Additional examples for exercise 5: Reaction equations and stoichiometry in reaction equations

Example 1:

Write down the chemical formulas for the following ionic compounds (salts):

a) Magnesium sulfate
b) Calcium chloride
a) Potassium fluoride

Example 2:

Balance the following reaction equations:

a) $Al_{(s)} + Cl_{2\,(g)} \rightarrow AlCl_{3\,(s)}$
b) $Ca(OH)_{2\,(aq)} + HBr_{(aq)} \rightarrow CaBr_{2\,(aq)} + H_2O_{(l)}$
a) $N_2O_{5\,(s)} + H_2O_{(l)} \rightarrow HNO_{3\,(l)}$
b) $HCl_{(g)} + CaO_{(s)} \rightarrow CaCl_{2\,(s)} + H_2O_{(g)}$

Example 3:

Write a complete chemical equation for the following reactions described in words:

a) Phosphine $PH_{3\,(g)}$ burns in air to form gaseous water and solid diphosphorus pentoxide.

b) When ammonia gas NH_3 is passed over liquid, hot sodium (metallic), hydrogen is released and a solid of sodium amide $NaNH_2$ is formed.

c) Liquid phosphorus trichloride is added to water and reacts violently to form dissolved hydrochloric acid HCl and phosphoric acid H_3PO_4.

d) Solid potassium nitrate is heated and decomposes to solid potassium nitrite with the formation of oxygen gas.

e) Hydrogen sulfide gas H_2S is passed over solid, hot iron(III) hydroxide, forming solid iron(III) sulfide and gaseous water.

Example 4:

Complete the following reaction equation (add stoichiometric factors!) and describe in words what happens during the reaction:

a) $Al(OH)_{3\,(s)} + HNO_{3\,(aq)} \rightarrow$ _____(aq) + _____(l)

b) $C_2H_5OH_{(l)} + O_{2\,(g)} \rightarrow$ _____(g) + _____(l)

c) $Cu(OH)_{2\,(s)} + HCl_{(aq)} \rightarrow$ _____(aq) + _____(l)

Example 5:

Write a complete chemical equation for the following reactions described in words:

a) Boron sulfide $B_2S_{3\,(s)}$ reacts violently with water to form dissolved boric acid H_3BO_3 and hydrogen sulfide gas H_2S (hydrolysis = splitting of a chemical compound through reaction with water).

b) Metallic copper reacts with hot, concentrated sulfuric acid to form an aqueous solution of copper(II) sulfate and water, as well as gaseous sulfur dioxide.

Example 6:
Write a complete chemical equation for the following reactions described in words:

a) Gaseous cyanic acid HOCN is very unstable and is hydrolyzed in water to form ammonia and gaseous carbon dioxide.

b) If solid mercury(II) nitrate is heated, it decomposes into solid mercury(II) oxide and into gaseous nitrogen dioxide and oxygen.

Example 7:
Complete the following reaction equation (add stoichiometric factors!) and describe in words what happens during the reaction:

a) $C_4H_{10\ (g)} + O_{2\ (g)} \rightarrow$ _____(g) + _____(l)

b) $AgNO_{3\ (aq)} + H_2SO_{4\ (aq)} \rightarrow$ _____(s) + _____(aq)

Example 8:
Complete the following reaction equation (add stoichiometric factors!) and describe the processes during the reaction in words:

a) $CaCl_{2\ (aq)} + Na_3PO_{4\ (aq)} \rightarrow$ _____(s) + _____(aq)

Example 9:

5.38 g Li_3N is reacted with an arbitrary amount of water to form ammonia.

a) Set up the reaction equation

b) What mass of ammonia is formed?

Example 10:

In the synthesis of ammonia, only 6.8 t of ammonia are produced from 45 t of nitrogen. Create the reaction equation and determine the yield.

Example 11:

When burning 22.00 g of propane C_3H_8, 15.0 g of water was collected. What is the percentage of propane that has burned?

Example 12:

A rock consists of 92% magnesium carbonate. Heating produces magnesium oxide and carbon dioxide. Write down the reaction equation. How many tons of magnesium oxide can you get by heating 5 tons of the rock?

Example 13:

A strip of zinc metal weighing 2.00 grams is placed in an aqueous solution of 2.50 grams of silver nitrate.

   a) What reaction takes place? (see exercise)

   b) Which reactant is limiting? (see exercise)

   c) How many g of Ag are formed?

   d) How many g of $Zn(NO_3)_2$ are formed?

   e) What is the mass of excess reactant left at the end of the reaction?

   f) To what percentage has the reaction gone to completion?

Example 14:

Consider the reaction of aluminum with elemental chlorine to form aluminum chloride. A mixture of 4.00 mol Al and 10.0 mol Cl_2 is reacted.

   a) a) Write down the reaction equation. (see exercise)

   b) Which reactant is limiting? (see exercise)

   c) How many mol of $AlCl_3$ are formed?

   d) How many moles of excess reactant are there at the end of the reaction?

   e) How many g of $AlCl_3$ are formed?