

## Critical Thinking Items

### 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium 13.

What are the necessary conditions for energy transfer by heat to occur between two bodies through the process of conduction?

- a. They should be at the same temperature, and they should be in thermal contact.
- b. They should be at the same temperature, and they should not be in thermal contact.
- c. They should be at different temperatures, and they should be in thermal contact.
- d. They should be at different temperatures, and they should not be in thermal contact.

14.

Oil is heated in a pan on a hot plate. The pan is in thermal equilibrium with the hot plate and also with the oil. The temperature of the hot plate is  $150^{\circ}\text{C}$ . What is the temperature of the oil?

- a.  $160^{\circ}\text{C}$
- b.  $150^{\circ}\text{C}$
- c.  $140^{\circ}\text{C}$
- d.  $130^{\circ}\text{C}$

### 12.2 First law of Thermodynamics: Thermal Energy and Work 15.

When an inflated balloon experiences a decrease in size, the air pressure inside the balloon remains nearly constant. If there is no transfer of energy by heat to or from the balloon, what physical change takes place in the balloon?

- a. The average kinetic energy of the gas particles decreases, so the balloon becomes colder.
- b. The average kinetic energy of the gas particles increases, so the balloon becomes hotter.
- c. The average potential energy of the gas particles decreases, so the balloon becomes colder.
- d. The average potential energy of the gas particles increases, so the balloon becomes hotter.

16.

What are two reasonable outcomes of adding heat energy to an inflated balloon?

- a. Increased pressure and constant volume.
- b. Constant pressure and increased volume.
- c. Constant pressure and constant volume.
- d. Increased pressure and increased volume.

17.

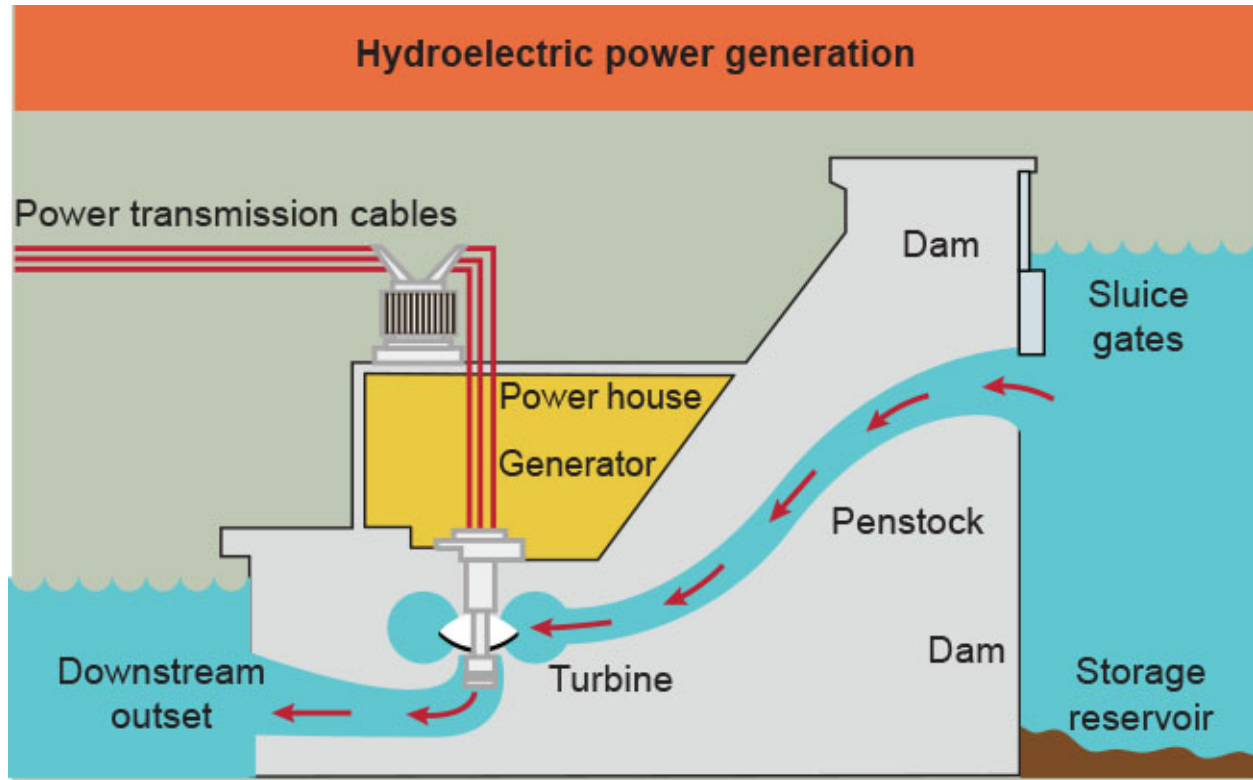


Figure 12.17

A hydroelectric dam produces electricity by moving water from a reservoir fed by a river above through a turbine below. Consider the system to include the dam and the reservoir. If the turbine jams and stops producing electricity, what effect will this have on the internal energy of the system?

- a. The internal energy would be converted to work.
- b. The internal energy would remain constant because work is no longer being done.
- c. The excess internal energy would radiate as heat.
- d. The internal energy will increase as the reservoir fills up.

18.

Air is pumped into a car tire, causing its temperature to increase. In another tire, the temperature increase is due to exposure to the sun. Is it possible to tell what caused the temperature increase in each tire? Explain your answer.

- a. No, because it is a chemical change, and the cause of that change does not matter; the final state of both systems are the same.

- b. Although the final state of each system is identical, the source is different in each case.
- c. No, because the changes in energy for both systems are the same, and the cause of that change does not matter; the state of each system is identical.
- d. Yes, the changes in the energy for both systems are the same, but the causes of that change are different, so the states of each system are not identical.

19.

How does the transfer of energy from the sun help plants?

- a. Plants absorb solar energy from the sun and utilize it during the fertilization process.
- b. Plants absorb solar energy from the sun and utilize it during the process of photosynthesis to turn it into plant matter.
- c. Plants absorb solar energy from the sun and utilize it to increase the temperature inside them.
- d. Plants absorb solar energy from the sun and utilize it during the shedding of their leaves and fruits.

### 12.3 Second Law of Thermodynamics: Entropy 20.

If an engine were constructed to perform such that there would be no losses due to friction, what would be its efficiency?

- a. It would be 0 percent.
- b. It would be less than 100 percent.
- c. It would be 100 percent.
- d. It would be greater than 100 percent.

21.

Entropy never decreases in a spontaneous process. Give an example to support this statement.

- a. The transfer of energy by heat from colder bodies to hotter bodies is a spontaneous process in which the entropy of the system of bodies increases.
- b. The melting of an ice cube placed in a room causes an increase in the entropy of the room.
- c. The dissolution of salt in water is a spontaneous process in which the entropy of the system increases.
- d. A plant uses energy from the sun and converts it into sugar molecules by the process of photosynthesis.

### 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators 22.

What is the advantage of a heat pump as opposed to burning fuel (as in a fireplace) for keeping warm?

- a. A heat pump supplies energy by heat from the cold, outside air.
- b. A heat pump supplies energy generated by the work done.
- c. A heat pump supplies energy by heat from the cold, outside air and also from the energy generated by the work done.
- d. A heat pump supplies energy not by heat from the cold, outside air, nor from the energy generated by the work done, but from more accessible sources.

23.

What is thermal efficiency of an engine? Can it ever be 100 percent? Why or why not?

- a. Thermal efficiency is the ratio of the output (work) to the input (heat). It is always 100 percent.
- b. Thermal efficiency is the ratio of the output (heat) to the input (work). It is always 100 percent.
- c. Thermal efficiency is the ratio of the output (heat) to the input (work). It is never 100 percent.
- d. Thermal efficiency is the ratio of the output (work) to the input (heat). It is never 100 percent.

24.

When would 100 percent thermal efficiency be possible?

- a. When all energy is transferred by heat to the environment
- b. When mass transferred to the environment is zero
- c. When mass transferred to the environment is at a maximum
- d. When no energy is transferred by heat to the environment