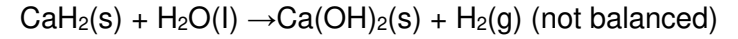
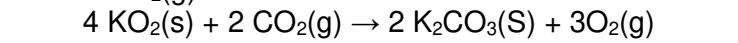
1. The reaction of calcium hydride with water can be used to prepare small quantities of hydrogen gas, as is done to fill weather-observation balloons.



$$CaH_2(s) + H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g) \text{ (not balanced)}$$

   (a) How many grams of water are consumed in the reaction of 56.2 g CaH_2?
   (b) What mass of $CaH_2(s)$ must react with an excess of water to produce 8.12 X 10^{24} molecules of H_2?

2. The reaction of potassium superoxide, KO_2, is used in life-support systems to replace $CO_2(g)$ in expired air with $O_2(g)$.



$$4\ KO_2(s) + 2\ CO_2(g) \rightarrow 2\ K_2CO_3(S) + 3O_2(g)$$

   (a) How many moles of $O_2(g)$ are produced by the reaction of 156 g CO_2 with excess KO_2?
   (b) How many grams of KO_2 are consumed per 100.0 g CO_2 removed from expired air?

3. Ammonia can be generated by heating together the solids NH_4Cl and $Ca(OH)_2$ with $CaCl_2$ and H_2O also being formed. **(a)** If a mixture containing 33.0 g each of NH_4Cl and $Ca(OH)_2$ is heated, how many grams of NH_3 will form? **(b)** Which reactant remains in excess, and in what mass?

4. How many grams of acetic acid must be allowed to react with an excess of PCl_3 to produce 75 g of acetyl chloride (C_2H_3OCl), if the reaction has a 78.2% yield?

$$C_2H_4O_2 + PCl_3 \rightarrow C_2H_3OCl + H_3PO_3 \text{ (not balanced)}$$

5. Azobenzene ($(C_6H_5N)_2$), an intermediate in the manufacture of dyes, can be prepared from nitrobenzene ($C_6H_5NO_2$) by reaction with triethylene glycol ($C_6H_{14}O_4$). In one reaction, 0.10 L of nitrobenzene (*d* = 1.20 g/mL) and 0.30 L of triethylene glycol (*d* = 1.12 g/mL) yields 55 g azobenzene. What are the (a) theoretical yield, (b) actual yield, and (c) percent yield of this reaction?

$$2\ C_6H_5NO_2 + 4\ C_6H_{14}O_4 \rightarrow (C_6H_5N)_2 + 4\ C_6H_{12}O_4 + 4\ H_2O$$

6. Suppose that reactions (a) and (b) have a 92% yield. Starting with 112 g CH_4 in reaction (a) and an excess of $Cl_2(g)$, how many grams of CH_2Cl_2 are formed in reaction (b)?
   (a) $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$
   (b) $CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$