Unit 6C: Stoichiometry Study Guide Name: ______________________________ Date: ________

1. Balance and determine the reaction type:

   a. __2__ Mg + __1__ O_2 → __2__ MgO Rxn Type: __Syn__

   b. __1__ Mg + __1__ $Co(NO_3)_2$ → __1__ Co + __1__ $Mg(NO_3)_2$ Rxn Type: __SR__

   c. __1__ $Sr(OH)_2$ + __2__ HCl → __1__ $SrCl_2$ + __2__ H_2O Rxn Type: __DR__

   d. __2__ C_2H_6 + __7__ O_2 → __4__ CO_2 + __6__ H_2O Rxn Type: __COMBUST.__

2. 2 Na + Cl_2 → 2NaCl ΔH = – 411.12 kJ

   a. Is the reaction endothermic or exothermic?

      EXOTHERMIC (ΔH is Negative)

   b. How many grams of chlorine gas is needed to produce 0.75 moles of sodium chloride?

      $$\frac{0.75 \text{ mol NaCl}}{} \left| \frac{1 \text{ mol } Cl_2}{2 \text{ mol NaCl}} \right| \frac{70.9 \text{ g } Cl_2}{1 \text{ mol } Cl_2} = 27 \text{ g } Cl_2$$

   c. How many particles of NaCl will be produced when 35 grams of Na reacts with excess chlorine?

      $$\frac{35 \text{ g Na}}{} \left| \frac{1 \text{ mol Na}}{22.99 \text{ g Na}} \right| \frac{2 \text{ mol NaCl}}{2 \text{ mol Na}} \left| \frac{6.02 \times 10^{23} \text{ particles NaCl}}{1 \text{ mol NaCl}} \right. = 9.2 \times 10^{23} \text{ particles NaCl}$$

3. $CaCO_3$ → CaO + CO_2 ΔH = + 176.8 kJ

   a. Is the reaction endothermic or exothermic?

      ENDOTHERMIC (ΔH is positive)

   b. How many liters of carbon dioxide are produced at STP when 25.0 g of calcium carbonate decompose?

      $$\frac{25.0 \text{ g } CaCO_3}{} \left| \frac{1 \text{ mol } CaCO_3}{100.09 \text{ g } CaCO_3} \right| \frac{1 \text{ mol } CO_2}{1 \text{ mol } CaCO_3} \left| \frac{22.4 \text{ L } CO_2}{1 \text{ mol } CO_2} \right. = 5.59 \text{ L } CO_2$$

   c. How many grams of $CaCO_3$ are required to produce 4.11 grams of CaO?

      $$\frac{4.11 \text{ g CaO}}{} \left| \frac{1 \text{ mol CaO}}{56.08 \text{ g CaO}} \right| \frac{1 \text{ mol } CaCO_3}{1 \text{ mol CaO}} \left| \frac{100.09 \text{ g } CaCO_3}{1 \text{ mol } CaCO_3} \right. = 7.34 \text{ g } CaCO_3$$

4. $C(s) + 2 H_2(g) \rightarrow CH_4(g) + 74.3$ kJ

a. Is the reaction endothermic or exothermic?

EXOTHERMIC (Energy/Heat is a Product)

b. How many liters of CH_4 will be produced when 31 grams of carbon react with excess hydrogen at STP?

31 g C	1 mol C	1 mol CH_4	22.4 L CH_4
	12.01 g C	1 mol C	1 mol CH_4

= **58 L CH_4**

c. How many grams of carbon are required to react with 4.22×10^{24} molecules of H_2?

4.22×10^{24} molec H_2	1 mol H_2	1 mol C	12.01 g C
	6.02×10^{23} molec H_2	2 mol H_2	1 mol C

= **42.1 g C**

d. 55 liters of H_2 at STP react with excess carbon. How many moles of CH_4 will be produced?

55 L H_2	1 mol H_2	1 mol CH_4
	22.4 L H_2	2 mol H_2

= **1.2 mol CH_4**

5. $2 Al + 3 Cl_2 \rightarrow 2 AlCl_3$

Aluminum reacts with chlorine to produce aluminum chloride according to the equation above. 4.25×10^{22} atoms of aluminum are mixed with 18.23 grams of chlorine gas and allowed to react.

a. What is the limiting reactant?
b. What is the excess reactant?
c. How many grams of the excess reactant remain after the reaction?
d. What is the maximum mass (theoretical yield) of aluminum chloride that will be made?
e. What is the percent yield if ~~17.48 g~~ 7.48 of aluminum chloride is produced in lab?

4.25×10^{22} atoms Al	1 mol Al
	6.02×10^{23} atoms Al

= 0.070598 mol Al

18.23 g Cl_2	1 mol Cl_2
	70.9 g Cl_2

= 0.257123 mol Cl_2

	$2\,Al$	$+\;3\,Cl_2 \longrightarrow$	$2\,AlCl_3$
B	0.070598 mol	0.257123 mol	ϕ mol
C	-0.070598	$-\frac{3}{2}(0.070598)$ = -0.105897	$+\frac{2}{2}(0.070598)$ = +0.070598
A	ϕ mol	0.151226 mol	0.070598 mol

a) Limiting Reactant = Al (ϕ mol after rxn)

b) Excess Reactant = Cl_2 (extra mols left over after rxn)

c) $\dfrac{0.151226 \text{ mol } Cl_2 \mid 70.9 \text{ g } Cl_2}{\mid 1 \text{ mol } Cl_2} = \boxed{10.7 \text{ g } Cl_2}$

d) $\dfrac{0.070598 \text{ mol } AlCl_3 \mid 133.33 \text{ g } AlCl_3}{\mid 1 \text{ mol } AlCl_3} = \boxed{9.41 \text{ g } AlCl_3}$

e) $\% \text{ yield} = \dfrac{\text{Actual (Lab)}}{\text{theoretical (BCA/Dimensional Analysis)}} \times 100$

$\% \text{ yield} = \dfrac{7.48 \text{ g } AlCl_3}{9.41 \text{ g } AlCl_3} \times 100 = \boxed{79.5\,\%}$