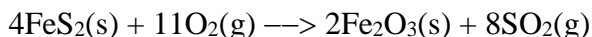1. The ore, iron pyrites, FeS_2, is used in a multi-step process as a source of iron. In the first stage of this process, the ore is roasted to convert the iron(IV) sulfide to iron(III) oxide according to the equation:

$$4FeS_2(s) + 11O_2(g) \longrightarrow 2Fe_2O_3(s) + 8SO_2(g)$$

What is the maximum mass of iron(III) oxide which may be formed from the roasting of 80 tonnes of the ore? (1 tonne = 10^6g)

2. The combustion of propane in air is represented by the equation:

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g)$$
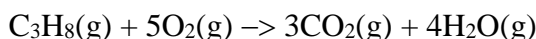
What mass of propane would produce 164 g of carbon dioxide

3. Aspirin, $C_9H_8O_4$, is taken by many people for the relief of headaches or minor pain. It is produced from salicylic acid, $C_7H_6O_3$, and acetic anhydride, $C_4H_6O_3$. The equation is:

$$C_7H_6O_3 + C_4H_6O_3 \longrightarrow C_9H_8O_4 + C_2H_4O_2$$
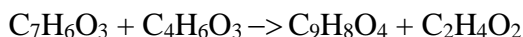
Find the mass of salicylic acid needed to produce 234 g aspirin.

4. The silver used in jewellery and tableware becomes tarnished when exposed to air containing small amounts of hydrogen sulfide. The tarnish is a layer of silver sulfide.

$$4Ag(s) + 2H_2S(g) + O_2(g) \longrightarrow 2Ag_2S(s) + 2H_2O(g)$$
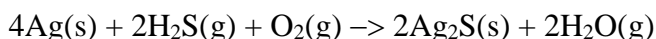
Calculate the mass of the tarnish when 0.055 g of silver is reacted.

5. When sodium is placed on water it reacts violently to produce hydrogen gas and a solution of sodium hydroxide.

    a. Write a balanced chemical equation for this reaction.

    b. If 14.2 g of sodium reacts completely, calculate the mass of gas that would be produced.

    c. What mass of water would react completely with 9.7 g of sodium?

    d. If 1.0 kg of sodium was placed in 400 mL of water, which reactant would be used up first?

6. Sodium and chlorine react according to the following equation:

$$2Na(s) + Cl_2(g) \longrightarrow 2NaCl(s)$$
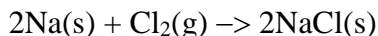
If 15.8 g of sodium and 34.3 g of chlorine are available for reaction, determine:

    a. the limiting reactant
    b. the mass of NaCl formed.

7. In the sealed environment of a space shuttle, canisters of the strong base lithium hydroxide are used to absorb carbon dioxide so that toxic levels do not build up. The reaction is shown in the following equation:

$2LiOH(s) + CO_2(g) \rightarrow Li_2CO_3 (s) + H_2O(l)$
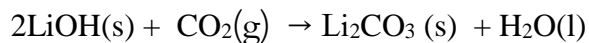
What mass of carbon dioxide can be absorbed by 350 g of lithium hydroxide?

8. 3 A piece of copper wire of mass 3.55 g completely dissolves in a solution of silver nitrate. The balanced full equation for this metal displacement reaction is:

$Cu(s) + 2AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)$
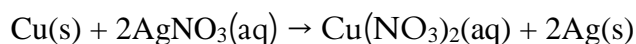
a What mass of copper(II) nitrate will be produced?

b What mass of crystals of pure silver will be produced in this process?

9. When a cake mixture containing bicarb soda, $NaHCO_3$, is baked, the sodium hydrogen carbonate decomposes according to the following equation:

$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$
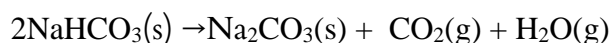
The CO_2 gas produced rises through the mixture, causing the cake to 'rise'. However, if too much bicarb soda is used, the cake will be spoilt because the sodium carbonate produced has a bitter, foul taste.

If 0.85 g of bicarb soda is used:

a What mass of carbon dioxide gas will be produced?

b What mass of sodium carbonate will be produced?

c From your answers to parts a and b, deduce the mass of water vapour that will be produced. State your reasoning.

1. 53222314.7 g = 53.3 t

2. 54.7 g

3. 179.4 g = 179 g

4. 0.063 g

5. a. $2Na(g) + 2H2O(l) \rightarrow H2(g) + 2NaOH(aq)$

   b. 0.617 g

   c. 7.59 g

   d. sodium

6. a. Sodium

   b. 40.2 g

7. 320.8 = 321 g

8. a. 10.5 g

   b. 12.1 g

9. a. 0.22 g

   b. 0.54 g

   c. 0.090 g   (if keeping figures in the calculator, figure is 0.091 g)