STOICHIOMETRY

- study of relative amounts of reactants & products in a chemical reaction.

BALANCE $Al_2O_{3(s)} \longrightarrow Al_{(s)} + O_{2(g)}$
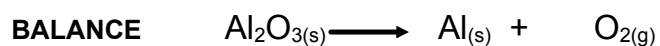
- we can create 6 conversion factors using the above coefficients

- *coefficients represent **# of particles** OR **# of moles** but NOT grams*

EXAMPLES:

1. How many moles of O_2 can be created from 4.76 mol of Al_2O_3?

2. How many moles of Al are formed if 15.3 mol of O_2 are formed?

EXAMPLES:

3. How many grams of oxygen gas are needed to completely react with 7.35 grams of ammonia gas?

$$NH_{3(g)} \; + \quad\quad O_{2(g)} \xrightarrow{\text{Pt}} \quad NO_{(g)} \; + \quad\quad H_2O_{(g)}$$
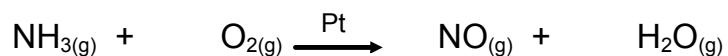
4. Write the balanced equation for the production of ammonia from its elements.

   A) How many molecules of ammonia gas are produced from 3.00 g hydrogen gas?

   B) What mass of nitrogen gas is needed to react with 4.50×10^{25} molecules of hydrogen gas?

5. What mass of carbon dioxide gas is produced if 1.00×10^2 g of C_3H_8 (propane) is burned in an excess of oxygen? What type of reaction is this?

Practice Problems

4. Aluminum bromide can be prepared by reacting small pieces of aluminum foil with liquid bromine at room temperature. The reaction is accompanied by flashes of red light.

$$2Al_{(s)} + 3Br_{2(\ell)} \rightarrow 2AlBr_{3(s)}$$
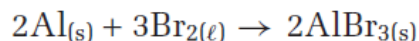
How many moles of Br_2 are needed to produce 5 mol of $AlBr_3$, if sufficient Al is present?

**7.** Magnesium nitride reacts with water to produce magnesium hydroxide and ammonia gas, NH_3 according to the balanced chemical equation

$$Mg_3N_{2(s)} + 6H_2O_{(\ell)} \rightarrow 3Mg(OH)_{2(s)} + 2NH_{3(g)}$$
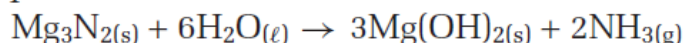
a) How many molecules of water are required to react with 2.3 mol Mg_3N_2?

b) How many molecules of $Mg(OH)_2$ will be expected in part (a)?

9. Nitrogen, N_2, can combine with oxygen, O_2, to form several different oxides of nitrogen. These oxides include NO_2, NO, and N_2O.

(a) How many moles of O_2 are required to react with 9.35×10^{-2} moles of N_2 to form N_2O?

(b) How many moles of O_2 are required to react with 9.35×10^{-2} moles of N_2 to form NO_2?

Practice Problems

15. Powdered zinc reacts rapidly with powdered sulfur in a highly exothermic reaction.

$$8Zn_{(s)} + S_{8(s)} \rightarrow 8ZnS_{(s)}$$
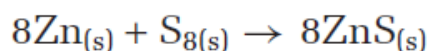
What mass of zinc sulfide is expected when 32.0 g of S_8 reacts with sufficient zinc?

17. Aluminum carbide, Al_4C_3, is a yellow powder that reacts with water to produce aluminum hydroxide and methane.

$$Al_4C_{3(s)} + 12H_2O_{(\ell)} \rightarrow 4Al(OH)_{3(s)} + 3CH_{4(g)}$$
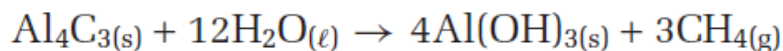
What mass of water is required to react completely with 25.0 g of aluminum carbide?

18. Magnesium oxide reacts with phosphoric acid, H_3PO_4, to produce magnesium phosphate and water.

$$3MgO_{(s)} + 2H_3PO_{4(aq)} \rightarrow Mg_3(PO_4)_{2(s)} + 3H_2O_{(\ell)}$$
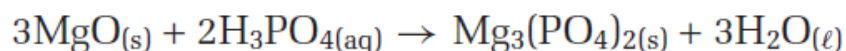
How many grams of magnesium oxide are required to react completely with 33.5 g of phosphoric acid?

Practice Problems

19. Nitrogen gas is produced in an automobile air bag. It is generated by the decomposition of sodium azide, NaN_3.

$$2NaN_{3(s)} \rightarrow 3N_{2(g)} + 2Na_{(s)}$$
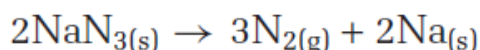
(a) To inflate the air bag on the driver's side of a certain car, 80.0 g of N_2 is required. What mass of NaN_3 is needed to produce 80.0 g of N_2?

(b) How many atoms of Na are produced when 80.0 g of N_2 are generated in this reaction?

20. The reaction of iron(III) oxide with powdered aluminum is known as the thermite reaction.

$$2Al_{(s)} + Fe_2O_{3(s)} \rightarrow Al_2O_{3(s)} + 2Fe_{(\ell)}$$
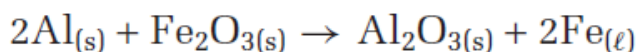
(a) Calculate the mass of aluminum oxide, Al_2O_3, that is produced when 1.42×10^{24} atoms of Al react with Fe_2O_3.

(b) How many formula units of Fe_2O_3 are needed to react with 0.134 g of Al?