# Honors Chemistry Stoichiometry Review

1. How many grams of hydrogen are formed from the reaction of 12.5 grams of potassium with 10.0 grams of water?

2. The decomposition of 125.0 grams of potassium chlorate produced 35 grams of oxygen. What is the percent yield of oxygen?

3. Marble is 95.0% calcium carbonate. When calcium carbonate reacts with hydrochloric acid, carbon dioxide gas and water are produced, rather than carbonic acid. How many grams of marble are needed to make 100.0 grams of carbon dioxide? *$CaCl_2$ also produced

4. Burning coal in a power plant produces sulfur dioxide gas, a severe air pollutant, because the coal, which is mostly carbon, contains a small amount of sulfur. When the coal is burned, the sulfur reacts with some of the oxygen in the air. What mass of sulfur dioxide is formed for each metric ton of coal burned, if the coal is 1.50% sulfur?

5. Brass is an alloy, or mixture, of copper and zinc. When 150 grams of a certain type of brass were reacted with hydrochloric acid, 180 grams of zinc chloride were recovered, while the copper was left unreacted. What is the percent of copper in the brass?

6. 5.35 grams of 20.0% sodium phosphate solution are mixed with 3.68 grams of 35.0% barium nitrate solution. How many grams of barium phosphate precipitate are formed?

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1. $2K + 2H_2O \rightarrow 2KOH + H_2$

Limiting Reactant Problem

12.5g 10.0g g?

$12.5\,g\,K\left(\frac{1\,mol\,K}{39.10\,g\,K}\right)\left(\frac{1\,mol\,H_2}{2\,mol\,K}\right)\left(\frac{2.02\,g\,H_2}{1\,mol\,H_2}\right) = 0.323\,g\,H_2$

$10.0\,g\,H_2O\left(\frac{1\,mol\,H_2O}{18.02\,g\,H_2O}\right)\left(\frac{1\,mol\,H_2}{2\,mol\,H_2O}\right)\left(\frac{2.02\,g\,H_2}{1\,mol\,H_2}\right) = 0.560\,g\,H_2$

2. $2KClO_3 \rightarrow 2KCl + 3O_2$

Percent Yield Problem

125.0g 35g

$125.0\,g\,KClO_3\left(\frac{1\,mol\,KClO_3}{122.55\,g\,KClO_3}\right)\left(\frac{3\,mol\,O_2}{2\,mol\,KClO_3}\right)\left(\frac{32.00\,g\,O_2}{1\,mol\,O_2}\right) = 48.96\,g\,O_2$

$\%\,Yield = \frac{Actual}{Theoretical} \times 100 = \frac{35\,g\,O_2}{48.96\,g\,O_2} \times 100 = 71\%\,O_2$

3. $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

Basic Stoich. Problem & Challenge

Marble
95.0% $CaCO_3$
g Marble ?

100.0g $CO_2$

$100.0\,g\,CO_2\left(\frac{1\,mol\,CO_2}{44.01\,g\,CO_2}\right)\left(\frac{1\,mol\,CaCO_3}{1\,mol\,CO_2}\right)\left(\frac{100.09\,g\,CaCO_3}{1\,mol\,CaCO_3}\right)\left(\frac{100\,g\,Marble}{95.0\,g\,CaCO_3}\right) = 239\,g\,Marble$

4. Coal
1.50% Sulfur $S + O_2 \rightarrow SO_2$
g ?

Basic Stoich. Problem & Challenge

1 metric ton = 1,000 kg

$1.00\,metric\,ton\,coal\left(\frac{1,000\,kg}{1\,metric\,ton}\right)\left(\frac{1000\,g\,Coal}{1\,kg\,Coal}\right)\left(\frac{1.50\,g\,S}{100\,g\,Coal}\right)\left(\frac{1\,mol\,S}{32.10\,g\,S}\right)\left(\frac{1\,mol\,SO_2}{1\,mol\,S}\right)\left(\frac{64.10\,g}{1\,mol\,SO_2}\right)$

$= 3.00 \times 10^4\,g\,SO_2$

Basic Stoich Problem & Challenge

5. Brass = Cu + Zn

$$\underset{150\,g}{\text{Brass}} + HCl \longrightarrow \underset{180\,g}{ZnCl_2}$$

Only the Zn in the Brass reacted ...

Therefore, the reaction is:

$$Zn + 2HCl \rightarrow \underset{180\,g}{ZnCl_2} + H_2$$

The amount of Zn needs to be found to solve for percent.

$$180\,g\ ZnCl_2 \left(\frac{1\ mol\ ZnCl_2}{136.29\,g\ ZnCl_2}\right)\left(\frac{1\ mol\ Zn}{1\ mol\ ZnCl_2}\right)\left(\frac{65.39\,g\ Zn}{1\ mol\ Zn}\right) = 86\,g\ Zn$$

$$\%\,Zn = \frac{g\ Zn}{g\ Brass} \times 100 = \frac{86\,g\ Zn}{150\,g\ Brass} \times 100 = 57\%\ Zn$$

∴ Cu is 43% in Brass

6. $\underset{5.35\,g}{2Na_3PO_{4(aq)}} + \underset{3.68\,g}{3Ba(NO_3)_{2(aq)}} \longrightarrow \underset{g?}{Ba_3(PO_4)_{2(s)}} + 6NaNO_{3(aq)}$

20.0% Soln. 35.0% Soln.

$$5.35\,g\ Na_3PO_4\ Solution \left(\frac{20.0\,g\ Na_3PO_4}{100\,g\ Soln.}\right)\left(\frac{1\ mol\ Na_3PO_4}{163.97\,g\ Na_3PO_4}\right)\left(\frac{1\ mol\ Ba_3(PO_4)_2}{2\ mol\ Na_3PO_4}\right)\left(\frac{601.93\,g\ Ba_3(PO_4)_2}{1\ mol\ Ba_3(PO_4)_2}\right) = 1.96\,g\ Ba_3(PO_4)_2$$

$$3.68\,g\ Ba(NO_3)_2\ Solution \left(\frac{35.0\,g\ Ba(NO_3)_2}{100\,g\ Solution}\right)\left(\frac{1\ mol\ Ba(NO_3)_2}{261.30\,g\ Ba(NO_3)_2}\right)\left(\frac{1\ mol\ Ba_3(PO_4)_2}{3\ mol\ Ba(NO_3)_2}\right)\left(\frac{601.93\,g\ Ba_3(PO_4)_2}{1\ mol\ Ba_3(PO_4)_2}\right) = 0.989\,g\ Ba_3(PO_4)_2$$