

Chapter 15

Exercises

5. You cannot establish by your own touch whether or not you are running a fever because there would be no temperature difference between your hand and forehead. If your forehead is a couple of degrees higher in temperature than normal, your hand is also a couple of degrees higher.

7. The hot coffee has a higher temperature, but not a greater internal energy. Although the iceberg has less internal energy per mass, its enormously greater mass gives it a greater total energy than that in the small cup of coffee. (For a smaller volume of ice, the fewer number of more energetic molecules in the hot cup of coffee may constitute a greater total amount of internal energy – but not compared to an iceberg.)

10. The hot rock will cool and the cool water will warm, regardless of the relative amounts of each. The amount of temperature change, however, does depend in great part on the relative masses of the materials. For a hot rock dropped into the Atlantic Ocean, the change in temperature would be too small to measure. Keep increasing the mass of the rock or keep decreasing the mass of the ocean and the change will be evident.

23. The climate of Bermuda, like that of all islands, is moderated by the high specific heat of water. What moderates the climates are the large amounts of energy given off and absorbed by water for small changes in temperature. When the air is cooler than the water, the water warms the air; when the air is warmer than the water, the water cools the air.

33. The tires heat up, which heats the air within. The molecules in the heated air move faster, which increases air pressure in the tires. (See Exercise 12.)

48. Thin glass is used because of the sudden temperature changes. If the glass were thicker, unequal expansions and contractions would break the glass with sudden temperature changes.

58. It is important to keep water in pipes from freezing because when the temperature drops below freezing, the water expands as it freezes whereas the pipe (if metal) will fracture if water in them freezes.

Problems

1. Heat gained by the cooler water = heat lost by the warmer water. Since the masses of water are the same, the final temperature is midway, 30°C . So you'll end up with 100 g of 30°C water.

5. Heat gained by water = heat lost by nails

$$(cm \Delta T)_{\text{water}} = (cm \Delta T)_{\text{nails}}$$

$$(1)(100)(T - 20) = (0.12)(100)(40 - T), \text{ giving } T = \mathbf{22.1^\circ\text{C}}.$$

8. This is similar to the previous problem, with different values.

$$\text{By formula: } \Delta L = L_{\text{orig}}\alpha\Delta T = (10.0 \text{ m})(11 \times 10^{-6}/^\circ\text{C})(20^\circ\text{C}) = \mathbf{0.002 \text{ m, or } 0.2 \text{ cm} = 2 \text{ mm}}.$$

9. **Aluminum expands more** as evidenced by its greater coefficient of linear expansion. The ratio of the increases is equal to the ratios of the coefficients of expansion, i.e., $24 \times 10^{-6}/11 \times 10^{-6} = 2.2$. So the same increase in temperature, the change in length of aluminum will be **2.2 times greater** than the change in length of steel.