Name: _____Answer Key_____ Date: _____

Honors Physics Test #8 Review

Thermodynamics

1. Read Chapters 10 & 11

2. Terms to know: kinetic molecular theory, thermal expansion, internal energy, temperature, heat/thermal energy, thermal equilibrium, radiation, convection, conduction, work, system, environment, entropy, mole, ideal gas law, isothermal, isochoric, isobaric

3. State the 1st and 2nd law of thermodynamics in your own words.

4. On a winter day, does cold flow into the house through the windows?
   No, heat flows from hot to cold, so heat flows out of the house.

5. When a piece of aluminum and a piece of wood are at room temperature, which feels colder? Why?
   The aluminum because it transfers heat with your hand more readily than the piece of wood.

Directions: Read each question carefully and record your answers in the space provided. Be sure to show all work! Answers should be in significant figures. You will be graded on proper use of the GUESS method. **These will be the same directions on the test. Practice the GUESS method now.**

6. The side of Mercury facing the Sun can reach 700.25 Kelvin.
   a. Convert this temperature to Celsius.

$$T_C = T_K - 273 = 700.25K - 273 = 427°C$$

   b. Convert this temperature to Fahrenheit.

$$T_F = \frac{9}{5}T_c + 32 = \frac{9}{5}(427°C) + 32 = 801°F$$

7. During the night, the temperature on the Moon can dip as low as minus 280 Fahrenheit.
   a. Convert this temperature to Celsius.

$$T_C = \frac{5}{9}(T_F - 32) = \frac{5}{9}(-280 - 32) = -170°C$$

   b. Convert this temperature to Kelvin.

$$T_K = T_C + 273 = -170°C + 273 = 103K$$

8. If 100 J of work is done on a system and 200 J of heat leave the system, what is the change in internal energy?

$$\Delta U = Q + W = -200J + 100J = -100J$$

9. If 500 J of heat are added to a system and the system does 250 J of work, what is the change in internal energy of the system?

$$\Delta U = Q + W = 500J + (-250J) = 250J$$

10. A 0.200 mole of an ideal monatomic gas is trapped in a cylinder of volume 1.50 x 10^{-3} m^3 at a pressure of 0.455 MPa.

    a. Calculate the temperature of the gas in the cylinder.

$$PV = nRT$$

$$T = \frac{PV}{nR} = \frac{(0.455\times10^{6}Pa)(1.50\times10^{-3}m^{3})}{(0.200mol)(8.31\frac{J}{mol\cdot K})} = 411K$$

    b. Calculate the number of gas particles in the cylinder.

$$n = \frac{N}{N_A}$$

$$N = nN_A = (0.200mol)(6.02\times10^{23}mol^{-1})$$

$$N = 1.20\times10^{23}molecules$$

    c. Calculate the average kinetic energy of the gas particles.

$$KE = \tfrac{3}{2}k_BT$$

$$KE = \tfrac{3}{2}(1.38\times10^{-23}\tfrac{J}{K})(411K)$$

$$KE = 8.51\times10^{-21}J$$

11. One mole of an ideal gas is heated at a constant volume of 2.0 x 10^{-3} m^3 from an initial pressure of 1.0 x 10^5 Pa to a final pressure of 5.0 x 10^5 Pa. Determine the initial and final temperatures of the gas.

$$PV = nRT$$

$$T_i = \frac{PV}{nR} = \frac{(1.0\times10^5 Pa)(2.0\times10^{-3} m^3)}{(1mol)(8.31\,\frac{J}{mol\cdot K})} = 24K$$

$$PV = nRT$$

$$T_f = \frac{PV}{nR} = \frac{(5.0\times10^5 Pa)(2.0\times10^{-3} m^3)}{(1mol)(8.31\,\frac{J}{mol\cdot K})} = 120K$$

OR

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$T_2 = \frac{T_1 P_2}{P_1} = \frac{(24K)(5.0\times10^5 Pa)}{(1.0\times10^5 Pa)} = 120K$$

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

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

13. If the average kinetic energy of the particles that make up a liquid increases,

(A) the liquid must change state
(B) the temperature of the liquid increases
(C) the liquid loses heat to its surroundings
(D) all of the above take place

14. When a student drops a beaker, it shatters, spreading randomly shaped pieces of glass over a large area of the floor. According to the second law of thermodynamics, the measure of the disorder of the system is known as

(A) absolute order (B) molecular collision (C) entropy (D) vaporization

15. What do the laws of thermodynamics indicate about the energy and entropy of the universe?

(A) Energy is constant and entropy is decreasing.
(B) Energy is constant and entropy is increasing
(C) Energy is increasing and entropy is decreasing.
(D) Energy is decreasing and entropy is increasing.

16. Equal masses of aluminum and copper, both at 0^0C, are placed in the same insulated can of hot water. Which statement describes this system at equilibrium (the net exchange of internal energy is zero)?

(A) The aluminum has a higher temperature than the copper and water.
(B) The aluminum, copper and water have the same temperature.
(C) The copper has a higher temperature than the aluminum and water.
(D) The water has a higher temperature than the aluminum and copper.

17. Two objects in thermal equilibrium have

(A) the same energy | (B) the same temperature | (C) different temperatures | (D) the same heat

18. Which of the following things has the most thermal energy?

(A) the ocean | (B) a camp fire | (C) a hot oven | (D) a hot water bottle

19. Which physics principle could be used to solve a problem pertaining to the following:
If the pressure of a gas remains constant and the temperature is doubled, what happened to the volume of the gas?

(A) First Law of Thermodynamics
(B) Second Law of Thermodynamics
(C) Ideal Gas Law
(D) Heat of Fusion and Heat of Vaporization
(E) Heat Engine Efficiency

20. Which physics principle could be used to solve a problem pertaining to the following:
A new soft drink bottle is opened, allowing gas to escape. As the gas escapes, how does it degree of disorder change?

(A) First Law of Thermodynamics
(B) Second Law of Thermodynamics
(C) Ideal Gas Law
(D) Heat of Fusion and Heat of Vaporization
(E) Heat Engine Efficiency

21. Which physics principle could be used to solve a problem pertaining to the following:
An unknown liquid at a high temperature is safely mixed with water until an equilibrium temperature is reached. How much heat was gained by the water?

(A) First Law of Thermodynamics
(B) Second Law of Thermodynamics
(C) Ideal Gas Law
(D) Heat of Fusion and Heat of Vaporization
(E) Heat Engine Efficiency

22. The average kinetic energy of the molecules in a substance is most associated with

(A) heat capacity | (B) temperature | (C) specific heat | (D) absolute zero | (E) potential energy

23. The temperature of absolute zero is equal to

(A) 0 ^{o}C | (B) 100 ^{o}C | (C) 273 ^{o}C | (D) -273 ^{o}C | (E) -100 ^{o}C

24. An ideal gas in a closed container initially has volume V, pressure P, and Kelvin temperature, T. If the temperature is changed to 3T, which of the following pairs of pressure and volume values is possible?

(A) 3P and V | (B) P and V | (C) P and V/3 | (D) P/3 and V | (E) 3P and 3V

25. A liquid is poured into a pan and heated over a flame. The hot liquid begins rising of the top. This type of heat transfer is called

(A) conduction (B) convection (C) radiation (D) thermal expansion (E) specific heat

26. If the volume of a gas is decreased while temperature is constant, which will occur?

(A) The average kinetic energy of the molecules of the gas will increase
(B) The average kinetic energy of the molecules of the gas will decrease
(C) The mass of the gas will decrease
(D) The pressure of the gas will increase
(E) The pressure of the gas will decrease

27. If the average speed of molecules in an ideal gas is doubled, the temperature of the gas

(A) remains the same (B) is doubled (C) is halved (D) is quadrupled (E) is quartered

28. The law of entropy states that

(A) heat always flows spontaneously from a colder body to a hotter one
(B) every natural system will tend toward lower entropy
(C) heat lost by one object must be gained by another
(D) the specific heat of a substance cannot exceed a certain value
(E) every natural system will tend toward disorder

29. Which of the following is NOT true of an ideal gas?

(A) Gas molecules have no intermolecular forces
(B) Gas particles are in random motion
(C) Gas particles have no volume
(D) The collisions between any two gas particles are elastic
(E) The average kinetic energy of the gas molecules is proportional to the temperature in Celsius degrees

30. A sample of argon occupies 50 liters at standard temperature. Assuming constant pressure, what volume will argon occupy if the temperature is doubled?

(A) 25 L (B) 50 L (C) 100 L (D) 200 L (E) 2,500 L

31. An ideal gas is made up of N diatomic molecules, each of mass M. All of the following statements about this gas are true EXCEPT

(A) The temperature of the gas is proportional to the average translational kinetic energy of the molecules
(B) All of the molecules have the same speed
(C) The molecules make elastic collisions with the walls of the container
(D) The molecules make elastic collisions with each other
(E) The average number of collisions per unit time that the molecules make with the walls of the container depends on the temperature of the gas

Answers:
6. a. 427 °C
b. 801 °F
7. a. -170 °C
b. 103 K
8. -100J
9. 250 J
10. a. 411 K
b. 1.20×10^{23}
c. 8.51×10^{-21} J
11. 24K, 120 K
12. C
13. B
14. C
15. B
16. B
17. B
18. A
19. C
20. B
21. A
22. B
23. D
24. A
25. B
26. D
27. D
28. E
29. C
30. C
31. B