Section 4.2: Synthesis and Decomposition Reactions

Tutorial 1 Practice, page 157
1. (a) Step 1. Identify the reactants.
   Ca     Br₂

   **Step 2.** Identify the type of reaction.
The reactants fit the pattern of a synthesis reaction.
A + B → AB
Ca + Br₂ → CaₓBrᵧ

   **Step 3.** Use the ionic charges of the reactants to predict the formula of the product.
   Ionic charges: Ca²⁺ Br⁻
   Product: CaBr₂
   Skeleton equation: Ca + Br₂ → CaBr₂

   **Step 4.** Balance the chemical equation and write the balanced chemical equation, including state symbols.
The balanced chemical equation is: Ca(s) + Br₂(l) → CaBr₂(s)

(b) Step 1. Identify the reactants.
Al     O₂

   **Step 2.** Identify the type of reaction.
The reactants fit the pattern of a synthesis reaction.
A + B → AB
Al + O₂ → AlₓOᵧ

   **Step 3.** Use the ionic charges of the reactants to predict the formula of the product.
   Ionic charges: Al³⁺ O²⁻
   Product: Al₂O₃
   Skeleton equation: Al + O₂ → Al₂O₃

   **Step 4.** Balance the chemical equation and write the balanced chemical equation, including state symbols.
The balanced chemical equation is: 4 Al(s) + 3 O₂(g) → 2 Al₂O₃(s)

Section 4.2 Questions, page 161
1. (a) The reaction is a synthesis reaction because two simple reactants, Al and Br₂, combine to make a more complex compound, and this fits the pattern A + B → AB.

(b) The reaction is a decomposition reaction because a complex compound, HCl, breaks down into two simpler products, H₂ and Cl₂, and this fits the pattern AB → A + B.

(c) The reaction is a synthesis reaction because two simple reactants, CaO and H₂O, combine to make a more complex compound, Ca(OH)₂, and this fits the pattern A + B → AB.

(d) The reaction is a synthesis reaction because two simple reactants, P₄ and O₂, combine to make a more complex compound, P₂O₅, and this fits the pattern A + B → AB.

2. (a) The product of the reaction is ZnS.
The balanced chemical equation is: Zn + S → ZnS

(b) The products of the reaction are Ca and Cl₂.
The balanced chemical equation is: CaCl₂ → Ca + Cl₂
(c) The product of the reaction is NH₄Cl.
The balanced chemical equation is: NH₃ + HCl → NH₄Cl
(d) The products of the reaction are K and O₂.
The balanced chemical equation is: 2 K₂O → 4 K + O₂
(e) The products of the reaction are Al and Cl₂.
The balanced chemical equation is: 2 AlCl₃ → 2 Al + 3 Cl₂
(f) The products of the reaction are H₂O and MgO.
The balanced chemical equation is: Mg(OH)₂ → H₂O + MgO

3. (a) The gas that causes the splint to relight is oxygen.
(b) The reaction is a decomposition reaction.
(c) 2 H₂O₂(aq) → 2 H₂O(l) + O₂(g)
4. (a) 4 Al(s) + 3 O₂(g) → 2 Al₂O₃(s)
(b) CuCO₃(s) → CuO(s) + CO₂(g)
(c) 2 NI₃(s) → N₂(g) + 3 I₂(g)
5. Photosynthesis is similar to the synthesis reactions since small compounds (water and carbon dioxide) combine to form a more complex compound, glucose. However, photosynthesis does not follow the A + B → AB pattern completely since oxygen is also produced.
6. (a) S(s) + O₂(g) → SO₂(g)
(b) 2 SO₂(g) + O₂(g) → 2 SO₃(g)
(c) SO₃(g) + H₂O(l) → H₂SO₄(aq)
7. (a) The gas produced is carbon dioxide since it turns limewater cloudy.
(b) 2 NaHCO₃(s) → Na₂CO₃(s) + H₂O(g) + CO₂(g)
8. (a) The reaction in the test tube is a decomposition reaction since at least two products are produced from heating the red solid.
(b) The gaseous product is oxygen since it relights a glowing splint.
(c) The metal is mercury.
(d) The red solid compound is mercury(II) oxide, HgO.
(e) 2 HgO(s) → 2 Hg(l) + O₂(g)
9. (a) 2 NaN₃(s) → 3 N₂(g) + 2 Na(g)
(b) Answers may vary. Sample answer: Automotive airbags are designed to slow the forward momentum of the car’s occupants, preventing them from crashing into the windshield during a collision. The mandatory use of airbags has significantly reduced the number of fatalities and serious injuries in automobile accidents. However, airbags are designed for an average male occupant. Consequently, children should not sit in the front seat. Many children and short adults have been seriously injured as a result of airbag inflations.
10. Answers may vary. Sample answer:

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>• The use of old tires as fuel reduces the amount of fossil fuels required by kilns.</td>
<td>• The combustion of tires may release pollutants into the environment, particularly when the combustion temperature is not high enough.</td>
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<tr>
<td>• This practice helps reduce large stockpiles of tires.</td>
<td>• Destroying the tires prevents them from being recycled into useful products.</td>
</tr>
<tr>
<td>• Large stockpiles of tires are a potential fire hazard.</td>
<td>• The destruction of tires also promotes a “use and throw away” lifestyle.</td>
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