23. Suppose the waste heat at a power plant is exhausted to a pond of water. Could the efficiency of the plant be increased by refrigerating the water in the pond?

24. A salt solution is placed in a bowl and set in sunlight. The salt crystals that remain after the water has evaporated are more highly ordered than the randomly dispersed sodium and chloride ions in the solution. Has the requirement that total entropy increase been violated? Explain your answer.

25. Use a discussion of internal energy and entropy to explain why the statement, "Energy is not conserved in an inelastic collision," is not true.

Practice Problems

For problems 26–28, see Sample Problem C.

26. In one cycle, an engine burning a mixture of air and methanol (methyl alcohol) absorbs 525 J and expels 415 J. What is the engine's efficiency?

27. The energy provided each hour as heat to the turbine in an electric power plant is 9.5×10^{12} J. If 6.5×10^{12} J of energy is exhausted each hour from the engine as heat, what is the efficiency of this heat engine?

28. A heat engine absorbs 850 J of energy per cycle from a high-temperature source. The engine does 3.5×10^2 J of work during each cycle, expelling 5.0×10^2 J as heat. What is the engine's efficiency?

MIXED REVIEW

29. A gas expands when 606 J of energy is added to it as heat. The expanding gas does 418 J of work on its surroundings.
    a. What is the overall change in the internal energy of the gas?
    b. If the work done by the gas were equal to 1212 J (rather than 418 J), how much energy would need to be added as heat in order for the change in internal energy to equal the change in internal energy in part **a**?

Graphing Calculator Practice

Carnot Efficiency

Sadi Carnot (1796-1832), a French engineer, studied the efficiencies of heat engines. He described an ideal engine—now called the *Carnot engine*—that consists of an ideal gas inside a thermally nonconductive cylinder that has a piston and a replaceable base.

In the Carnot engine, the piston moves upward as the cylinder's conductive base is brought in contact with a heat reservoir, T_h. The piston continues to rise when the base is replaced by a nonconductive base. Then, the energy is transferred to a cooler reservoir at a temperature, T_c, followed by further compression when the base is again replaced. Carnot discovered that the efficiency of such an engine can be determined by the following equation:

$$\textit{highest theoretical efficiency} = 1 - \frac{T_c}{T_h}$$

In this graphing calculator activity, you will enter various values for T_h and T_c to calculate the highest theoretical efficiency of a heat engine. Because of friction and other problems, the actual efficiency of a heat engine will be lower than the calculated efficiency.

Visit go.hrw.com and type in the keyword **HF6TDYX** to find this graphing calculator activity. Refer to **Appendix B** for instructions on downloading the program for this activity.