Quiz.

1. Which involves more energy?
   a) the cooling of 1 gram of water at 100 ºC to 1 gram of ice at absolute zero
   b) the condensation of 1 gram of steam at 100 ºC to water at 100 ºC
   c) Both involve the same number of calories.
   d) Neither involves calories.

2. Systems that are left alone, tend to move toward a state of
   a) more entropy.
   b) no entropy.
   c) less entropy.

3. When a volume of air is compressed, and no heat enters or leaves, the air temperature will
   a) decrease.
   b) remain unchanged.
   c) increase.

4. Blow on your hand with your open mouth and feel the warmth of your breath. Pucker your lips so your breath expands as you blow, and your breath is
   a) cooler.
   b) neither warmer nor cooler.
   c) warmer still.

5. The first law of thermodynamics is a restatement of the
   a) law of heat addition.
   b) Carnot cycle.
   c) conservation of energy.
   d) principle of entropy.
   e) none of these

6. Entropy is closely related to the
   a) 1st law of thermodynamics.
   b) 2nd law of thermodynamics.
   c) both of these
   d) neither of these

7. As a system becomes more disordered, entropy
   a) remains the same.
   b) increases.
   c) decreases.

8. When a volume of air expands against the environment and no heat enters or leaves, the air temperature will
   a) remain unchanged.
   b) decrease.
   c) increase.

9. During an adiabatic compression of an ideal gas
   a) no heat is supplied to or removed from the gas.
   b) the temperature of the gas does not change.
   c) no work is done on the gas.
   d) the internal energy of the gas remains constant.
   e) None of the above choices are true.

Answer Key.

1. b)

It requires much more energy to form the exceptionally stronger hydrogen bonds when condensing steam to water than it does to form the relatively weak chemical bonds when solidifying liquid water into ice. Regardless, steam must undergo two phase transitions at atmospheric pressure in order to freeze, whereas liquid water must only change phases once.

2. a)

Processes that increase entropy have the highest probability of occurring. According to the second law of thermodynamics, heat will only ever spontaneously flow from a hot body to a cooler body, which translates to an increase of entropy.

3. c)

This statement is describing an adiabatic process. Adiabatic compression can be portrayed by the example of using a bike pump. When you press down, the cylinder is fairly well insulated, and the change in volume occurs so rapidly that it is essentially an adiabatic process; however, although no heat is allowed in or out, the pump's temperature does increase.

4. a)

Expanding air cools. One ingenious third-world solution to a lack of air conditioning in extreme heat which utilizes this concept is placing boards that have holes cut out and are fitted with bottles or cups into open windows, exploiting the geometry of the vessels by positioning them in such a way that the air entering the room through them is expanding.

5. c)

The first law of thermodynamics can be summarized by the phrase, "You can't win." This is essentially another form of the conservation of energy which tells us that you cannot create nor destroy energy. The first law tells us that heat and mechanical work and internal energy, all forms of energy, must be conserved.

6. b)

The second law of thermodynamics can be summarized by the phrase, "You can't break even." This means that you cannot completely convert work or heat into mechanical work but must lose some as heat. This heat loss is related to the entropy of the system.

7. b)

Entropy can be thought of as a form of disorder.

8. b)

Here is another example of an adiabatic process, and this one can be demonstrated by the use of canned air, such as Dust-Off® Duster. As the volume expands adiabatically it cools (expanding air cools, anyway), and its effects are easily apparent.

9. a)

The four main thermodynamic processes are defined by holding a parameter constant, and for adiabatic processes that constant is heat. Since entropy depends on heat flow, an adiabat is at a constant entropy.