37. A student drops two metallic objects into a 120 g steel container holding 150 g of water at 25°C. One object is a 253 g cube of copper that is initially at 85°C, and the other is a chunk of aluminum that is initially at 5°C. To the surprise of the student, the water reaches a final temperature of 25°C, its initial temperature. What is the mass of the aluminum chunk?

38. At what Fahrenheit temperature are the Kelvin and Fahrenheit temperatures numerically equal?

39. A 250 g aluminum cup holds and is in thermal equilibrium with 850 g of water at 83°C. The combination of cup and water is cooled uniformly so that the temperature decreases by 1.5°C per minute. At what rate is energy being removed?

40. A jar of tea is placed in sunlight until it reaches an equilibrium temperature of 32°C. In an attempt to cool the liquid, which has a mass of 180 g, 112 g of ice at 0°C is added. At the time at which the temperature of the tea (and melted ice) is 15°C, determine the mass of the remaining ice in the jar. Assume the specific heat capacity of the tea to be that of pure liquid water.

Alternative Assessment

1. According to legend, Archimedes determined whether the king's crown was pure gold by comparing its water displacement with the displacement of a piece of pure gold of equal mass. But this procedure is difficult to apply to very small objects. Use the concept of specific heat capacity to design a method for determining whether a ring is pure gold. Present your plan to the class, and ask others to suggest improvements to your design. Discuss each suggestion's advantages and disadvantages.

2. The host of a cooking show on television claims that you can greatly reduce the baking time for potatoes by inserting a nail through each potato. Explain whether this advice has a scientific basis. Would this approach be more efficient than wrapping the potatoes in aluminum foil? List all arguments and discuss their strengths and weaknesses.

3. The graph of decreasing temperature versus time of a hot object is called its cooling curve. Design and perform an experiment to determine the cooling curve of water in containers of various materials and shapes. Draw cooling curves for each one. Which trends represent good insulation? Use your findings and graphs to design a lunch box that keeps food warm or cold.

4. Research the life and work of James Prescott Joule, who is best known for his apparatus demonstrating the equivalence of work and heat and the conservation of energy. Many scientists initially did not accept Joule's conclusions. Research the reasoning behind their objections. Prepare a presentation for a class discussion either supporting the objections of Joule's critics or defending Joule's conclusion before England's Royal Academy of Sciences.

5. Research how scientists measure the temperature of the following: the sun, a flame, a volcano, outer space, liquid hydrogen, mice, and insects. Find out what instruments are used in each case and how they are calibrated to known temperatures. Using what you learn, prepare a chart or other presentation on the tools used to measure temperature and the limitations on their ranges.

6. Get information on solar water heaters that are available where you live. How does each type work? Compare prices and operating expenses for solar water heaters versus gas water heaters. What are some of the other advantages and limitations of solar water heaters? Prepare an informative brochure for homeowners who are interested in this technology.