Name: _____

1. In order for two objects to have the same temperature, they must

   a. be in thermal equilibrium…. <=
   b. be in thermal contact with each other.
   c. have the same relative "hotness" or "coldness" when touched.
   d. have all of the properties listed above.
   e. have only properties (b) and (c) above.

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2. A thermometer registers a change in temperature of 100°F. What change in temperature does this correspond to on the Kelvin Scale?

   a. 453
   b. 328
   c. 180
   d. 55.6… <=
   e. 24.5

3. What is the change in area (in cm^2) of a 60.0 cm by 150 cm automobile windshield when the temperature changes from 0°C to 36.0°C. The coefficient of linear expansion of glass is $9\times10^{-6}/°C$.

   a. 1.62
   b. 2.92
   c. 3.24
   d. 4.86
   e. 5.83… <=

4. A container with a one-liter capacity at 27°C is filled with helium to a pressure of 2 atm. (1 atm = $1.0\times10^5\ N/m^2$.) How many moles of helium does it hold?

   a. 0.040
   b. 0.080… <=
   c. 0.45
   d. 0.90
   e. 1.0

5. A 5-kg piece of lead (specific heat 0.03 cal/g °C) having a temperature of 80°C is added to 500 g of water having a temperature of 20°C. What is the final equilibrium temperature (in °C) of the system?

a. 79
b. 26
c. 54
d. 34…. <=
e. 20

6. How much heat (in kcal) must be removed to make ice at –10°C from 2 kg of water at 20°C? (The specific heat of ice is 0.5 cal/g °C, the latent heat of fusion of water is 333 kJ/kg)

a. 190
b. 200
c. 240
d. 210… <=
e. 50

7. Five moles of an ideal gas expands isothermally at 100°C to five times its initial volume. Find the heat flow into the system.

a. 2.5×10^4 J… <=
b. 1.1×10^4 J
c. 6.7×10^3 J
d. 2.9×10^3 J
e. 7.0×10^2 J

.

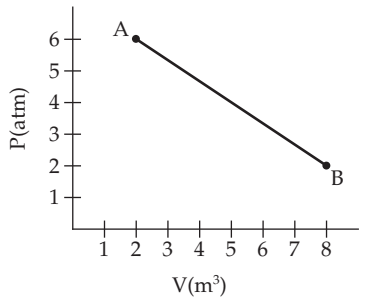
8. In which process will the internal energy of the system ***NOT*** change?

a. An adiabatic expansion of an ideal gas.
b. An isothermal compression of an ideal gas…<=
c. An isobaric expansion of an ideal gas.
d. The freezing of a quantity of liquid at its melting point.
e. The evaporation of a quantity of a liquid at its boiling point.

9. For an astronaut working outside a spaceship, the greatest loss of heat would occur by means of

a. conduction.
b. convection.
c. radiation…. <=
d. conduction and convection.
e conduction and radiation.

10. A gas expands as shown in the graph. If the heat taken in during this process is 1.02×10^{6} J and 1 atm= 1.01×10^{5} N/m^2, the change in internal energy of the gas (in J) is



a. -2.42×10^{6}
b. -1.40×10^{6} **<=**
c. -1.02×10^{6}
d. 1.02×10^{6}
e. 1.40×10^{6}

11. Five gas molecules are found to have speeds of 100, 200, 300, 400, and 500 m/s. The rms speed (in m/s) is

a. 390.
b. 300.
c. 360.
d. 330. **<=**
e. 320.

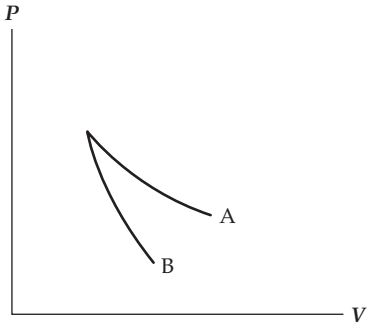
12. The air in an automobile engine at 20°C is compressed from an initial pressure of 1.0 atm and a volume of 200 cm^3 to a volume of 20 cm^3. Find the temperature if the air behaves like an ideal gas (γ= 1.4) and the compression is adiabatic.

a. 730°C
b. 460°C . **<=**
c. 25°C
d. 50°C
e. 20°C

13. The internal energy of n moles of an ideal gas depends on

a. one state variable T. . **<=**
b. two state variables T and V.
c. two state vartiables T and P.
d. three state variables T, P and V.
e. four variables R, T, P and V.

14. The relation $PV = nRT$ holds for all ideal gases. The additional relation PV^γ holds for an adiabatic process. The figure below shows two curves: one is an adiabat and one is an isotherm. Each starts at the same pressure and volume. Which statement is correct? (Note: "$\propto$" means "is proportional to".)



a. Isotherm: $P \propto \frac{1}{V}$; Adiabat: $P \propto \frac{1}{V}$: A is both an isotherm and an adiabat.

b. Isotherm: $P \propto \frac{1}{V^\gamma}$; Adiabat: $P \propto \frac{1}{V}$: B is an isotherm, A is an adiabat.

c. Isotherm: $P \propto \frac{1}{V}$; Adiabat: $P \propto \frac{1}{V^\gamma}$: A is an isotherm, B is an adiabat. **<=**

d. Isotherm: $P \propto \frac{1}{V^\gamma}$; Adiabat: $P \propto \frac{1}{V^\gamma}$: B is both an isotherm and an adiabat.

e. I cannot answer this without additional information about the starting temperature.

15. One mole of hydrogen, one mole of nitrogen and one mole of oxygen are held in a 22.4×10^{3} cm^3 enclosed vessel at 20° C. The pressure in the vessel, in N/m^2, is

a. 109.
b. 304.
c. 326.
d. 1.09×10^{5}.
e. 3.26×10^{5}. <=

16. When we say that the speed of sound is measured under adiabatic conditions we assume that

a. the time associated with heat conduction is slow relative to the speed of the wave. <=
b. no heat can flow between the system and its surroundings.
c. the speed of the wave is directly proportional to the bulk modulus.
d. the speed of the wave is proportional to the square root of the bulk modulus.
e. air is an ideal gas.

17. A bicycle pump contains air at STP (standard conditions for temperature and pressure). As the tire is pumped up, the volume of air decreases by 50% with each stroke. What is the new pressure of air (in atm) in the chamber after the first stroke, assuming no temperature change?

a. 2 <=
b. 1
c. 0.5
d. 0.1
e. 3

18. A bridge is made with segments of concrete 50 m long. If the linear expansion coefficient is 12×10^{-6} $(°C)^{-1}$, how much spacing (in cm) is needed to allow for expansion during an extreme temperature change of 150°F?

a. 10
b. 2.5
c. 7.5
d. 5.0 <=
e. 9.5

19. A cup of coffee is enclosed on all sides in an insulated cup 1/2 cm thick in the shape of a cube 10 cm on a side. The temperature of the coffee is 95°C, and the temperature of the surroundings is 21°C. Find the rate of heat loss (in J/s) due to conduction if the thermal conductivity of the cup is 2×10^{-4} cal/s · cm · °C.

a. 62
b. 74 <=
c. 230
d. 160
e. 12

20. A 100-kg student eats a 200-Calorie doughnut. To "burn it off", he decides to climb the steps of a tall building. How high (in m) would he have to climb to expend an equivalent amount of work? (1 food Calorie = 10^3 calories.)

a. 273
b. 623
c. 418
d. 854 <=
e. 8400