Conceptual Questions

14.1 Heat

1.

How is heat transfer related to temperature?

2.

Describe a situation in which heat transfer occurs. What are the resulting forms of energy?

3.

When heat transfers into a system, is the energy stored as heat? Explain briefly.

14.2 Temperature Change and Heat Capacity

4.

What three factors affect the heat transfer that is necessary to change an object's temperature?

5.

The brakes in a car increase in temperature by ΔT when bringing the car to rest from a speed v. How much greater would ΔT be if the car initially had twice the speed? You may assume the car to stop sufficiently fast so that no heat transfers out of the brakes.

14.3 Phase Change and Latent Heat

6.

Heat transfer can cause temperature and phase changes. What else can cause these changes?

7.

How does the latent heat of fusion of water help slow the decrease of air temperatures, perhaps preventing temperatures from falling significantly below 0^{o}C, in the vicinity of large bodies of water?

8.

What is the temperature of ice right after it is formed by freezing water?

9.

If you place 0^{o}C ice into 0^{o}C water in an insulated container, what will happen? Will some ice melt, will more water freeze, or will neither take place?

10.

What effect does condensation on a glass of ice water have on the rate at which the ice melts? Will the condensation speed up the melting process or slow it down?

11.

In very humid climates where there are numerous bodies of water, such as in Florida, it is unusual for temperatures to rise above about 35ºC(95ºF). In deserts, however, temperatures can rise far above this. Explain how the evaporation of water helps limit high temperatures in humid climates.

12.

In winters, it is often warmer in San Francisco than in nearby Sacramento, 150 km inland. In summers, it is nearly always hotter in Sacramento. Explain how the bodies of water surrounding San Francisco moderate its extreme temperatures.

13.

Putting a lid on a boiling pot greatly reduces the heat transfer necessary to keep it boiling. Explain why.

14.

Freeze-dried foods have been dehydrated in a vacuum. During the process, the food freezes and must be heated to facilitate dehydration. Explain both how the vacuum speeds up dehydration and why the food freezes as a result.

15.

When still air cools by radiating at night, it is unusual for temperatures to fall below the dew point. Explain why.

16.

In a physics classroom demonstration, an instructor inflates a balloon by mouth and then cools it in liquid nitrogen. When cold, the shrunken balloon has a small amount of light blue liquid in it, as well as some snow-like crystals. As it warms up, the liquid boils, and part of the crystals sublimate, with some crystals lingering for awhile and then producing a liquid. Identify the blue liquid and the two solids in the cold balloon. Justify your identifications using data from Table 14.2.

14.4 Heat Transfer Methods

17.

What are the main methods of heat transfer from the hot core of Earth to its surface? From Earth's surface to outer space?

18.

When our bodies get too warm, they respond by sweating and increasing blood circulation to the surface to transfer thermal energy away from the core. What effect will this have on a person in a 40.0°C hot tub?

19.

Figure 14.30 shows a cut-away drawing of a thermos bottle (also known as a Dewar flask), which is a device designed specifically to slow down all forms of heat transfer. Explain the functions of the various parts, such as the vacuum, the silvering of the walls, the thin-walled long glass neck, the rubber support, the air layer, and the stopper.

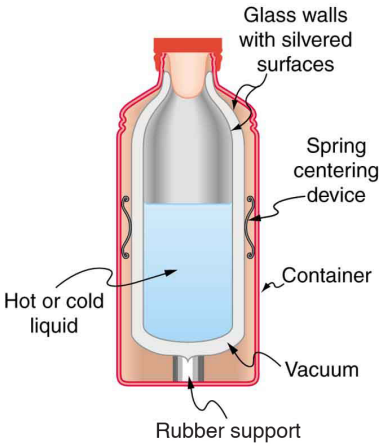

Figure 14.30 The construction of a thermos bottle is designed to inhibit all methods of heat transfer.

14.5 Conduction

20.

Some electric stoves have a flat ceramic surface with heating elements hidden beneath. A pot placed over a heating element will be heated, while it is safe to touch the surface only a few centimeters away. Why is ceramic, with a conductivity less than that of a metal but greater than that of a good insulator, an ideal choice for the stove top?

21.

Loose-fitting white clothing covering most of the body is ideal for desert dwellers, both in the hot Sun and during cold evenings. Explain how such clothing is advantageous during both day and night.

Figure 14.31 A jellabiya is worn by many men in Egypt. (credit: Zerida)

14.6 Convection

22.

One way to make a fireplace more energy efficient is to have an external air supply for the combustion of its fuel. Another is to have room air circulate around the outside of the fire box and back into the room. Detail the methods of heat transfer involved in each.

23.

On cold, clear nights horses will sleep under the cover of large trees. How does this help them keep warm?

14.7 Radiation

24.

When watching a daytime circus in a large, dark-colored tent, you sense significant heat transfer from the tent. Explain why this occurs.

25.

Satellites designed to observe the radiation from cold (3 K) dark space have sensors that are shaded from the Sun, Earth, and Moon and that are cooled to very low temperatures. Why must the sensors be at low temperature?

26.

Why are cloudy nights generally warmer than clear ones?

27.

Why are thermometers that are used in weather stations shielded from the sunshine? What does a thermometer measure if it is shielded from the sunshine and also if it is not?

28.

On average, would Earth be warmer or cooler without the atmosphere? Explain your answer.