Homework Answers

Physics 1405 **Homework Assignment #12**

Conceptual Physics **Chapter 17**

Spring 2010

Chapter 17
Exercises

2. When a wet finger is held to the wind, evaporation is greater on the windy side, which feels cool. The cool side of your finger is windward.

3. The water evaporates rapidly in the dry air, gaining its energy from your skin, which is cooled.

7. The temperature of the water lowers.

10. In this hypothetical case evaporation would not cool the remaining liquid because the energy of exiting molecules would be no different than the energy of molecules left behind. Although internal energy of the liquid would decrease with evaporation, energy per molecule would not change. No temperature change of the liquid would occur. (The surrounding air, on the other hand, would be cooled in this hypothetical case. Molecules flying away from the liquid surface would be slowed by the attractive force of the liquid acting on them.)

12. Water leaks through the porous canvas bag, evaporating from its outer surface and cooling the bag. The motion of the car increases the rate of evaporation and therefore the rate of cooling, just as blowing over a hot bowl of soup increases the rate at which soup cools (Exercise 5).

14. The body maintains its temperature at a normal 37°C by the process of evaporation. When the body tends to overheat, perspiration occurs, which cools the body if the perspiration is allowed to evaporate. (Interestingly enough, if you're immersed in hot water, perspiration occurs profusely, but evaporation and cooling do not follow—that's why it is inadvisable to stay too long in a hot bath.)

22. Enormous thermal energy is released as molecular potential energy is transformed to molecular kinetic energy in condensation. (Freezing of the droplets to form ice adds even more thermal energy.)

30. No. Food is cooked by the high temperature it is subjected to, not by the bubbling of the surrounding water. For example, put room-temperature water in a vacuum and it will boil. But an egg in this boiling water won't cook at all!

36. Cooking time will be no different for vigorously boiling water and gently boiling water, for both have the same temperature. The reason spaghetti is cooked in vigorously boiling water is simply to keep the spaghetti from sticking to itself and the pan. For fuel economy, simply stir your spaghetti in gently boiling water.

37. The lid on the pot traps heat that quickens boiling; the lid also slightly increases pressure on the boiling water that raises its boiling temperature. The hotter water correspondingly cooks food in a shorter time, although the effect is not significant unless the lid is held down as on a pressure cooker.

56. Every gram of water that undergoes freezing releases 80 calories of thermal energy to the cellar. This continual release of energy by the freezing water keeps the temperature of the cellar from going below 0°C. Sugar and salts in the canned goods prevent them from freezing at 0°C. Only when all the water in the tub freezes will the temperature of the cellar go below 0°C and then freeze the canned goods. The farmer must, therefore, replace the tub before or just as soon as all the water in it has frozen.

Problems

1. (a) 1 kg 0°C ice to 0°C water requires 80 kilocalories.
(b) 1 kg 0°C water to 100°C water requires 100 kilocalories.
(c) 1 kg 100°C water to 100°C steam requires 540 kilocalories.
(d) 1 kg 0°C ice to 100°C steam requires (80 + 100 + 540) = 720 kilocalories or 720,000 calories.