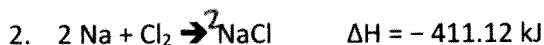
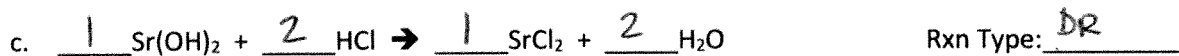
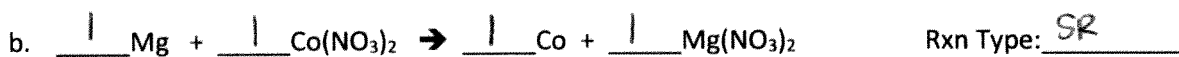


1. Balance and determine the reaction type:



a. Is the reaction endothermic or exothermic?

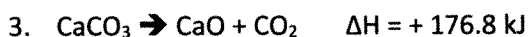
EXOTHERMIC ( $\Delta H$  is Negative)

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

$$\frac{0.75 \text{ mol NaCl} \mid 1 \text{ mol Cl}_2 \mid 70.9 \text{ g Cl}_2}{2 \text{ mol NaCl} \mid 1 \text{ mol Cl}_2} = \boxed{27 \text{ g Cl}_2}$$

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

$$\frac{35 \text{ g Na} \mid 1 \text{ mol Na} \mid 2 \text{ mol NaCl} \mid 6.02 \times 10^{23} \text{ particles NaCl}}{22.99 \text{ g Na} \mid 2 \text{ mol Na} \mid 1 \text{ mol NaCl}} = \boxed{9.2 \times 10^{23} \text{ particles NaCl}}$$



a. Is the reaction endothermic or exothermic?

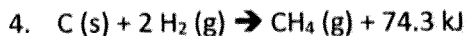
ENDOTHERMIC ( $\Delta H$  is Positive)

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

$$\frac{25.0 \text{ g CaCO}_3 \mid 1 \text{ mol CaCO}_3 \mid 1 \text{ mol CO}_2 \mid 22.4 \text{ L CO}_2}{100.09 \text{ g CaCO}_3 \mid 1 \text{ mol CaCO}_3 \mid 1 \text{ mol CO}_2} = \boxed{5.59 \text{ L CO}_2}$$

c. How many grams of CaCO<sub>3</sub> are required to produce 4.11 grams of CaO?

$$\frac{4.11 \text{ g CaO} \mid 1 \text{ mol CaO} \mid 1 \text{ mol CaCO}_3 \mid 100.09 \text{ g CaCO}_3}{56.08 \text{ g CaO} \mid 1 \text{ mol CaO} \mid 1 \text{ mol CaCO}_3} = \boxed{7.34 \text{ g CaCO}_3}$$



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?

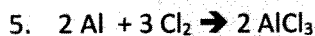
$$\frac{31 \text{ g C} \mid 1 \text{ mol C} \mid 1 \text{ mol CH}_4 \mid 22.4 \text{ L CH}_4}{12.01 \text{ g C} \mid 1 \text{ mol C} \mid 1 \text{ mol CH}_4} = \boxed{58 \text{ L CH}_4}$$

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

$$\frac{4.22 \times 10^{24} \text{ molec H}_2 \mid 1 \text{ mol H}_2 \mid 1 \text{ mol C} \mid 12.01 \text{ g C}}{6.02 \times 10^{23} \text{ molec H}_2 \mid 2 \text{ mol H}_2 \mid 1 \text{ mol C}} = \boxed{42.1 \text{ g C}}$$

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

$$\frac{55 \text{ L H}_2 \mid 1 \text{ mol H}_2 \mid 1 \text{ mol CH}_4}{22.4 \text{ L H}_2 \mid 2 \text{ mol H}_2} = \boxed{1.2 \text{ mol CH}_4}$$



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

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

$$\frac{4.25 \times 10^{22} \text{ atoms Al} \mid 1 \text{ mol Al}}{6.02 \times 10^{23} \text{ atoms Al}} = 0.070598 \text{ mol Al}$$

$$\frac{18.23 \text{ g Cl}_2 \mid 1 \text{ mol Cl}_2}{70.9 \text{ g Cl}_2} = 0.257123 \text{ mol Cl}_2$$

	2 Al	+ 3 Cl <sub>2</sub>	→	2 AlCl <sub>3</sub>
B	0.070598 mol	0.257123 mol		∅ mol
C	-0.070598	- $\frac{3}{2}(0.070598)$ = -0.105897		+ $\frac{2}{2}(0.070598)$ = +0.070598
A	∅ mol	0.151226 mol		0.070598 mol

- a) Limiting Reactant = Al (∅ mol after rxn)  
 b) Excess Reactant = Cl<sub>2</sub> (extra mols left over after rxn)

c) 
$$\frac{0.151226 \text{ mol Cl}_2}{1 \text{ mol Cl}_2} \times 70.9 \text{ g Cl}_2 = \boxed{10.7 \text{ g Cl}_2}$$

d) 
$$\frac{0.070598 \text{ mol AlCl}_3}{1 \text{ mol AlCl}_3} \times 133.33 \text{ g AlCl}_3 = \boxed{9.41 \text{ g AlCl}_3}$$

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

$$\% \text{ yield} = \frac{7.48 \text{ g AlCl}_3}{9.41 \text{ g AlCl}_3} \times 100 = \boxed{79.5 \%}$$