1. Balance the following chemical equations.

$$KO_2 \ (s) + \ H_2O \ (l) \ \rightarrow \ KOH \ (aq) + \ O_2 \ (g) + \ H_2O_2 \ (l)$$

$$Fe_2O_3 \ (s) + \ HNO_3 \ (aq) \ \rightarrow \ Fe(NO_3)_3 \ (aq) + \ H_2O \ (l)$$

$$NH_3 (g) + \ O_2 \ (g) \ \rightarrow \ NO \ (g) + \ H_2O \ (g)$$

$$PCl_5 \ (l) + \ H_2O \ (l) \ \rightarrow \ H_3PO_4 \ (aq) + \ HCl \ (g)$$

$$CaO \ (s) + \ C \ (s) \ \rightarrow \ CaC_2 \ (s) + \ CO_2 \ (g)$$

$$MoS_2 \ (s) + \ O_2 \ (g) \ \rightarrow \ MoO_3 \ (s) + \ SO_2 \ (g)$$

$$FeCO_3 (s) + \ H_2CO_3 \ (aq) \ \rightarrow \ Fe(HCO_3)_2 \ (aq)$$
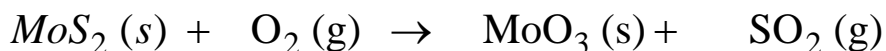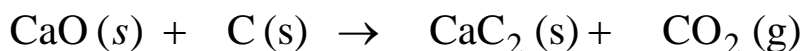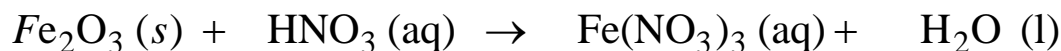
2. Cumene is a hydrocarbon. Combustion of 47.6 mg of cumene produces 42.8 mg of water. The molar mass of cumene is between 115 and 125 g/mol. Determine the empirical and molecular formulas of cumene.

3. Aspirin ($C_9H_8O_4$) is synthesized by reacting salicylic acid ($C_7H_6O_3$) with acetic anhydride ($C_4H_6O_3$). The balanced equation for this reaction is:

$$C_7H_6O_3(aq) + \ C_4H_6O_3 \ (aq) \ \rightarrow \ C_9H_8O_4(s) \ + \ HC_2H_3O_2(aq)$$
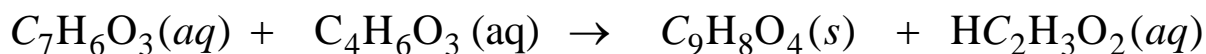
- What mass of acetic anhydride is needed to completely react with 1.00 x 10^2 g of salicylic acid?

- What is the maximum mass of aspirin (theoretical yield) that could be produced in this reaction?

4. Acrylonitrile (C_3H_3N) is the starting material for many synthetic carpets and fabrics. It is produced by the following reaction.

$$2 \ C_3H_6(g) + \ 2 \ NH_3 \ (g) + 3 \ O_2 \ (g) \rightarrow \ 2 \ C_3H_3N(g) \ + \ 6 \ H_2O (g)$$

If 15.0 g of C_3H_6, 10.0 g of O_2, and 5.00 g of NH_3 are reacted, what mass of acrylonitrile can be produced?