# Math Tutor CALCULATIONS USING ENTHALPIES OF FUSION

When one mole of a liquid freezes to a solid, energy is released as attractive forces between particles pull the disordered particles of the liquid into a more orderly crystalline solid. When the solid melts to a liquid, the solid must absorb the same quantity of energy in order to separate the particles of the crystal and overcome the attractive forces opposing separation. This quantity of energy used to melt or freeze one mole of a substance at its melting point is called its molar enthalpy of fusion, $\Delta H_f$.

## Problem-Solving TIPS

- The enthalpy of fusion of a substance can be given as either joules per gram or kilojoules per mole.
- *Molar* enthalpy of fusion is most commonly used in calculations.
- The enthalpy of fusion is the energy absorbed or given off as heat when a substance melts or freezes at the melting point of the substance.
- No net change in temperature occurs as the state change occurs.

## SAMPLE 1

**7.30 kJ of energy is required to melt 0.650 mol of ethylene glycol ($C_2H_6O_2$) at its melting point. Calculate the molar enthalpy of fusion, $\Delta H_f$, of ethylene glycol and the energy absorbed.**

molar enthalpy of fusion = $\Delta H_f$ =

$$\frac{\text{energy absorbed}}{\text{moles of substance}}$$

$$\Delta H_{f,\text{ethylene glycol}} = \frac{7.30\ \text{kJ}}{0.065\ \text{mol}} = 11.2\ \frac{\text{kJ}}{\text{mol}}$$

## SAMPLE 2

**Determine the quantity of energy that will be needed to melt $2.50 \times 10^5$ kg of iron at its melting point, 1536°C. The $\Delta H_f$ of iron is 13.807 kJ/mol.**

To calculate the number of moles of iron, use the equation below.

$$\text{moles of substance} = \frac{\text{mass of substance}}{\text{molar mass of substance}}$$

Next, use the following equation for energy as heat absorbed.

energy absorbed = $\Delta H_f \times$ moles of substance

Now, substitute the calculation for moles of substance, and solve.

energy absorbed =

$$\Delta H_f \times \frac{\text{grams of substance}}{\text{molar mass of substance}} =$$

$$13.807\ \frac{\text{kJ}}{\text{mol}} \times \frac{2.50 \times 10^8\ \text{g Fe}}{55.847\ \text{g Fe/mol Fe}}$$

energy absorbed = $6.18 \times 10^7$ kJ

## PRACTICE PROBLEMS

1. Calculate the molar enthalpy of fusion of silver if 1.940 mol of silver requires 22.60 kJ of energy to change from a solid to a liquid at its melting point, 961°C.

2. What quantity of energy in kJ must be absorbed by 6.47 mol of solid acetic acid, $C_2H_4O_2$, to melt it at its melting point, 16.7°C? The $\Delta H_f$ for acetic acid is 11.54 kJ/mol.