Representing Enthalpy Changes, Extra Exercises

1. Iron(II) sulfide ore is roasted according to the following chemical equation.

$4\ FeS_{(s)} + 7\ O_{2(g)} \rightarrow 2\ Fe_2O_{3(s)} + 4\ SO_{2(g)} \qquad \Delta H_c = -2456\ kJ$

(a) Rewrite this chemical equation including the energy as a term in the balanced equation.

(b) What is the molar enthalpy for iron(II) sulfide in this reaction?

(c) What is the molar enthalpy for iron(III) oxide in this reaction?

2. Boron reacts with hydrogen to form diboron hexahydride (diborane) gas. The molar enthalpy of reaction for boron is +15.7 kJ/mol.

(a) Write the balanced chemical equation using whole number coefficients and including the energy change as a ΔH_r.

(b) Write the balanced chemical equation using whole number coefficients and including the energy change as a term in the balanced equation.

3. The molar enthalpy of combustion for octane, $C_8H_{18(l)}$, is reported to be –1.3 MJ/mol.

(a) Write the balanced chemical equation using whole number coefficients and including the energy change as a ΔH_r.

(b) Write the balanced chemical equation using whole number coefficients and including the energy change as a term in the balanced equation.

(continued)

4. Draw potential energy diagrams to communicate the following chemical reactions. Assume SATP conditions.
   (a) the formation of chromium(III) oxide
   (b) the simple decomposition of silver iodide
   (c) the formation of carbon disulfide

Representing Enthalpy Changes, Extra Exercises, Solution

1. Iron(II) sulfide ore is roasted according to the following chemical equation.

   $4\ FeS_{(s)} + 7\ O_{2(g)} \rightarrow 2\ Fe_2O_{3(s)} + 4\ SO_{2(g)} \qquad \Delta H_c = -2456\ kJ$

   (a) Rewrite this chemical equation including the energy as a term in the balanced equation.

   $4\ FeS_{(s)} + 7\ O_{2(g)} \rightarrow 2\ Fe_2O_{3(s)} + 4\ SO_{2(g)} + 2456\ kJ$

   (b) What is the molar enthalpy for iron(II) sulfide in this reaction?

   $$H_{c\ FeS} = \frac{-2456\ kJ}{4\ mol} = -614\ kJ/mol$$

   (c) What is the molar enthalpy for iron(III) oxide in this reaction?

   $$H_{c\ Fe_2O_3} = \frac{-2456\ kJ}{2\ mol} = -1228\ kJ/mol$$

2. Boron reacts with hydrogen to form diboron hexahydride (diborane) gas. The molar enthalpy of reaction for boron is 115.7 kJ/mol.

   (a) Write the balanced chemical equation using whole number coefficients and including the energy change as a ΔH_r.

   $2\ B_{(s)} + 3\ H_{2(g)} \rightarrow B_2H_{6(g)} \quad \Delta H_r = 2\ mol \times +15.7\ kJ/mol = +31.4\ kJ$

   (b) Write the balanced chemical equation using whole number coefficients and including the energy change as a term in the balanced equation.

   $2\ B_{(s)} + 3\ H_{2(g)} + 31.4\ kJ \rightarrow B_2H_{6(g)}$

3. The molar enthalpy of combustion for octane, $C_8H_{18(l)}$, is reported to be –1.3 MJ/mol.

   (a) Write the balanced chemical equation using whole number coefficients and including the energy change as a ΔH_r.

   $2\ C_8H_{18(l)} + 25\ O_{2(g)} \rightarrow 16\ CO_{2(g)} + 18\ H_2O_{(g)}$

   $\Delta H_r = 2\ mol \times -1.3\ MJ/mol = -2.6\ MJ$

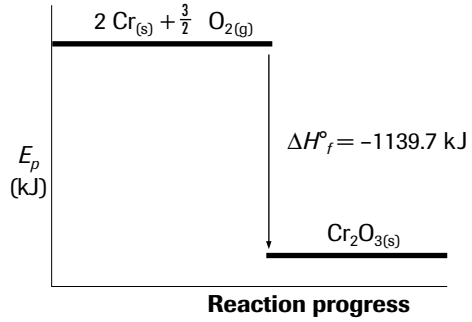
   (b) Write the balanced chemical equation using whole number coefficients and including the energy change as a term in the balanced equation.

   $2\ C_8H_{18(l)} + 25\ O_{2(g)} \rightarrow 16\ CO_{2(g)} + 18\ H_2O_{(g)} + 2.6\ MJ$

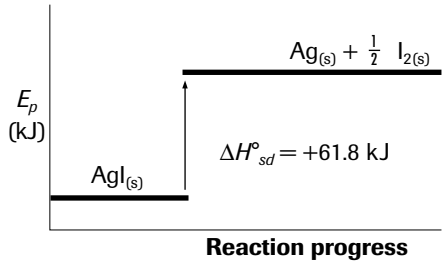
(continued)

4. Draw potential energy diagrams to communicate the following chemical reactions. Assume SATP conditions.
   (a) the formation of chromium(III) oxide
   (b) the simple decomposition of silver iodide
   (c) the formation of carbon disulfide

(a) The Formation of Chromium(III) Oxide



(b) The Simple Decomposition of Silver Iodide



(c) The Formation of Carbon Disulfide