

### Conceptual Questions

2. When a hot object warms a cooler object, does temperature flow between them? Are the temperature changes of the two objects equal? Explain.
  5. The specific heat of water is quite large. Explain why this fact makes water particularly good for heating systems (that is, hot-water radiators)
  7. Explain why burns caused by steam at  $100^{\circ}\text{C}$  on the skin are often more severe than burns caused by water at  $100^{\circ}\text{C}$ .
  10. Very high in the Earth's atmosphere the temperature can be  $700^{\circ}\text{C}$ . Yet an animal there would freeze to death rather than roast. Explain.
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### Problems

#### *19-1 Heat as Energy Transfer*

1. To what temperature will 8700 J of heat raise 3.0 kg of water that is initially at  $10.0^{\circ}\text{C}$ ?
3. An average active person consumes about 2500 Cal a day. (a) What is this in joules? (b) What is this in kilowatt-hours? (c) If your power company charges about 10¢ per kilowatt-hour, how much would your energy cost per day if you bought it from the power company? Could you feed yourself on this much money per day?
5. How many joules and kilocalories are generated when the brakes are used to bring a 1200-kg car to rest from a speed of 95 km/h?

#### *19-3 and 19-4 Specific Heat; Calorimetry*

7. An automobile cooling system holds 18 L of water. How much heat does it absorb if its temperature rises from  $15^{\circ}\text{C}$  to  $95^{\circ}\text{C}$ ?
9. (a) How much energy is required to bring a 1.0-L pot of water at  $20^{\circ}\text{C}$  to  $100^{\circ}\text{C}$ ? (b) For how long could this amount of energy run a 100-W lightbulb?
11. How long does it take a 750-W coffeepot to bring to a boil 0.75 L of water initially at  $8.0^{\circ}\text{C}$ ? Assume that the part of the pot which is heated with the water is made of 280g of aluminum, and that no water boils away.
13. A 31.5-g glass thermometer reads  $23.6^{\circ}\text{C}$  before it is placed in 135 mL of water. When the water and thermometer come to equilibrium, the thermometer reads  $39.2^{\circ}\text{C}$ . What was the original temperature of the water? [*Hint*: Ignore the mass of fluid inside the glass thermometer.]

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15. When a 290-g piece of iron at  $180^{\circ}\text{C}$  is placed in a 95-g aluminum calorimeter cup containing 250g of glycerin at  $10^{\circ}\text{C}$ , the final temperature is observed to be  $38^{\circ}\text{C}$ . Estimate the specific heat of glycerin.

17. The 1.20-kg head of a hammer has a speed of 7.5 m/s just before it strikes a nail (Fig.19-29) and is brought to rest. Estimate the temperature rise of a 14-g iron nail generated by 10 such hammer blows done in quick succession. Assume the nail absorbs all the energy.

### *19-5 Latent Heat*

18. How much heat is needed to melt 26.50 kg of silver that is initially at  $25^{\circ}\text{C}$ ?

20. A 35-g ice cube at its melting point is dropped into an insulated container of liquid nitrogen. How much nitrogen evaporates if it is at its boiling point of 77K and has a latent heat of vaporization of 200 kJ/kg? Assume for simplicity that the specific heat of ice is constant and is equal to its value near its melting point.

22. An iron boiler of mass 180 kg contains 730kg of water at  $18^{\circ}\text{C}$ . A heater supplies energy at the rate of 52,000 kJ/h. How long does it take for the water (a) to reach the boiling point, and (b) to all have changed to steam?