1. Absolute zero is best described as the temperature at which

   A. water freezes at standard pressure
   B. water is at its triple point
   C. the molecules of a substance have maximum kinetic energy
   D. the molecules of a substance have minimum kinetic energy

2. The minimum average kinetic energy of the molecules in a substance occurs at a temperature of

   A. –273 K B. 273ºC C. 0ºC **D. 0 K**

3. Doubling the absolute temperature of an ideal gas will affect the molecules of the gas by doubling their average

   A. kinetic energy B. potential energy C. momentum D. velocity

4. As heat is added to a solid at a temperature below its melting point, its average molecular kinetic energy

   A. decreases **B. increases**
   C. remains the same

5. The sum of the kinetic and potential energies of an object's molecules is called the object's

   A. temperature B. heat of fusion **C. internal energy** D. specific heat

6. When water at 10° Celsius is heated to 20° Celsius its internal energy

   A. decreases **B. increases**
   C. remains the same

7. The temperature at which no thermal energy can be transferred from one object to another is

   A. –273 K **B. 0 K** C. 0º C D. 273º C

8. If only the respective temperatures of two objects are known, what additional information can be determined?

   A. how much heat the objects contain
   B. how much heat the warmer object can supply to the colder object
   C. whether a heat exchange would take place if the objects were in contact
   D. the total amount of energy the objects contain

9. Two solid metal blocks are placed in an insulated container. If there is a net flow of heat between the blocks, they must have different

   A. initial temperatures B. melting points
   C. specific heats D. heats of fusion

10. Heat will always flow from object *A* to object *B* if object *B* has a lower

    A. mass B. total energy C. specific heat **D. temperature**

11. What is the boiling point of water at standard pressure on the Kelvin scale?

    A. 100 K B. 212 K C. 273 K **D. 373 K**

12. A Celsius temperature reading may be converted to the corresponding Kelvin temperature reading by

A. subtracting 273 **B. adding 273** C. subtracting 180 D. adding 180

13. What temperature reading on the Kelvin scale is equivalent to a reading of zero degrees Celsius?

A. –273 K B. –100 K C. 100 K **D. 273 K**

14. A covered Styrofoam cup contains 0.30 kilogram of water at 100º C. If 0.10 kilogram of water at 20º C is added to the Styrofoam cup, the temperature of the mixture will be

A. 40º C B. 60º C **C. 80º C** D. 100º C

15. A change in temperature of 100 Celsius degrees is equal to a change in Kelvin temperature of

A. 373 K B. 200 K **C. 100 K** D. 50 K

16. What is the number of Kelvin (Absolute) degrees between the freezing point and the boiling point of pure water at standard pressure?

A. 0 K **B. 100 K** C. 180 K D. 273 K

17. The amount of heat energy liberated by a sample of water depends upon its

A. temperature change, only
B. temperature change and mass, only
C. temperature change and phase, only
D. temperature change, mass, and phase

18. As water changes to ice without sublimation at zero degrees Celsius, its mass

A. decreases
B. increases
C. remains the same

19. A thermometer is dipped into alcohol and the alcohol is allowed to evaporate from the thermometer. As the alcohol evaporates, the temperature reading of the thermometer

A. decreases
B. increases
C. remains the same

20. Salt is often used on sidewalks to help melt accumulated ice. The salt melts the ice by

A. increasing the temperature of the ice
B. raising the melting point of the ice
C. increasing the temperature of the surrounding air
D. lowering the melting point of the ice

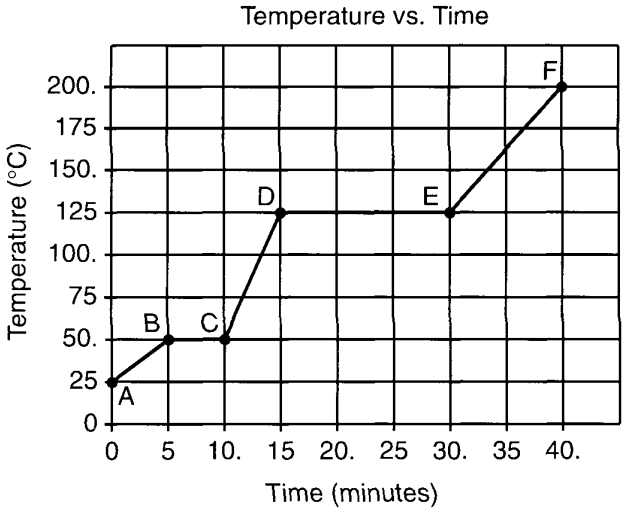
21. Dry ice changes from a solid phase to a gas phase without becoming a liquid. This process is known as

A. sublimation B. evaporation C. condensation D. diffusion

22. How do the freezing point and boiling point of ocean water compare to those of distilled water?

A. Ocean water freezes at a lower temperature and boils at a lower temperature.
B. Ocean water freezes at a lower temperature and boils at a higher temperature.
C. Ocean water freezes at a higher temperature and boils at a lower temperature.
D. Ocean water freezes at a higher temperature and boils at a higher temperature.

Base your answers to questions **23** and **24** on the graph below, which represents changes in a 5.00-kilogram sample of a substance as it absorbs heat at a constant rate of 41.9 kilojoules per minute.



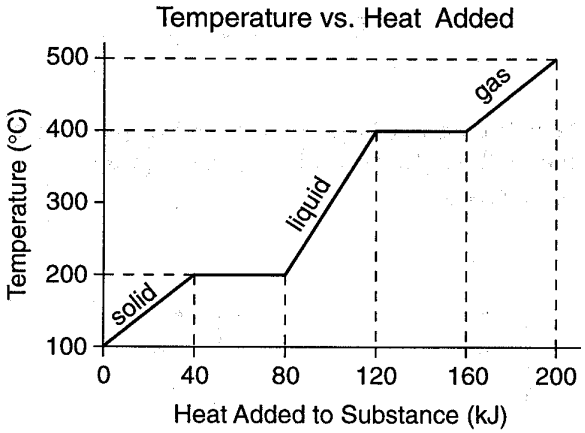
23. The heat of vaporization of the substance is

A. 210. kJ/kg **B. 126 kJ/kg** C. 12.6 kJ/kg D. 629 kJ/kg

24. The boiling point of the substance is

A. 25°C B. 50.°C **C. 125°C** D. 150.°C

Base your answers to questions **25** through **27** on the graph below which shows the relationship between the temperature of 1.0 kilogram of a pure substance and the heat energy added to the substance.



25. The freezing point of the substance is

A. 400ºC B. 300ºC **C. 200ºC** D. 100ºC

26. What is the specific heat of the substance as a gas?

A. 0.04 kJ/kg-ºC **B. 0.4 kJ/kg-ºC** C. 40 kJ/kg-ºC D. 4 kJ/kg-ºC

27. What is the heat of fusion of the substance?

A. 40 kJ/kg B. 80 kJ/kg C. 120 kJ/kg D. 160 kJ/kg

28. Heat will spontaneously flow from object *A* to object *B* if object *B* has a lower

A. mass B. total energy **C. temperature** D. specific heat

29. Heat will flow from a region of low temperature to a region of higher temperature if

A. the specific heat of the cooler region is greater than the specific heat of the warmer region
B. the temperature of the cooler region is near absolute zero
C. work is done to produce the flow
D. the cooler region is liquid and the warmer region is solid

30. A 1.0-kilogram sample of water is boiling at 100.ºC in an open container. If a 0.50-kilogram piece of lead at 300.ºC is placed in the boiling water, how will the temperature of the two substances be affected?

A. The temperature of the water will decrease, and the temperature of the lead will remain the same.
B. The temperature of the water will increase, and the temperature of the lead will remain the same.
C. The temperature of the water will remain the same, and the temperature of the lead will decrease.
D. The temperature of the water will remain the same, and the temperature of the lead will increase.

31. According to the second law of thermodynamics, which phenomenon will most likely occur?

A. The entropy of the universe will steadily decrease.
B. The universe will steadily become more disordered.
C. The universe will eventually reach equilibrium at absolute zero.
D. Within the universe, more heat will flow from colder to warmer regions than from warmer to colder regions.

Answer Key
Thermodynamics

1. **D**
2. **D**
3. **A**
4. **B**
5. **C**
6. **B**
7. **B**
8. **C**
9. **A**
10. **D**
11. **D**
12. **B**
13. **D**
14. **C**
15. **C**
16. **B**
17. **D**
18. **C**
19. **A**
20. **D**
21. **A**
22. **B**
23. **B**
24. **C**
25. **C**
26. **B**
27. **A**
28. **C**
29. **C**
30. **C**
31. **B**