Stoichiometry

1.) In the reaction ___ C_2H_6 + ___ O_2 → ___ CO_2 + ___ H_2O
a.) How many oxygen molecules react with 6 mol of C_2H_6?
b.) How many H_2O molecules are produced when 12 mol of C_2H_6 react?
c.) How many moles of oxygen molecules are needed to produce 18 mol of CO_2?
d.) How many moles of CO_2 are produced when 13 mol of C_2H_6 are used up?

2.) In the reaction ___ Fe + ___ H_2O → ___ Fe_3O_4 + ___ H_2
a.) How many molecules of Fe_3O_4 are produced when 12 mol of Fe react?
b.) How many moles of Fe are required to produce 16 mol of H_2?
c.) How many H_2 molecules are made when 40 mol of Fe_3O_4 are produced?
d.) How many moles of H_2O are required to react with 14.5 mol of Fe?

3.) How many moles of H_2O are produced when 9.6 mol of O_2 (g) react according to the equation:
___ H_2 (g) + ___ O_2 (g) → ___ H_2O (g)

4.) Consider the equation ___ I_2 (g) + ___ F_2 (g) → ___ IF_5 (g) + ___ I_4F_2 (g)
a.) How many moles of I_4F_2 (g) are produced by 5.40 mol of F_2 (g)?
b.) How many moles of F_2 (g) are required to produce 4.50 mol of IF_5 (g)?
c.) How many moles of I_2 (g) are required to react with 7.60 mol of F_2 (g)?

5.) A student decomposes some hydrogen peroxide, H_2O_2, according to the following reaction:
___ H_2O_2 → ___ H_2O + ___ O_2
If a total of 0.125 mol of reactants and products are involved in the reaction, how many moles of O_2 are produced

More Stoichoimetry

1.) ___ NH_3 (g) + ___ O_2 (g) → ___ H_2O (g) + ___ NO (g)

a.) What mass of NO (g) is produced when 2.00 g of NH_3 (g) are reacted with excess O_2 (g)?

b.) What mass of H_2O (g) is produced when 4.00 g of O_2 (g) are reacted with excess NH_3 (g)?

c.) What volume of NH_3 (g) at STP is required to react with 3.00 g of O_2?

d.) What volume of NH_3 (g) at STP is required to react with 0.750 g of H_2O (g)?

2.) ___ C_5H_{12} (l) + ___ O_2 (g) → ___ CO_2 (g) + ___ H_2O (g)

a.) What mass of CO_2 (g) is produced when 100.0 g of C_5H_{12} (l) is burned?

b.) What mass of O_2 is required to produce 60.0 g of H_2O (l)?

c.) What mass of C_5H_{12} (l) is required to produce 90.0 g of CO_2 (g) at STP?

d.) What volume of O_2 (g) at STP is required to produce 70.0 g of CO_2 (g)?

e.) What volume of O_2 (g) at STP is required to produce 48.0 g of CO_2 (g)?

f.) What mass of H_2O (l) is made when the burning of C_5H_{12} gives 106 g of CO_2 (g) at STP?

3.) Tetraethyl lead, $Pb(C_2H_5)_4$, is an “antiknock” ingredient which was added to some gasoline. Tetraethyl lead burns according to this equation:

2 $Pb(C_2H_5)_4$ (l) + 27 O_2 (g) → 2 PbO (s) + 16 CO_2 (g) + 20 H_2O (g)

a.) What volume of O_2 (g) at STP is consumed when 100.0 g of PbO (s) are formed?

b.) How many molecules of CO_2 are formed when 1.00×10^{24} molecules of tetraethyl lead are burned?

c.) How many molecules of H_2O are formed when 135 g of O_2 react?

d.) What volume of O_2 (g) at STP, in mL, is required to react with 1.00×10^{23} molecules of tetraethyl lead?

Molarity

1.) A student wants to put 50.0 L of hydrogen gas at STP into a plastic bag by reacting excess aluminum metal with 3.00 M of sodium hydroxide solution according to the reaction below. What volume of NaOH solution is required?

___ Al (s) + ___ NaOH (aq) + ___ H_2O (l) → ___ $NaAlO_2$ (aq) + ___ H_2 (g)

2.) What volume of 0.250 M HCl is required to completely neutralize 25.0 mL of 0.318 M NaOH? (Hint: balance the equation)

3.) A technician analyzes a sample of water from a mine's tailings pond for mercury. After treatment, a 25.0 mL water sample reacts with 15.4 mL of 0.0148 M Cl^- solution.

Hg^{2+} (aq) + 2 Cl^- (aq) → $HgCl_2$ (s)

a.) What is the molar concentration of mercury in the water sample?

b.) What mass of $HgCl_2$ is formed in the reaction?

4.) A 0.10 mL sample of saturated $Ca(OH)_2$ solution reacts with 23.5 mL of 0.0156 M HCl.

a.) What is the molarity of $Ca(OH)_2$ in the saturated solution?

b.) What mass of $Ca(OH)_2$ is dissolved in 250.0 mL of the saturated solution?

5.) A student titrates a 2.00 mL sample of hydrogen peroxide (H_2O_2) solution:

2 MnO_4^- (aq) + 5 H_2O_2 (aq) + 6 H^+ (aq) → 2 Mn^{2+} (aq) + 5 O_2 (g) + 8 H_2O (l)

The solution is labeled as "3.00% by volume" = 1.24 M H_2O_2.

a.) What volume of 0.0496 M MnO_4^- is required for the titration?

b.) What volume of O_2 (g) at STP is produced during the reaction?

6.) A 1.00 mL sample of pure phosphoric acid (H_3PO_4) is titrated with 43.8 mL of 0.853 M NaOH.

___ NaOH + ___ H_3PO_4 → ___ Na_2HPO_4 + ___ H_2O

a.) What is the molar concentration of pure H_3PO_4?

b.) Calculate the density of pure H_3PO_4.

7.) The iron in a sample of iron ore is converted to Fe^{2+} and titrated with dichromate:

$Cr_2O_7^{2-}$ + 6 Fe^{2+} + 14 H^+ → 2 Cr^{3+} + 6 Fe^{3+} + 7 H_2O

A 25.0 mL sample of Fe^{2+} requires 17.6 mL of 0.125 M dichromate.

a.) What is the molarity of Fe^{2+}?

b.) What mass of iron is present in the 25.0 mL sample?

8.) A chemist dissolves 15.5 g of pure NH_4NO_3 and dilutes it to 500.0 mL. They titrate 10.0 mL of this solution, and it requires 25.0 mL of NaOH.

NH_4NO_3 (aq) + NaOH (aq) → NH_3 (g) + H_2O (l) + $NaNO_3$ (aq)

a.) What is the molarity of NaOH they should use?

b.) What volume of NH_3 (g) at STP is produced?

9.) The CO_2 content of a 10.0 L sample of air at STP is determined by bubbling it through 25.0 mL of 0.0538 M $Ba(OH)_2$.

$Ba(OH)_2$ (aq) + CO_2 (g) → $BaCO_3$ (s) + H_2O (l)

a.) How many moles of $Ba(OH)_2$ are present in the solution?

b.) The remaining $Ba(OH)_2$ is titrated with 23.0 mL of 0.104 M HCl. How many moles of $Ba(OH)_2$ remain?

c.) How many moles of $Ba(OH)_2$ reacted with CO_2?

d.) How many moles of CO_2 are in the air sample?

e.) How many litres of CO_2 at STP are in the 10.0 L air sample? What percentage of the air is CO_2?

Diluations

How much concentrated 18 M sulfuric acid is needed to prepare 250 mL of a 6.0 M solution?

How much concentrated 12 M hydrochloric acid is needed to prepare 100 mL of a 2.0 M solution?

To what volume should 25 mL of 15 M nitric acid be diluted to prepare a 3.0 M solution?

To how much water should 50. mL of 12 M hydrochloric acid be added to produce a 4.0 M solution?

To how much water should 100. mL of 18 M sulfuric acid be added to prepare a 1.5 M solution?

Limiting Reagent

1a) What mass of CS_2 is produced when 17.5 g of C are reacted with 39.5 g of SO_2 according to the equation:
$5\ C + 2\ SO_2 \rightarrow CS_2 + 4\ CO$

1b) What mass of the excess reactant will be left over?

2a) What mass of NO is produced when 87.0 g of Cu are reacted with 225 g of HNO_3?
Reaction: $3\ Cu + 8\ HNO_3 \rightarrow 3\ Cu(NO_3)_2 + 2\ NO + 4\ H_2O$

2b) What mass of the excess reactant will be left over?

3a) What mass of P_4 is produced when 41.5 g of $Ca_3(PO_4)_2$, 26.5 g of SiO_2, and 7.80 g of C are reacted?
Equation: $2\ Ca_3(PO_4)_2 + 6\ SiO_2 + 10\ C \rightarrow P_4 + 6\ CaSiO_3 + 10\ CO$

3b) How many grams of each excess reactant will remain unreacted?

4a) What mass of Br_2 is produced when 25.0 g of $K_2Cr_2O_7$, 55.0 g of KBr, and 60.0 g of H_2SO_4 are reacted?
Reaction: $K_2Cr_2O_7 + 6\ KBr + 7\ H_2SO_4 \rightarrow 4\ K_2SO_4 + Cr_2(SO_4)_3 + Br_2 + 7\ H_2O$

4b) How many grams of each excess reactant will remain unreacted?

5. What volume of CO_2 (g) at STP can be made when 0.0250 L of C_5H_{12} (l) (density = ___ g/mL) is reacted with 40.0 L of O_2 (g) at STP?
   Equation: $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$

6. If 50.0 mL of 0.100 M HCl is allowed to react with 30.0 mL of 0.200 M NaOH, which is the reactant in excess?

7. If 0.250 g of $Ba(OH)_2$ is mixed with 15.0 mL of 0.125 M HBr, what mass of $BaBr_2$ can be formed?

Percentage Yield

1.)

The roasting of siderite ore, $FeCO_3$, produces iron(III) oxide:

$4\ FeCO_3 + O_2 \rightarrow 2\ Fe_2O_3 + 4\ CO_2$

A 35.0 g sample of siderite ore produces 22.5 g of Fe_2O_3.

What is the percentage yield of the reaction?

2.)

The reaction $SiO_2 + 4\ HF \rightarrow SiF_4 + 2\ H_2O$ produces 2.50 g of H_2O when 12.20 g of SiO_2 is treated with excess HF.

a) What mass of SiF_4 is formed?

b) What mass of SiO_2 is left unreacted?

c) What is the percentage yield of SiF_4?

3.)

When 5.00 kg of malachite ore containing 4.30% $Cu_2(OH)_2CO_3$ is heated, the product is copper(II) oxide:

$Cu_2(OH)_2CO_3 \rightarrow CO_2 + 2\ CuO + H_2O$

If the reaction has an 84.0% yield, how many grams of CuO are produced?

4.)

A mine produces silver ore named argentite, Ag_2S. The ore is smelted:

$Ag_2S + C + 2\ O_2 \rightarrow 2\ Ag + CO_2 + SO_2$

A 152.6 g sample of pure Ag_2S produces 117.4 g of pure silver.

What is the percentage yield of the smelting process?