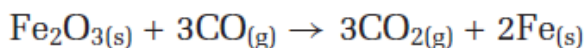


## Sample Problem

### Using Enthalpies of Formation

#### Problem

Iron(III) oxide reacts with carbon monoxide to produce elemental iron and carbon dioxide. Determine the enthalpy change of this reaction, using known enthalpies of formation.



#### What Is Required?

You need to find  $\Delta H^\circ$  of the given chemical equation, using  $\Delta H^\circ_f$  data.

#### What Is Given?

From Appendix E, you can obtain the enthalpies of formation.

$$\Delta H^\circ_f \text{ of } \text{Fe}_2\text{O}_{3(s)} = -824.2 \text{ kJ/mol}$$

$$\Delta H^\circ_f \text{ of } \text{CO}_{(g)} = -110.5 \text{ kJ/mol}$$

$$\Delta H^\circ_f \text{ of } \text{CO}_{2(g)} = -393.5 \text{ kJ/mol}$$

$$\Delta H^\circ_f \text{ of } \text{Fe}_{(s)} = 0 \text{ kJ/mol (by definition)}$$

#### Plan Your Strategy

Multiply each  $\Delta H^\circ_f$  value by its molar coefficient from the balanced chemical equation. Substitute into the following equation, and then solve.

$$\Delta H^\circ = \Sigma(n\Delta H^\circ_f \text{ products}) - \Sigma(n\Delta H^\circ_f \text{ reactants})$$

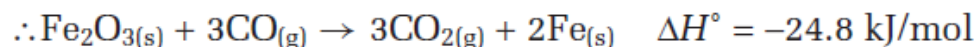
#### Act on Your Strategy

$$\Delta H^\circ = \Sigma(n\Delta H^\circ_f \text{ products}) - \Sigma(n\Delta H^\circ_f \text{ reactants})$$

$$= [3(\Delta H^\circ_f \text{ CO}_{2(g)}) + 2(\Delta H^\circ_f \text{ Fe}_{(s)})] - [(\Delta H^\circ_f \text{ Fe}_2\text{O}_{3(s)}) + 3(\Delta H^\circ_f \text{ CO}_{(g)})]$$

$$= [(-393.5 \text{ kJ/mol}) + 2(0 \text{ kJ/mol})] - [(-824.2 \text{ kJ/mol}) + 3(-110.5 \text{ kJ/mol})]$$

$$= -24.8 \text{ kJ/mol}$$



#### Check Your Solution

A balanced chemical equation was used in the calculation. The number of significant digits is correct. The units are also correct.