Stoichiometry Problems

Key

$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$

1. If 90.0 g of sodium are dropped into excess water, how many liters of hydrogen gas would be produced at standard pressure and 22°C assuming all of the sodium reacts?

$2Na + 2H_2O \rightarrow H_2 + 2NaOH$

$90.0g \times \frac{1mol}{22.99g} \times \frac{1H_2}{2Na} = 1.957 moles\ H_2$

$\frac{RT}{P}n = V = \frac{(1.957)(295)(0.0821)}{1.00atm}$

$V = 47.4L\ H_{2(g)}$

$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$

2. If 100.0 g of aluminum is oxidized completely, how many grams of aluminum oxide would be produced?

$4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$

$100.0g\ Al \times \frac{1mol}{26.98} \times \frac{2Al_2O_3}{4Al} \times \frac{101.96g}{mol} = 189.0g$

$189.0g\ Al_2O_{3(s)}$

$SnO_{2(s)} + C_{(s)} \rightarrow Sn_{(s)} + CO_{2(g)}$

3. How many liters of carbon dioxide would be produced at standard pressure and 25 °C for every 1.00 kg of tin produced?

$1.00 \times 10^3 g\ Sn \times \frac{1mol}{118.71} \times \frac{1CO_2}{1Sn} = 8.42 mol\ CO_2$

$V = \frac{nRT}{P} = \frac{(8.42)(0.0821)(298)}{1.00} =$

$206L\ CO_{2(g)}$

$Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$

4. 5.00 grams of copper are placed into 300.0mL of a 0.20M solution of silver nitrate. How many grams of silver are produced? Does any unreacted copper remain?

$5.00g\ Cu \times \frac{1mol}{63.55g} = 0.07868mol - 0.030 = 0.04868 \times 63.55g = 3.09g\ Cu$ remain

$*\ 0.3000L \times 0.2M = 0.060mol \times \frac{2Ag}{2AgNO_3} \times \frac{107.87g}{mol} = 6.472g\ Ag$ produced

$2Fe_{(s)} + 3H_2SO_{4(aq)} \rightarrow Fe_2(SO_4)_{3(aq)} + 3H_{2(g)}$

5. If a balloon is to be filled with 5.0 L of hydrogen at standard pressure and 20 °C, how many mL of 0.3M sulfuric acid are needed and how many grams of iron are needed. (Assume the reaction has a 92% yield).

$n_{H_2} = \frac{PV}{RT} = \frac{(1.00)(5.0)}{(.0821)(293)} = 0.20785_{H_2} \times \frac{3H_2SO_4}{3H_2} = 0.20785_{H_2SO_4}$

$0.20785mol \times \frac{1L}{.3M} = .693L = 693mL\ 100\%$

753mL (92%) H_2SO_4 required.

$2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$

48
39.10
35.45
122.55

6. If 10.0 grams of potassium chlorate are heated until no more oxygen is released, how many grams of potassium chloride will remain in the reaction vessel?

$10.0g \times \frac{1mol}{122.55} \times \frac{2KCl}{2KClO_3} \times 74.55g = 6.08g\ KCl$