15. Consider the generic chemical reaction:

$$A + 2\,B \longrightarrow C$$

How many moles of C are formed upon complete reaction of:

(a) 2 mol of A
(b) 2 mol of B
(c) 3 mol of A
(d) 3 mol of B

17. For the reaction shown, calculate how many moles of NO_2 form when each amount of reactant completely reacts.

$$2\,N_2O_5(g) \longrightarrow 4\,NO_2(g) + O_2(g)$$

(a) 1.3 mol N_2O_5
(b) 5.8 mol N_2O_5
(c) 4.45×10^3 mol N_2O_5
(d) 1.006×10^{-3} mol N_2O_5

21. For each reaction, calculate how many moles of product form when 1.75 mol of the reactant in color completely reacts. Assume there is more than enough of the other reactant.

(a) $H_2(g) + Cl_2(g) \longrightarrow 2\,HCl(g)$
(b) $2\,H_2(g) + O_2(g) \longrightarrow 2\,H_2O(l)$
(c) $2\,Na(s) + O_2(g) \longrightarrow Na_2O_2(s)$
(d) $2\,S(s) + 3\,O_2(g) \longrightarrow 2\,SO_3(g)$

23. For the reaction shown, calculate how many moles of each product form when the given amount of each reactant completely reacts. Assume there is more than enough of the other reactant.

$$2\,PbS(s) + 3\,O_2(g) \longrightarrow 2\,PbO(s) + 2\,SO_2(g)$$

(a) 2.4 mol PbS
(b) 2.4 mol O_2
(c) 5.3 mol PbS
(d) 5.3 mol O_2

25. Consider the balanced equation:

$$2\,N_2H_4(g) + N_2O_4(g) \longrightarrow 3\,N_2(g) + 4\,H_2O(g)$$

Complete the table with the appropriate number of moles of reactants and products. If the number of moles of a reactant is provided, fill in the required amount of the other reactant, as well as the moles of each product formed. If the number of moles of a product is provided, fill in the required amount of each reactant to make that amount of product, as well as the amount of the other product that is made.

mol N_2H_4	mol N_2O_4	mol N_2	mol H_2O
____	2	____	____
6	____	____	____
____	____	____	8
____	5.5	____	____
3	____	____	____
____	____	12.4	____

27. Consider the unbalanced equation for the combustion of butane:

$$C_4H_{10}(g) + O_2(g) \longrightarrow CO_2(g) + H_2O(g)$$

Balance the equation and determine how many moles of O_2 are required to react completely with 4.9 mol of C_4H_{10}.

31. For the reaction shown, calculate how many grams of oxygen form when each quantity of reactant completely reacts.

$$2\,HgO(s) \longrightarrow 2\,Hg(l) + O_2(g)$$

(a) 2.13 g HgO
(b) 6.77 g HgO
(c) 1.55 kg HgO
(d) 3.87 mg HgO

35. For the reaction shown, calculate how many grams of each product form when the given amount of each reactant completely reacts to form products. Assume there is more than enough of the other reactant.

$$2\,Al(s) + Fe_2O_3(s) \longrightarrow Al_2O_3(s) + 2\,Fe(l)$$

(a) 4.7 g Al
(b) 4.7 g Fe_2O_3

37. Consider the balanced equation for the combustion of methane, a component of natural gas:

$$CH_4(g) + 2\,O_2(g) \longrightarrow CO_2(g) + 2\,H_2O(g)$$

Complete the table with the appropriate masses of reactants and products. If the mass of a reactant is provided, fill in the mass of other reactants required to completely react with the given mass, as well as the mass of each product formed. If the mass of a product is provided, fill in the required masses of each reactant to make that amount of product, as well as the mass of the other product that forms.

Mass CH_4	Mass O_2	Mass CO_2	Mass H_2O
____	2.57 g	____	____
22.32 g	____	____	____
____	____	____	11.32 g
____	____	2.94 g	____
3.18 kg	____	____	____
____	____	2.35×10^3 kg	____

43. Consider the generic chemical equation:

$$2\,A + 4\,B \longrightarrow 3\,C$$

What is the limiting reactant when each of the initial quantities of A and B is allowed to react?

(a) 2 mol A; 5 mol B
(b) 1.8 mol A; 4 mol B
(c) 3 mol A; 4 mol B
(d) 22 mol A; 40 mol B

45. Determine the theoretical yield of C when each of the initial quantities of A and B is allowed to react in the generic reaction:

$$A + 2\,B \longrightarrow 3\,C$$

(a) 1 mol A; 1 mol B
(b) 2 mol A; 2 mol B
(c) 1 mol A; 3 mol B
(d) 32 mol A; 68 mol B

49. For the reaction shown, calculate the theoretical yield of product in moles for each of the initial quantities of reactants.

$$2\,Mn(s) + 3\,O_2(g) \longrightarrow 2\,MnO_3(s)$$

(a) 2 mol Mn; 2 mol O_2
(b) 4.8 mol Mn; 8.5 mol O_2
(c) 0.114 mol Mn; 0.161 mol O_2
(d) 27.5 mol Mn; 43.8 mol O_2

51. Consider the generic reaction between reactants A and B:

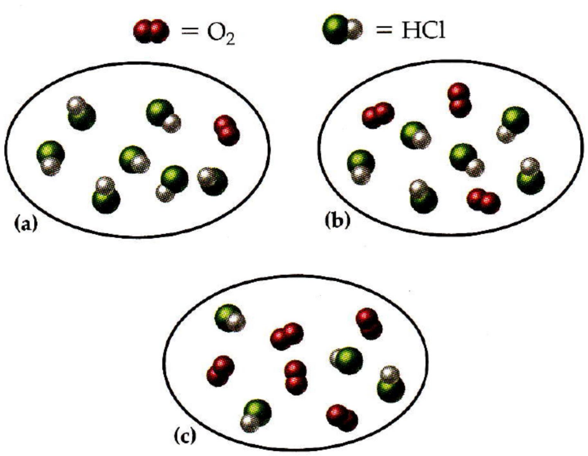
$$3\,A + 4\,B \longrightarrow 2\,C$$

If a reaction vessel initially contains 9 mol A and 8 mol B, how many moles of A, B, and C will be in the reaction vessel after the reactants have reacted as much as possible? (Assume 100% actual yield.)

53. Consider the reaction:

$$4\,HCl(g) + O_2(g) \longrightarrow 2\,H_2O(g) + 2\,Cl_2(g)$$

Each molecular diagram represents an initial mixture of the reactants. How many molecules of Cl_2 are formed by complete reaction in each case? (Assume 100% actual yield.)



57. For the reaction shown, calculate the theoretical yield of the product in grams for each of the initial quantities of reactants.

$$2\,Al(s) + 3\,Cl_2(g) \longrightarrow 2\,AlCl_3(s)$$

(a) 1.0 g Al; 1.0 g Cl_2
(b) 5.5 g Al; 19.8 g Cl_2
(c) 0.439 g Al; 2.29 g Cl_2

61. Consider the reaction between calcium oxide and carbon dioxide:

$$CaO(s) + CO_2(g) \longrightarrow CaCO_3(s)$$

A chemist allows 14.4 g of CaO and 13.8 g of CO_2 to react. When the reaction is finished, the chemist collects 19.4 g of $CaCO_3$. Determine the limiting reactant, theoretical yield, and percent yield for the reaction.

65. Lead ions can be precipitated from solution with NaCl according to the reaction:

$$Pb^{2+}(aq) + 2\,NaCl(aq) \longrightarrow PbCl_2(s) + 2\,Na^+(aq)$$

When 135.8 g of NaCl are added to a solution containing 195.7 g of Pb^{2+}, a $PbCl_2$ precipitate forms. The precipitate is filtered and dried and found to have a mass of 252.4 g. Determine the limiting reactant, theoretical yield of $PbCl_2$, and percent yield for the reaction.

69. Classify each process as exothermic or endothermic and indicate the sign of ΔH_{rxn}.

(a) butane gas burning in a lighter
(b) the reaction that occurs in the chemical cold packs used to ice athletic injuries
(c) the burning of wax in a candle

71. Consider the generic reaction:

$$A + 2\,B \longrightarrow C \qquad \Delta H_{rxn} = -55\text{ kJ}$$

Determine the amount of heat emitted when each amount of reactant completely reacts (assume that there is more than enough of the other reactant).

(a) 1 mol A
(b) 2 mol A
(c) 1 mol B
(d) 2 mol B

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73. Consider the equation for the combustion of acetone (C_3H_6O), the main ingredient in nail polish remover:

$$C_3H_6O(l) + 4\,O_2(g) \longrightarrow 3\,CO_2(g) + 3\,H_2O(g) \qquad \Delta H_{rxn} = -1790\text{ kJ}$$

If a bottle of nail polish remover contains 155 g of acetone, how much heat is released by its complete combustion?