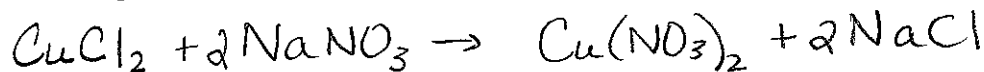


## Limiting Reagent Worksheet

1) Copper (II) chloride reacts with sodium nitrate.

a) Write the balanced equation for the reaction given above:



b) If 15.0 grams of copper (II) chloride react with 20.0 grams of sodium nitrate, how much sodium chloride can be formed?

$$15.0\text{g CuCl}_2 \times \frac{1\text{mol CuCl}_2}{134.5\text{g}} \times \frac{2\text{mol NaCl}}{1\text{mol CuCl}_2} = .223\text{mol NaCl} \times \frac{58.5\text{g}}{1\text{mol NaCl}} = 13.0\text{g NaCl}$$

$$20.0\text{g NaNO}_3 \times \frac{1\text{mol NaNO}_3}{85.0\text{g}} \times \frac{2\text{mol NaCl}}{2\text{mol NaNO}_3} = .235\text{mol NaCl}$$

c) What is the limiting reagent for the reaction in #2? CuCl<sub>2</sub>

d) How many grams of copper(II) nitrate is formed?

$$15.0\text{g CuCl}_2 \times \frac{1\text{mol CuCl}_2}{134.5\text{g}} \times \frac{1\text{mol Cu}(\text{NO}_3)_2}{1\text{mol CuCl}_2} \times \frac{187.5\text{g}}{1\text{mol Cu}(\text{NO}_3)_2} = 20.9\text{g Cu}(\text{NO}_3)_2$$

e) How much of the excess reagent is left over in this reaction?

$$15.0\text{g CuCl}_2 \times \frac{1\text{mol CuCl}_2}{134.5\text{g}} \times \frac{2\text{mol NaNO}_3}{1\text{mol CuCl}_2} \times \frac{85.0\text{g}}{1\text{mol}} = 18.95\text{g} \rightarrow 19.0\text{g used}$$

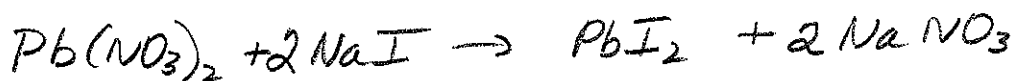
$$\begin{array}{r} 20.0\text{g} \\ \text{have} \end{array} - \begin{array}{r} 19.0\text{g} \\ \text{used} \end{array} = 1.0\text{g left over NaNO}_3$$

f) If 11.3 grams of sodium chloride are formed in the reaction described in problem #2, what is the percent yield of this reaction?

$$\frac{11.3}{13.0} \times 100 = 86.9\% \text{ yield}$$

2) Lead (II) nitrate reacts with sodium iodide.

a) Write the balanced equation:



b) If I start with 25.0 grams of lead (II) nitrate and 15.0 grams of sodium iodide, how many grams of sodium nitrate can be formed?

$$25.0\text{g Pb}(\text{NO}_3)_2 \times \frac{1\text{mol Pb}(\text{NO}_3)_2}{331.2\text{g}} \times \frac{2\text{mol NaNO}_3}{1\text{mol Pb}(\text{NO}_3)_2} = .151\text{mol NaNO}_3$$

$$15.0\text{g NaI} \times \frac{1\text{mol NaI}}{149.9\text{g}} \times \frac{2\text{mol NaNO}_3}{2\text{mol NaI}} = .100\text{mol NaNO}_3 \times \frac{85.0\text{g}}{1\text{mol NaNO}_3} =$$

$$8.51\text{g NaNO}_3$$

c) What is the limiting reagent in the reaction described in problem 2?  $\text{NaI}$

d) How many grams of lead(II) iodide is formed?

$$15.0\text{g NaI} \times \frac{1\text{mol NaI}}{149.9\text{g}} \times \frac{1\text{mol PbI}_2}{2\text{mol NaI}} \times \frac{461.0\text{g}}{1\text{mol PbI}_2} = 23.1\text{g PbI}_2$$

e) How much of the nonlimiting reagent will be left over from the reaction in problem #2?

$$15.0\text{g NaI} \times \frac{1\text{mol NaI}}{149.9\text{g}} \times \frac{1\text{mol Pb}(\text{NO}_3)_2}{2\text{mol NaI}} \times \frac{331.2\text{g}}{1\text{mol Pb}(\text{NO}_3)_2} = 16.6\text{g} \text{ used}$$

$$\begin{array}{rcl} 25.0\text{g} & - & 16.6\text{g} \\ \text{have} & & \text{used} \end{array} = 8.4\text{g Pb}(\text{NO}_3)_2 \text{ remains left over}$$

f) If 6.00 grams of sodium nitrate are formed in the reaction described in problem #2, what is the percent yield of this reaction?

$$\frac{6.00}{8.51} \times 100 = 70.5\% \text{ yield}$$

3) 1000. grams of sodium chloride is combined with 2000. grams of barium phosphate.

a) Write the balanced equation:



b) What is the limiting reactant?

$$1000 \text{g NaCl} \times \frac{1 \text{mol NaCl}}{58.5 \text{g}} \times \frac{2 \text{mol Na}_3\text{PO}_4}{6 \text{mol NaCl}} = 5.70$$

$$2000 \text{g Ba}_3(\text{PO}_4)_2 \times \frac{1 \text{mol Ba}_3(\text{PO}_4)_2}{601.9 \text{g}} \times \frac{2 \text{mol Na}_3\text{PO}_4}{1 \text{mol Ba}_3(\text{PO}_4)_2} = 6.65$$

NaCl is the limiting reactant

c) How many grams of excess reactant are left?

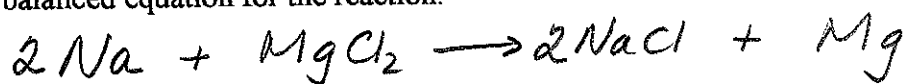
$$1000 \text{g NaCl} \times \frac{1 \text{mol NaCl}}{58.5 \text{g}} \times \frac{1 \text{mol Ba}_3(\text{PO}_4)_2}{6 \text{mol NaCl}} \times \frac{601.9 \text{g}}{1 \text{mol}} = 1715 \text{g Ba}_3(\text{PO}_4)_2 \text{ used}$$

$$2000. \text{g} - 1715 \text{g} = 285 \text{g Ba}_3(\text{PO}_4)_2 \text{ left over}$$

have                  used

4) A chemist combines 5.00g of sodium with 150.0g of 15.0% by mass solution of magnesium chloride.

Write a balanced equation for the reaction.



a) Determine the mass of magnesium produced.

$$5.00 \text{g Na} \times \frac{1 \text{mol Na}}{23.0 \text{g}} \times \frac{1 \text{mol Mg}}{2 \text{mol Na}} = .109 \text{mol Mg} \times \frac{24.3 \text{g}}{1 \text{mol Mg}} = 2.65 \text{g Mg}$$

$$(150 \times .15) \text{g MgCl}_2 \times \frac{1 \text{mol MgCl}_2}{95.3 \text{g}} \times \frac{1 \text{mol Mg}}{1 \text{mol MgCl}_2} = .236$$

b) Determine the number of grams of excess reactant.

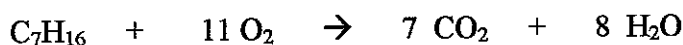
$$5.00 \text{g Na} \times \frac{1 \text{mol Na}}{23.0 \text{g}} \times \frac{1 \text{mol MgCl}_2}{2 \text{mol Na}} \times \frac{95.3 \text{g}}{1 \text{mol MgCl}_2} = 10.4 \text{g MgCl}_2 \text{ used}$$

$$(150 \times .15) = 22.5 \text{g MgCl}_2 \text{ in solution}$$

$$22.5 \text{g} - 10.4 \text{g} = 12.1 \text{g of MgCl}_2 \text{ remains}$$

have                  used

- 5) 4000. grams of heptane is combusted with 7000. grams of oxygen.



- a) What is the limiting reactant?  
 $4000\text{g C}_7\text{H}_{16} \times \frac{1\text{mol C}_7\text{H}_{16}}{100.2\text{g}} \times \frac{7\text{mol CO}_2}{1\text{mol C}_7\text{H}_{16}} = 279\text{mol CO}_2$

$$\rightarrow 7000\text{g O}_2 \times \frac{1\text{mol O}_2}{32.0\text{g}} \times \frac{7\text{mol CO}_2}{11\text{mol O}_2} = 139\text{mol CO}_2$$

$\text{O}_2$  is limiting

- b) How many grams of carbon dioxide is produced?

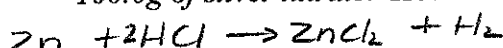
$$139\text{mol CO}_2 \times \frac{44.0\text{g}}{1\text{mol}} = 6125\text{g CO}_2$$

- c) How many grams of excess reactant are left?

$$7000\text{g O}_2 \times \frac{1\text{mol O}_2}{32.0\text{g}} \times \frac{1\text{mol C}_7\text{H}_{16}}{11\text{mol O}_2} \times \frac{100.2\text{g}}{1\text{mol C}_7\text{H}_{16}} = 1992\text{g C}_7\text{H}_{16} \text{ used}$$

$$4000.\text{g} - 1992\text{g} = 2008\text{g C}_7\text{H}_{16} \text{ have used left over}$$

- 6) 10.0g of zinc reacts with 10.0g of hydrochloric acid. The excess of this reaction is then reacted with 100.0g of silver nitrate. How many grams of silver are recovered?  $\rightarrow$  100g must be in excess!

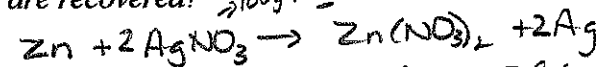


$$10\text{g Zn} \times \frac{1\text{mol}}{65.4\text{g}} \times \frac{1\text{mol ZnCl}_2}{1\text{mol Zn}} = .153$$

$$\text{limiting} \rightarrow 10\text{g HCl} \times \frac{1\text{mol}}{36.5\text{g}} \times \frac{1\text{mol ZnCl}_2}{2\text{mol HCl}} = .137$$

$$10\text{g HCl} \times \frac{1\text{mol HCl}}{36.5\text{g}} \times \frac{1\text{mol Zn}}{2\text{mol HCl}} \times \frac{65.4\text{g}}{1\text{mol}} = 8.96\text{g used}$$

$$10 - 8.96 = 1.04\text{g left over}$$



$$1.0\text{g Zn} \times \frac{1\text{mol Zn}}{65.4\text{g Zn}} \times \frac{2\text{mol Ag}}{1\text{mol Zn}} \times \frac{107.9\text{g}}{1\text{mol Ag}} = 3.43\text{g Ag}$$

$$3.43\text{g Ag}$$

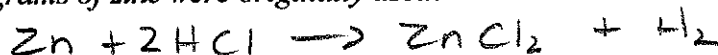
- 7) 12.5 g of copper are reacted with an excess of chlorine gas. If the percent yield is 90.2%, how many grams of copper (II) chloride are obtained?



$$12.5\text{g Cu} \times \frac{1\text{mol Cu}}{63.5\text{g}} \times \frac{1\text{mol CuCl}_2}{1\text{mol Cu}} \times \frac{134.5\text{g}}{1\text{mol CuCl}_2} = 26.5\text{g (theoretical)}$$

$$26.5 \times .902 = 23.9\text{g actually made}$$

- 8) In the reaction of Zn with HCl, 140.15 g of  $\text{ZnCl}_2$  was formed. If the percent yield is 87.2%, how many grams of zinc were originally used?



$$\frac{\text{act}}{\text{th}} \times 100 = \%$$

$$\frac{140.15}{x} \times 100 = 87.2$$

$$\text{Theor.} = 160.72$$

$$140.15\text{g ZnCl}_2 \times \frac{1\text{mol ZnCl}_2}{136.4\text{g}} \times \frac{1\text{mol Zn}}{1\text{mol ZnCl}_2} \times \frac{65.4\text{g}}{1\text{mol Zn}} = 77.06\text{g Zn}$$