All solutions for Practice Problems are provided in the *Solutions Manual*.

SUPPORTING DIVERSE STUDENT NEEDS

Gifted Students: Ask students to use the kinetic molecular theory to explain why boiling food (such as pasta) at a "rapid boil" does not cook food any faster than by cooking it at a "gentle boil."

6.1 Section Review Answers

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1. MC Copper has a lower specific heat capacity than steel and thus a copper bottom will heat up faster than a steel bottom because it requires less thermal energy (heat) to raise its temperature by a given amount.
2. K/U While the three objects would all have the same temperature, they would not feel that way to the touch. When you touch them, there will be a transfer of heat

from your hand to the objects. Since the amount of heat required to raise the object's temperature by a given amount depends on the specific heat capacity of the object, then the object with the largest specific heat capacity will feel the coldest. Of the three materials listed — snow, metal, and wood — the snow (solid water) has the largest specific heat capacity and thus feels the coldest to the touch. Also, the phase change from a solid (snow) to a liquid (water) will remove heat from your hand, due to water's large heat of fusion.

3. **(a)** K/U The specific heat capacity of the human body is less than that of water because the body is made up of other substances as well as water. These other substances have a specific heat capacity less than that of water.
   (b) MC The large value for specific heat capacity ensures that our body temperature does not easily change. To change the body temperature requires a very large amount of heat transfer to, or from, the body.

4. I The specific heat capacity of aluminum is much larger than that of silver. Thus, the silver will have a greater temperature rise for the same amount of heat transferred to it from the water. Assuming that the rate of heat transfer from the hot water to the glass is the same in each case, the glass made of silver will heat up faster than the glass made of aluminum and will be hotter to the touch more quickly.

5. K/U The work done to shake a bottle of lemonade gets converted into random motion of the lemonade molecules. This increased random motion means increased thermal energy and thus an increased temperature. In other words, shaking the bottle of lemonade increases its temperature.

6. K/U When any substance freezes, it releases energy known as the "latent heat of fusion" or "latent heat of solidification."

7. C The two plateaus on the heating curve represent the points where a phase change occurs. The first plateau corresponds to the phase change from solid to liquid and the second corresponds to the phase change from liquid to gas. During these plateaus, the energy added does not change the temperature of the substance but is used to change its phase instead.

8. I The rubbing alcohol feels cool when placed on your skin because it evaporates quickly. Its specific heat capacity of $= 2450 \frac{J}{kg \cdot °C}$ and boiling point of 78°C are relatively small compared to those for water. This means that a drop of alcohol placed on your skin will heat up more quickly than a drop of water and will also evaporate more quickly. As the alcohol evaporates, it removes thermal energy from your skin, which makes you feel cool.

6.2 Section Review Answers

Student Textbook page 290

1. **K/U** Work is a transfer of mechanical energy, whereas power is the rate at which work is being done.
2. **C** Answers will vary, An example is the path of energy consumed in a home: Electric potential energy in via power lines → light energy (by the light bulbs), heat energy (by various electric heaters, such as baseboard heaters, oven element, stovetop burners, hair dryer and clothes dryer, etc.), and mechanical energy (by the electric motors in various appliances, such as blenders, mixers, refrigerator, clothes dryer, etc.).
3. **I** Since $P = \frac{W}{\Delta t}$ and $W = F_{\parallel}\Delta d$, then $P = \frac{W}{\Delta t} = \frac{F_{\parallel}\Delta d}{\Delta t}$. But $v = \frac{\Delta d}{\Delta t}$. Thus, $P = Fv$.
4. **MC** The second law of thermodynamics states that heat flows only from a hot to a cold object or from an orderly to a disorderly state. Since an air conditioner creates order (i.e., places lower-energy molecules in the house and high-energy molecules outside), it would appear that it breaks the second law of thermodynamics. However, the second law states what will occur spontaneously. An air conditioner uses energy to separate high-energy and low-energy molecules. Since it is thermal energy that moves, the air conditioner pumps heat out of the house.
5. **(a)** **I** Chemical potential energy into engine → thermal energy (~ 80–85%) and mechanical (kinetic) energy (~ 15–20%).
   (b) **I** Chemical energy into engine → thermal energy and mechanical (kinetic) energy.
6. **MC** Compared to the bicycle's energy consumption of 52 kJ/km, the efficiency of the other transportation modes are:

Car:

$$\text{efficiency} = \frac{52\frac{\text{kJ}}{\text{km}}}{674\frac{\text{kJ}}{\text{km}}} \times 100\% = 7.7\%$$

Plane:

$$\text{efficiency} = \frac{52\frac{\text{kJ}}{\text{km}}}{2252\frac{\text{kJ}}{\text{km}}} \times 100\% = 2.3\%$$

Snowmobile:

$$\text{efficiency} = \frac{52\frac{\text{kJ}}{\text{km}}}{6743\frac{\text{kJ}}{\text{km}}} \times 100\% = 0.08\%$$