**2 PLAN**

Combine the given equations according to Hess's law. We need $C_5H_{12}$ as a product, so we reverse the equation for combustion of $C_5H_{12}$ and the sign for $\Delta H_c^0$. Multiply the equation for formation of $CO_2$ by 5 to give 5C as a reactant. Multiply the equation for formation of $H_2O$ by 6 to give $6H_2$ as a reactant.

**3 COMPUTE**

$$5C(s) + \cancel{5O_2(g)} \longrightarrow \cancel{5CO_2(g)} \qquad \Delta H^0 = 5(-393.5\ kJ)$$

$$6H_2(g) + \cancel{3O_2(g)} \longrightarrow \cancel{6H_2O(l)} \qquad \Delta H^0 = 6(-285.8\ kJ)$$

$$\cancel{5CO_2(g)} + \cancel{6H_2O(l)} \longrightarrow C_5H_{12}(g) + \cancel{8O_2(g)} \qquad \Delta H^0 = +3535.6\ kJ$$

$$5C(s) + 6H_2(g) \longrightarrow C_5H_{12}(g) \qquad \Delta H_f^0 = -146.7\ kJ$$

**4 EVALUATE**

The unnecessary reactants and products cancel to give the correct equation.

## PRACTICE

*Answers in Appendix E*

1. Calculate the enthalpy of formation of butane, $C_4H_{10}$, using the balanced chemical equation and information in Appendix Table A-5 and Table A-14. Write out the solution according to Hess's law.
2. Calculate the enthalpy of combustion of 1 mol of nitrogen, $N_2$, to form $NO_2$ using the balanced chemical equation and Appendix Table A-14.
3. Calculate the enthalpy of formation for sulfur dioxide, $SO_2$, from its elements, sulfur and oxygen. Use the balanced chemical equation and the following information.

$$S(s) + \tfrac{3}{2}O_2(g) \longrightarrow SO_3(g) \qquad \Delta H_c^0 = -395.2\ kJ$$

$$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g) \qquad \Delta H^0 = -198.2\ kJ$$

**extension**

Go to **go.hrw.com** for more problems that ask you to calculate enthalpies of formation and combustion.

Keyword: HC6NRGX

## SECTION REVIEW

1. What is meant by enthalpy change?
2. What is meant by enthalpy of reaction?
3. Describe the relationship between a compound's stability and its enthalpy of formation.
4. What is the importance of Hess's law to thermodynamic calculations?
5. How much energy would be absorbed as heat by 75 g of iron when heated from 295 K to 301 K?

### Critical Thinking

6. **INTEGRATING CONCEPTS** Isooctane ($C_8H_{18}$) is a major component of gasoline.
   a. Using the following thermodynamic data, calculate the change in enthalpy for the combustion of 1.0 mol of isooctane.

   $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)\ \Delta H^0 = -241.8\ kJ$;
   $C(s) + O_2(g) \longrightarrow CO_2(g)\ \Delta H^0 = -393.5\ kJ$;
   $8C(s) + 9H_2(g) \longrightarrow C_8H_{18}(l)\ \Delta H^0 = -224.13\ kJ$.

   b. One gallon of isooctane has a mass of 2.6 kg. What is the change in enthalpy for the combustion of one gallon of this compound?