## 11.1 Definition and Units of Heat

**1.** **MC** The SI unit of heat energy is the (a) calorie, (b) kilocalorie, (c) Btu, (d) joule. (d)

**2.** **MC** Which of the following is the largest unit of heat energy: (a) calorie, (b) Btu, (c) joule, or (d) kilojoule. (b)

**5.** ● A person goes on a 1500-Cal-per-day diet to lose weight. What is his daily allowance expressed in joules? $6.279 \times 10^6$ J

**6.** ● A window air conditioner has a rating of 20 000 Btu/h. What is this rating in watts? $5.86 \times 10^3$ W

**7.** ●● A typical person's normal metabolic rate (the rate at which it converts food/stored energy into heat, movement, and so on) is about $4 \times 10^5$ J/h and the average food energy in a Big Mac is 600 Calories. If a person lived on nothing but Big Macs, how many per day would he or she have to eat to maintain a constant body weight? 4

**8.** ●● A student ate a Thanksgiving dinner that totaled 2800 Cal. He wants to use up all that energy by lifting a 20-kg mass a distance of 1.0 m. Assume that he lifts the mass with constant velocity and no work is required in lowering the mass. (a) How many times must he lift the mass? (b) If he can lift and lower the mass once every 5.0 s, how long does this exercise take? (a) 60 000 times (b) 83 h

## 11.2 Specific Heat and Calorimetry

**9.** **MC** The amount of heat necessary to change the temperature of 1 kg of a substance by 1 C° is called the substance's (a) specific heat, (b) latent heat, (c) heat of combustion, (d) mechanical equivalent of heat. (a)

**10.** **MC** For gases, which of the following is true about the specific heat under constant pressure, $c_p$, and specific heat under constant volume, $c_v$: (a) $c_p > c_v$, (b) $c_p = c_v$, or (c) $c_p < c_v$? (a)

**11.** **MC** The same amount of heat *Q* is added to two objects of the same mass. If object 1 experienced a greater temperature change than object 2, $\Delta T_1 > \Delta T_2$, then (a) $c_1 > c_2$, (b) $c_1 < c_2$, (c) $c_1 = c_2$. (b)

**16.** ● A 5.0-g pellet of aluminum at 20°C gains 200 J of heat. What is its final temperature? 63°C

**17.** ● How many joules of heat must be added to 5.0 kg of water at 20°C to bring it to the boiling point? $1.7 \times 10^6$ J

**18.** ● Blood can carry excess heat from the interior to the surface of the body, where the heat is dispersed. If 0.250 kg of blood at a temperature of 37.0°C flows to the surface and loses 1500 J of heat, what is the temperature of the blood when it flows back into the interior? Assume blood has the same specific heat as water. 35.6°C

**21.** ●● A 0.200-kg glass cup at 20°C is filled with 0.40 kg of hot water at 90°C. Neglecting any heat losses to the environment, what is the equilibrium temperature of the water? 84°C

**22.** ●● A 0.250-kg coffee cup at 20°C is filled with 0.250 kg of brewed coffee at 100°C. The cup and the coffee come to thermal equilibrium at 80°C. If no heat is lost to the environment, what is the specific heat of the cup material? [*Hint*: Consider the coffee essentially to be water.] $1.4 \times 10^3$ J/(kg·C°)

**31.** ●●● Lead pellets of total mass 0.60 kg are heated to 100°C and then placed in a well insulated aluminum cup of mass 0.20 kg that contains 0.50 kg of water initially at 17.3°C. What is the equilibrium temperature of the mixture? 20.0°C