**Stoichiometry – Simpler Questions**

1. When heated, potassium chlorate decomposes into potassium chloride and oxygen gas:

2 KClO3(*s*) → 2 KCl(*s*) + 3 O2(*g*)

* 1. How many moles of O2 gas will be produced from 10.0 g of KClO3?
  2. What is the volume of this amount of O2 gas at STP?

1. The reaction of aluminium and iron(III) oxide gives off a great deal of heat and light:

2 Al(*s*) + Fe2O3(*s*) → 2 Fe(*s*) + Al2O3(*s*)

* 1. What mass of Fe2O3(*s*) is required to react completely with 1.0 kg of Al(*s*)?
  2. What mass of Fe(*s*) will be produced based on the quantities in a)?

1. The Marsh test was used historically to detect arsenic in cases of suspected poisoning:

As2O3(*s*) + 6 H2(*g*) → 2 AsH3(*g*) + 3 H2O(*g*)

A sample contains 640 mg of As2O3. What mass of AsH3 will be isolated from the above reaction? Assume that there is enough H2 to react with all the As2O3.

1. Glucose can be fermented by yeast to produce ethanol by the following reaction:

C6H12O6(*s*) → 2 C2H6O(*l*) + 2 CO2(*g*)

* 1. What mass of glucose is needed to produce 800 g of ethanol?
  2. What volume of CO2 (at 25oC and 1 atm pressure) will be produced by the fermentation of the amount of glucose you calculated in part a?

1. Titanium(IV) chloride reacts spectacularly with water vapour to form titanium dioxide and hydrogen chloride gas:

TiCl4(*l*) + 2 H2O(*g*) → TiO2(*s*) + 4 HCl(*g*)

* 1. What mass of water vapour is needed to react with 4.0 g of TiCl4?
  2. How many moles of HCl(*g*) will be formed given the amounts in a)?

1. The following *unbalanced* reaction is for the complete combustion of toluene, the main ingredient of paint thinner:

C7H8(*l*) + O2(*g*) → CO2(*g*) + H2O(*g*)

* + 1. What is the balanced equation for this transformation?
    2. What volume of O2 gas at STP is required for the complete combustion of 45.0 g of C7H8?
    3. What mass of CO2 is formed by the complete combustion of 45.0 g of C7H8?

1. Baking soda can be heated to form sodium carbonate by the following reaction:

2 NaHCO3(*s*) → Na2CO3(*s*) + CO2(*g*) + H2O(*g*)

* + 1. What mass of baking soda is required to make 100.0 g of Na2CO3?
    2. How many moles of CO2 are produced by the above reaction?

**Stoichiometry – Excess/limiting reagents & percent yield and purity**

1. The Haber-Bosch process produces ammonia from elemental nitrogen and hydrogen:

N2(*g*) + 3 H2(*g*) → 2 NH3(*g*)

* 1. If 10.0 kg of nitrogen gas are reacted with 10000 L of hydrogen gas (at SLC), which gas is the limiting reactant?
  2. What mass of ammonia is produced from the amounts in a)?
  3. \*How much of the excess of the excess reactant is left over?

1. Titanium (IV) chloride can be made by the following reaction:

2 FeTiO3(*s*) + 7 Cl2(*g*) + 6 C(*s*) → 2 TiCl4(*g*) + 6 CO(*g*) + 2 FeCl3(*s*)

1. If you start with 100.0 g of each reactant, which one limits the reaction?
2. What is the theoretical yield of TiCl4 based on the amounts in a)?
3. If only 70.0 g of TiCl4 is recovered, what is the percent yield of the reaction?

1. Small amounts of hydrogen gas can be generated by reacting magnesium metal with hydrochloric acid:

Mg(*s*) + 2 HCl(*aq*) → MgCl2(*aq*) + H2(*g*)

1. What is the theoretical yield of hydrogen gass in litres at STP if 200 mL of 0.4M HCl(aq) was reacted with excess Mg?
2. What is the theoretical volume of H2 gas produced at SLC if 575 mg of a Mg sample are reacted with excess HCl?
3. What is the percent purity of the Mg sample if only 4L of H2 were collected at SLC?

1. Reacting carbon monoxide with silver(II) fluoride generates carbonyl fluoride and silver(I) fluoride:

CO(*g*) + 2 AgF2(*s*) → COF2(*g*) + 2 AgF(*s*)

1. What mass of AgF2(*s*) is required to make 10.0 g of COF2(*g*)?
2. If 25.0 g of CO are reacted with a 250.0 g of a 90% pure sample of AgF2(*s*), what is the theoretical yield of COF2(*g*)?
3. When sodium sulfate and lead(II) nitrate are mixed, a precipitate of lead(II)sulfate forms:

Na2SO4(*aq*) + Pb(NO3)2(*aq*) → PbSO4(*s*) + 2 NaNO3(*aq*)

* + 1. When a sample of Na2SO4 is mixed with excess Pb(NO3)2, 2.27 g of PbSO4 was formed. Assuming the reaction is 100% efficient, what mass of Na2SO4 was dissolved in the sample?
    2. If 2.00 M Pb(NO3)2 was used, what was the minimum volume required to react with all the Na2SO4 in part a?

1. When calcium carbonate solution is mixed with hydrochloric acid, carbon dioxide is among the products:

CaCO3(*aq*) + 2 HCl(*aq*) → CaCl2(*aq*) + CO2(*g*) + H2O(*l*)

a. Which reactant is in excess if 25.0 mL of a 0.100 M solution of CaCO3 is mixed with 20.0 mL of 0.275 M HCl?

b. What is the final concentration of the excess reactant in solution?