PRACTICE C

Calorimetry

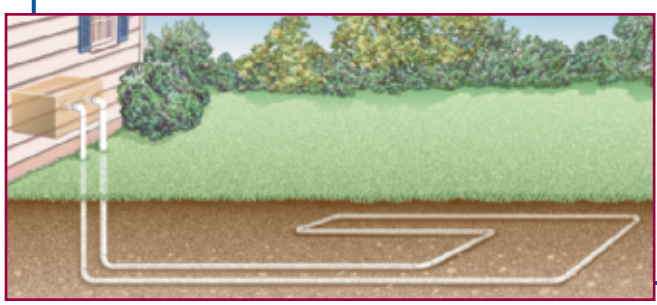
1. What is the final temperature when a 3.0 kg gold bar at 99°C is dropped into 0.22 kg of water at 25°C?
2. A 0.225 kg sample of tin initially at 97.5°C is dropped into 0.115 kg of water. The initial temperature of the water is 10.0°C. If the specific heat capacity of tin is 230 J/kg•°C, what is the final equilibrium temperature of the tin-water mixture?
3. Brass is an alloy made from copper and zinc. A 0.59 kg brass sample at 98.0°C is dropped into 2.80 kg of water at 5.0°C. If the equilibrium temperature is 6.8°C, what is the specific heat capacity of brass?
4. A hot, just-minted copper coin is placed in 101 g of water to cool. The water temperature changes by 8.39°C, and the temperature of the coin changes by 68.0°C. What is the mass of the coin?

Why it Matters

Earth-Coupled Heat Pumps

As the earliest cave dwellers knew, a good way to stay warm in the winter and cool in the summer is to go underground. Now, scientists and engineers are using the same premise—and using existing technology in a new, more efficient way—to heat and cool above-ground homes for a fraction of the cost of conventional systems.

The average specific heat capacity of earth is smaller than the average specific heat capacity of air. However, earth has a greater density than air does, which means that near a house, there are more kilograms of earth than of air. So, a 1°C change in temperature involves transferring more energy to or from the ground than to or from the air. Thus, the temperature of the ground in the winter will probably be higher than the temperature of the air above it. In the summer, the temperature of the ground will likely be lower than the temperature of the air.



An earth-coupled heat pump enables homeowners to tap the temperature just below the ground to heat their homes in the winter or cool them in the summer. The system includes a network of plastic pipes placed in trenches or inserted in holes drilled 2 to 3 m (6 to 10 ft) beneath the ground's surface. To heat a home, a fluid circulates through the pipe, absorbs energy from the surrounding earth, and transfers this energy to a heat pump inside the house. Although the system can function anywhere on Earth's surface, it is most appropriate in severe climates, where dramatic temperature swings may not be ideal for air-based systems.