16. Consider the generic chemical reaction: \[2A + 3B \rightarrow 3C\]

How many moles of B are required to completely react with:

(a) 6 mol of A \[\text{9 mol B}\]
(b) 2 mol of A \[\text{3 mol B}\]
(c) 7 mol of A \[\text{10.5 mol B}\]
(d) 11 mol of A \[\text{16.5 mol B}\]

18. For the reaction shown, calculate how many moles of NH\(_3\) form when each amount of reactant completely reacts.

\[3 \text{ N}_2\text{H}_4(l) \rightarrow 4 \text{ NH}_3(g) + \text{N}_2(g)\]

(a) 5.3 mol N\(_2\)H\(_4\) \[\text{7.1 mol NH}_3\]
(b) 2.28 mol N\(_2\)H\(_4\) \[\text{3.04 mol NH}_3\]
(c) 5.8\times10^{-2} \text{ mol N}_2\text{H}_4 \[\text{7.7\times10^{-2} mol NH}_3\]
(d) 9.76\times10^7 \text{ mol N}_2\text{H}_4 \[\text{1.30\times10^8 mol NH}_3\]

22. For each reaction, calculate how many moles of the product form when 0.112 mol of the reactant in bold completely reacts. Assume there is more than enough of the other reactant.

(a) \[\text{2 Ca(s) + O}_2(g) \rightarrow 2\text{ CaO(s)}\] \[0.112 \text{ mol CaO}\]
(b) \[\text{4 Fe(s) + 3 O}_2(g) \rightarrow 2\text{ Fe}_2\text{O}_3(s)\] \[0.0747 \text{ mol Fe}_2\text{O}_3\]
(c) \[\text{4 Li(s) + O}_2(g) \rightarrow 2\text{ Li}_2\text{O(s)}\] \[0.0560 \text{ mol Li}_2\text{O}\]
(d) \[\text{4 Al(s) + 3 O}_2(g) \rightarrow 2\text{ Al}_2\text{O}_3(s)\] \[0.0560 \text{ mol Al}_2\text{O}_3\]

24. Propane, C\(_3\)H\(_8\), burns in air. Write a balanced chemical equation and 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.

(a) 4.6 mol C\(_3\)H\(_8\) \[14 \text{ mol CO}_2 \text{ and } 18 \text{ mol H}_2\text{O}\]
(b) 4.6 mol O\(_2\) \[2.8 \text{ mol CO}_2 \text{ and } 3.68 \text{ mol H}_2\text{O}\]
(c) 0.0558 mol C\(_3\)H\(_8\) \[0.167 \text{ mol CO}_2 \text{ and } 0.223 \text{ mol H}_2\text{O}\]
(d) 0.0558 mol O\(_2\) \[0.0335 \text{ mol CO}_2 \text{ and } 0.0446 \text{ mol H}_2\text{O}\]

27. Butane, C\(_4\)H\(_{10}\), burns in air. Write a balanced chemical equation and determine how many moles of O\(_2\) are required to react completely with 4.9 mol of butane.

32 mol O\(_2\)

28. Acetic acid reacts with calcium hydroxide. Write a balanced chemical equation and determine how many moles of calcium hydroxide are required to completely neutralize 1.07 mol of acetic acid.

0.535 mol Ca(OH\(_2\))
29. Lead reacts with an aqueous solution of silver nitrate. Atoms of lead are converted into lead(II) ions.
   (a) Write a balanced chemical equation.
   (b) How many moles of silver nitrate are required to completely react with 9.3 mol of lead? 19 mol AgNO₃
   (c) How many moles of silver are formed by the complete reaction of 28.4 mol of lead? 56.8 mol Ag

30. Aluminum reacts with sulfuric acid.
   (a) Write a balanced chemical equation.
   (b) How many moles of sulfuric acid are required to completely react with 8.3 mol of aluminum? 12.5 mol H₂SO₄
   (c) How many moles of hydrogen gas are formed by the complete reaction of 0.341 mol of aluminum? 0.512 mol H₂

46. Determine the theoretical yield of C when each of the initial quantities of A and B is allowed to react in the generic reaction:
   \[ 2 \text{A} + 3 \text{B} \rightarrow 2 \text{C} \]
   (a) 2 mol A; 4 mol B 2 mol C
   (b) 3 mol A; 3 mol B 2 mol C
   (c) 5 mol A; 6 mol B 4 mol C
   (d) 4 mol A; 5 mol B 3.3 mol C

51. Consider the generic reaction between reactants A and B:
   \[ 3 \text{A} + 4 \text{B} \rightarrow 2 \text{C} \]
   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 once the reactants have reacted as much as possible? (Assume 100% actual yield.) 3 mol A; 0 mol B; 4 mol C

52. Consider the reaction between reactants S and O₂:
   \[ 2 \text{S(s)} + 3 \text{O}_2(g) \rightarrow 2\text{SO}_3(g) \]
   If a reaction vessel initially contains 5.0 mol S and 9.0 mol O₂, how many moles of S, O₂, and SO₃ will be in the reaction vessel once the reactants have reacted as much as possible? (Assume 100% actual yield.) 0 mol S; 1.5 mol O₂; 5.0 mol SO₃