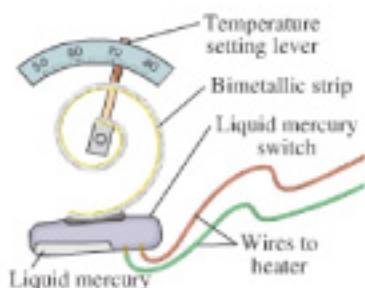


## Questions

- Which has more atoms: 1 kg of iron or 1 kg of aluminum? See the Periodic Table or Appendix B.
- Name several properties of materials that could be exploited to make a thermometer.
- Which is larger,  $1\text{ C}^\circ$  or  $1\text{ F}^\circ$ ?
- If system A is in thermal equilibrium with system B, but B is not in thermal equilibrium with system C, what can you say about the temperatures of A, B, and C?
- A flat bimetallic strip consists of aluminum riveted to a strip of iron. When heated, the strip will bend. Which metal will be on the outside of the curve? [Hint: See Table 13-1.] Why?
- In the relation  $\Delta L = \alpha L_0 \Delta T$ , should  $L_0$  be the initial length, the final length, or does it matter? Explain.
- The units for the coefficient of linear expansion  $\alpha$  are  $(\text{C}^\circ)^{-1}$ , and there is no mention of a length unit such as meters. Would the expansion coefficient change if we used feet or millimeters instead of meters? Explain.
- Figure 13-27 shows a diagram of a simple thermostat used to control a furnace (or other heating or cooling system). The bimetallic strip consists of two strips of different metals bonded together. The electric switch is a glass vessel containing liquid mercury that conducts electricity when it can flow to touch both contact wires. Explain how this device controls the furnace and how it can be set at different temperatures.



**FIGURE 13-27**  
A thermostat  
(Question 8).

- Long steam pipes that are fixed at the ends often have a section in the shape of a U. Why?
- A flat, uniform cylinder of lead floats in mercury at  $0^\circ\text{C}$ . Will the lead float higher or lower when the temperature is raised? Explain.
- When a cold mercury-in-glass thermometer is first placed in a hot tub of water, the mercury initially descends a bit and then rises. Explain.
- A glass container may break if one part of it is heated or cooled more rapidly than adjacent parts. Explain.
- The principal virtue of Pyrex glass is that its coefficient of linear expansion is much smaller than that for ordinary glass (Table 13-1). Explain why this gives rise to the increased heat resistance of Pyrex.
- Will a grandfather clock, accurate at  $20^\circ\text{C}$ , run fast or slow on a hot day ( $30^\circ\text{C}$ )? Explain. The clock uses a pendulum supported on a long, thin brass rod.
- Freezing a can of soda will cause its bottom and top to bulge so badly the can will not stand up. What has happened?
- When a gas is rapidly compressed (say, by pushing down a piston), its temperature increases. When a gas expands against a piston, it cools. Explain these changes in temperature using the kinetic theory, in particular noting what happens to the momentum of molecules when they strike the moving piston.
- Will the buoyant force on an aluminum sphere submerged in water increase or decrease if the temperature is increased from  $20^\circ\text{C}$  to  $40^\circ\text{C}$ ? Explain.
- Explain in words how Charles's law follows from kinetic theory and the relation between average kinetic energy and the absolute temperature.
- Explain in words how Gay-Lussac's law follows from kinetic theory.
- As you go higher in the Earth's atmosphere, the ratio of  $\text{N}_2$  molecules to  $\text{O}_2$  molecules increases. Why?
- Escape velocity for the Earth refers to the minimum speed an object must have to leave the Earth and never return. The escape velocity for the Moon is about one-fifth what it is for the Earth due to the Moon's smaller mass. Explain why the Moon has practically no atmosphere.
- Alcohol evaporates more quickly than water at room temperature. What can you infer about the molecular properties of one relative to the other?
- Explain why a hot humid day is far more uncomfortable than a hot dry day at the same temperature.
- Is it possible to boil water at room temperature ( $20^\circ\text{C}$ ) without heating it? Explain.
- Consider two days when the air temperature is the same but the humidity is different. Which is more dense, the dry air or the humid air at the same  $T$ ? Explain.
- Explain why it is dangerous to open the radiator cap of an overheated automobile engine.
- Why does exhaled air appear as a little white cloud in the winter (Fig. 13-28)?



**FIGURE 13-28** Question 27.