Skill and Practice Answer Key

9A Temperature Scales

1. Answers are:
   a. 100°C
   b. 37°C
   c. 4.4°C
   d. -12.2°C
   e. 32°F
   f. 77°F
   g. 167°F
2. 7.2°C
3. 177°C
4. 107°C
5. 374°F
6. 450°F
7. The table shows that the friend in Europe thinks that the temperature is on the Celsius scale because 15°C is equal to 59°F, a relatively warm air temperature. However, 15°F is a relatively cold air temperature, equivalent to -9.4°C.

15°F	=	-9.4°C
59°F	=	15°C

8. Answers are:
   a. -283°F
   b. The melting point for this liquid is 35°F which is equal to 1.7°C. The melting point for mercury is -38.9°C (-38.0°F). The unknown substance is not mercury, since its boiling point is not the same as that of mercury.

Extension Answers:

1. 184K to 242K
2. -108°C
3. -139°C
4. -223°C
5. 5,273K to 8,273K
6. 10,273K
7. 1,000,273K
8. 15,000,273K
9. 622K
10. 900°F

9B Reading a Heating/Cooling Curve

1. The iron changed from liquid to gas between points D and E.
2. The heat added to the iron was used to break the intermolecular forces between the iron atoms.
3. The melting temperature of iron is about 1,500°C.
4. The freezing temperature of iron is about 1,500°C. The melting and freezing temperatures of a substance are the same.
5. The boiling temperature of iron is about 2,800°C.
6. The boiling temperature of iron is about 2,700°C higher than the boiling temperature of water. That means it takes a lot more heat energy to break the intermolecular forces between iron atoms than those between water molecules. Iron's intermolecular forces are much stronger than water's.
7. Freezing occurred between points B and C.
8. The freezing and melting temperatures are the same—69°C.
9. The melting temperature of stearic acid is higher than water's melting temperature. The intermolecular forces between stearic acid molecules are stronger than those between water molecules. That's why it would take more heat energy to melt stearic acid.
10. Yes, a substance can definitely be cooled below its freezing temperature. The ice in the first graph started at -20°C. The iron

started 1,500°C below its freezing temperature, and the stearic acid continued to cool well below its freezing temperature. The molecules in a solid have some kinetic energy at their freezing temperatures. Their kinetic energy slowly decreases as they cool down further. Absolute zero (-273°C) is the point at which molecules have the minimum possible kinetic energy.

9C Specific Heat

1. Gold would heat up the quickest because it has the lowest specific heat.
2. Pure water is the best insulator because it has the highest specific heat.
3. Silver is a better conductor of heat than wood because its specific heat is lower than that of wood.
4. Aluminum, because it has the higher specific heat.
5. 5°C × 4,184J/kg°C = 20,920 J
6. At the same temperature, the larger mass of water contains more thermal energy.

9D Using the Heat Equation

1. 323 J
2. 588 J
3. 2,243 J
4. The gold would cool down fastest. It has to release only 323 J of energy to return to its original temperature.
5. 711,280 J
6. 440,000 J
7. 5.6 °C
8. 4,393,200 J

9E Heat Transfer

Definitions:

Heat conduction: The transfer of heat by the direct contact of particles of matter.

Convection: The transfer of heat by the motion of matter, such as by moving air or water.

Thermal radiation: Heat transfer by electromagnetic waves, including light.

1. Conduction. The water molecules collide with the frozen shrimp, transferring thermal energy by direct contact.
2. Radiation and heat conduction. Heat from the Sun is radiated to Earth. The black asphalt absorbs more of this radiation than the light-colored sidewalk. Heat is transferred from the sidewalk and the asphalt to Juan's feet by the process of heat conduction. Since the sidewalk absorbed more heat, it can transfer more heat to Juan's feet.
3. Convection. A thermal is a convection current in the atmosphere.
4. Radiation and convection. the hot space heater emits thermal radiation, and convection currents distribute the heat throughout the room.
5. Conduction. The mother duck is in direct contact with the eggs so the heat is transferred from her body directly to the eggs.
6. Radiation. Thermal energy from the Sun is absorbed by the car.
7. Conduction. The molecules of hot coffee collide with the molecules of cold milk. The average kinetic energy of the coffee molecules decreases, and the average kinetic energy of the milk molecules increases until thermal equilibrium is reached. The equilibrium temperature is lower than the initial temperature of the coffee.
8. Convection. A sea breeze is a convection current in the atmosphere, created when air over the land is heated and rises. Then cool air from over the water rushes in to take its place, creating the sea breeze.
9. Conduction. The heat from the water is transferred directly to the pipes, then to the marble floor, then to the feet.
10. Conduction and convection. First the heat from the water is transferred to the pipes and then to the floor. Then convection currents circulate the heat from the floor to all parts of the room.