For more help, go to the Math Tutor at the end of this chapter.

How much energy is absorbed when 47.0 g of ice melts at STP? How much energy is absorbed when this same mass of liquid water boils?

SOLUTION

1 ANALYZE

Given: mass of $H_2O(s)$ = 47.0 g; mass of $H_2O(l)$ = 47.0 g; molar enthalpy of fusion of ice = 6.009 kJ/mol; molar enthalpy of vaporization = 40.79 kJ/mol

Unknown: energy absorbed when ice melts; energy absorbed when liquid water boils

2 PLAN

First, convert the mass of water from grams to moles.

$$47.0 \text{ g } H_2O \times \frac{1 \text{ mol } H_2O}{18.02 \text{ g } H_2O} = 2.61 \text{ mol } H_2O$$

Then, use the molar enthalpy of fusion of a solid to calculate the amount of energy absorbed when the solid melts. Multiply the number of moles by the amount of energy needed to melt one mole of ice at its melting point (the molar enthalpy of fusion of ice). Using the same method, calculate the amount of energy absorbed when water boils by using the molar enthalpy of vaporization.

amount of substance (mol) × molar enthalpy of fusion or vaporization (kJ/mol) = energy (kJ)

3 COMPUTE

2.61 mol × 6.009 kJ/mol = 15.7 kJ (on melting)

2.61 mol × 40.79 kJ/mol = 106 kJ (on vaporizing or boiling)

4 EVALUATE

Units have canceled correctly. The answers have the proper number of significant digits and are reasonably close to estimated values of 18 (3 × 6) and 120 (3 × 40), respectively.

PRACTICE

Answers in Appendix E

1. What quantity of energy is released when 506 g of liquid water freezes?

2. What mass of steam is required to release 4.97×10^5 kJ of energy on condensation?

extension

Go to **go.hrw.com** for more practice problems that ask you to use enthalpies to calculate energies absorbed or released.

Keyword: HC6STMX

SECTION REVIEW

1. Why is a water molecule polar?

2. How is the structure of water responsible for some of water's unique characteristics?

3. Describe the arrangement of molecules in liquid water and in ice.

4. Why does ice float? Why is this phenomenon important?

5. Why is ice less dense than liquid water?

6. Is more energy required to melt one gram of ice at 0°C or to boil one gram of water at 100°C? How do you know?

Critical Thinking

7. **RELATING IDEAS** Why is exposure to steam dangerous?