1. **MC** Temperature is associated with molecular (a) rotational energy, (b) random translational energy, (c) vibrational energy, (d) all of the preceding.

2. **MC** A typical room temperature of 68°F on the Celsius scale is (a) 10°C, (b) 20°C, (c) 30°C.

3. **MC** A particular temperature interval, as opposed to a particular temperature value is written (a) C°, (b) °C, (c) $\text{C}^\circ - \text{C}^\circ$, (d) it makes no difference.

8. ● Convert the following to Celsius readings: (a) 500°F, (b) 0°F, (c) –20°F, and (d) –40°F.

13. ● The highest and lowest recorded air temperatures in the United States are, respectively, 134°F (Death Valley, California, 1913) and –80°F (Prospect Creek, Alaska, 1971). What are these temperatures on the Celsius scale?

16. ●● During open-heart surgery it is common to cool the patient's body down to slow body processes and gain an extra margin of safety. A drop of 8.5 C° is typical in these types of operations. If a patient's normal body temperature is 98.2°F, what is her final temperature in both Celsius and Fahrenheit?

18. ●●● Astronomers know that the temperatures of stellar interiors are "extremely high." By this they mean they can convert from Fahrenheit to Celsius temperature using a rough rule of thumb:

$$T(\text{in °C}) \approx \tfrac{1}{2} T(\text{in °F}).$$

(a) Determine the exact fraction (it isn't $\frac{1}{2}$) and (b) the percentage error astronomers make by using $\frac{1}{2}$ at high temperatures.

20. **MC** The temperature used in the ideal gas law must be expressed on which scale: (a) Celsius, (b) Fahrenheit, (c) Kelvin, or (d) any of the preceding?

21. **MC** Which of the following has the smallest degree interval: (a) Fahrenheit, (b) Celsius, or (c) Kelvin?

22. **MC** When the temperature of a quantity of gas is increased, (a) the pressure must increase, (b) the volume must increase, (c) both the pressure and volume must increase, (d) none of the preceding.

31. ● When lightning strikes, it can heat the air around it to more than 30 000 K, five times the surface temperature of the Sun. (a) What is this temperature on the Fahrenheit and Celsius scales? (b) The temperature is sometimes reported to be 30 000°C. Assuming that 30 000 K is correct, what is the percentage error of this Celsius value?

35. ●● An athlete has a large lung capacity, 7.0 L. Assuming air to be an ideal gas, how many molecules of air are in the athlete's lungs when the air temperature in the lungs is 37°C under normal atmospheric pressure?

40. ●● On a warm day (92°F), an air-filled balloon occupies a volume of $0.20\ \text{m}^3$ and is under a pressure of $20.0\ \text{lb/in}^2$. If the balloon is cooled to 32°F in a refrigerator while its pressure is reduced to $14.7\ \text{lb/in}^2$, what is the volume of the air in the container? (Assume that the air behaves as an ideal gas.)

41. ●● A steel-belted radial automobile tire is inflated to a gauge pressure of $30.0\ \text{lb/in}^2$ when the temperature is 61°F. Later in the day, the temperature rises to 100°F. Assuming that the volume of the tire remains constant, what is the tire's pressure at the elevated temperature? [*Hint*: Remember that the ideal gas law uses absolute pressure.]

44. ●● If $2.4\ \text{m}^3$ of a gas initially at STP is compressed to $1.6\ \text{m}^3$ and its temperature is raised to 30°C, what is the final pressure?

47. ●●● A diver releases an air bubble of volume $2.0\ \text{cm}^3$ from a depth of 15 m below the surface of a lake, where the temperature is 7.0°C. What is the volume of the bubble when it reaches just below the surface of the lake, where the temperature is 20°C?

10.5 The Kinetic Theory of Gases

72. **MC** If the average kinetic energy of the molecules in an ideal gas initially at 20°C doubles, what is the final temperature of the gas: (a) 10°C, (b) 40°C, (c) 313°C, or (d) 586°C?

73. **MC** If the temperature of a quantity of ideal gas is raised from 100 K to 200 K, is the internal energy of the gas (a) doubled, (b) halved, (c) unchanged, or (d) none of the preceding?

74. **MC** The smelling of odors is generally the result of (a) effusion, (b) diffusion, (c) osmosis, (d) reverse osmosis.

81. ●● If the temperature of an ideal gas increases from 300 K to 600 K, what happens to the rms speed of the gas molecules?

83. ●● (a) Estimate the total amount of translational kinetic energy in a classroom at normal room temperature. Assume the room measures 4.00 m by 10.0 m by 3.00 m. (b) If this energy were all harnessed, how high would it be able to lift an elephant with a mass of 1200 kg?

84. ●● If the temperature of an ideal gas is raised from 25°C to 100°C, how much faster is the new average (rms) speed of the gas molecules?

88. ●● Calculate the number of gas molecules in a container of volume $0.10\ m^3$ filled with gas under a partial vacuum of pressure 20 Pa at 20°C.