothermic or endothermic? exo

What is the value for ΔHrxn? -467 kJ

If the reaction is done in a test tube, will the glass get hotter or colder? hotter

Sketch an energy diagram for this reaction. Label the ΔH and the activation energy.



b. $NaNO_{3(s)} + 20.5\ kJ \text{ -------> } NaNO_{3(aq)}$

Is the above "reaction" exothermic or endothermic? endo

What is the value for ΔHrxn? +20.5 kJ

If the reaction is done in a test tube, will the glass get hotter or colder? Colder

Sketch an energy diagram for this reaction. Label the ΔH and the activation energy.

ethane

3. $2\ C_2H_{6(g)} + 7\ O_{2(g)} \text{ -------> } 4\ CO_{2(g)} + 6\ H_2O_{(g)} + 3120\ kJ$

a. What is the value for ΔH_{rxn}, including the sign? $\Delta H = -3120\ kJ$

b. List some possible conversion factors for the above reaction.

$\left(\frac{2\ mol\ C_2H_6}{3120\ kJ}\right)$ $\left(\frac{3120\ kJ}{7\ mol\ O_2}\right)$ $\left(\frac{3120\ kJ}{4\ mol\ CO_2}\right)$ etc

c. What mass of oxygen is needed to react completely with 10.0 grams of ethane?

$10.0\ g\ C_2H_6\left(\frac{1\ mol\ C_2H_6}{30.08\ g}\right)\left(\frac{7\ mol\ O_2}{2\ mol\ C_2H_6}\right)\left(\frac{32.00\ g}{1\ mol\ O_2}\right) = 37.2\ g\ O_2$

d. If 1 pound (454 grams) of ethane are react, what mass of carbon dioxide will be produced?

$454\ g\ C_2H_6\left(\frac{1\ mol\ C_2H_6}{30.08\ g}\right)\left(\frac{4\ mol\ CO_2}{2\ mol\ C_2H_6}\right)\left(\frac{44.01\ g}{1\ mol\ CO_2}\right) = 1328.4 \sim 1330\ g\ CO_2$

e. If 1 pound (454 grams) of ethane react, how much energy will be released?

$454\ g\ C_2H_6\left(\frac{1\ mol\ C_2H_6}{30.08\ g}\right)\left(\frac{3120\ kJ}{2\ mol\ C_2H_6}\right) = 23{,}545 \sim 2.35 \times 10^4\ kJ$

f. If 4.08×10^{22} molecules of oxygen react, how much energy will be released?

$4.08 \times 10^{22}\ molec\ O_2\left(\frac{1\ mol\ O_2}{6.02 \times 10^{23}\ molec}\right)\left(\frac{3120\ kJ}{7\ mol\ O_2}\right) = 211\ kJ$

g. How many grams of oxygen gas must react in order to produce 950. kiloJoules?

$950.\ kJ\left(\frac{7\ mol\ O_2}{3120\ kJ}\right)\left(\frac{32.00\ g}{1\ mol\ O_2}\right) = 68.2\ g\ O_2$

4. $2\ H_2O_{(l)} + 572\ kJ \text{ -----> } 2\ H_{2(g)} + O_{2(g)}$

a. Is this reaction endothermic or exothermic (which one)? endo

b. What is the value for ΔH_{rxn}, including the sign? $+572\ kJ$

c. How much energy (in kJ) is needed to separate 1.00 gram of water into its elements in the above reaction?

$1.00\ g\ H_2O\left(\frac{1\ mol\ H_2O}{18.02\ g}\right)\left(\frac{572\ kJ}{2\ mol\ H_2O}\right) = 15.9\ kJ$

d. What mass of oxygen gas can be produced if 500. kJ are available?

$500.\ kJ\left(\frac{1\ mol\ O_2}{572\ kJ}\right)\left(\frac{32.00\ g}{1\ mol\ O_2}\right) = 28.0\ g\ O_2$

5. Given this reaction, which occurs in sparklers: $2\ Mg_{(s)} + O_{2(g)} \text{ -----> } 2\ MgO_{(s)} + 287.6\ kcal$

a. If 0.400 grams of magnesium powder are burned, how much energy (in kilocalories) will be released?

$0.400\ g\ Mg\left(\frac{1\ mol\ Mg}{24.31\ g}\right)\left(\frac{287.6\ kcal}{2\ mol\ Mg}\right) = 2.37\ kcal$

b. What mass magnesium powder must be burned in order to produce 100. kcal?

$100.\ kcal\left(\frac{2\ mol\ Mg}{287.6\ kcal}\right)\left(\frac{24.31\ g}{1\ mol\ Mg}\right) = 16.9\ g\ Mg$

c. If 3.00 moles of oxygen gas react, what mass of magnesium oxide should form?

$3.00\ mol\ O_2\left(\frac{2\ mol\ MgO}{1\ mol\ O_2}\right)\left(\frac{40.31\ g}{1\ mol\ MgO}\right) = 242\ g\ MgO$