General Physics I (PHYS 2010)
Spring 2014
Prof Richard Ignace

HOMEWORK #8

Notes:

- This homework is due by the beginning of class on May 1. It covers material from chapter 10, 11, and 12.
- You will need a calculator and lots of scrap paper.
- Answers are to be recorded on a scantron that you will turn in. You may keep the questions (i.e., these sheets).
- You may (should) use your book. You may even work with other students. However, you should not copy the answers of other students. The homeworks are exam prep, and so you need to be able to work these problems yourself. If you do not apply yourself and do your own work, you are not likely to perform well on the exams.

1. Two ideal gases, X and Y, are thoroughly mixed and at thermal equilibrium in a single container. The molecular mass of X is 12 times smaller than Y. What is the ratio of root-mean-square velocities of the two gases, $v_{X,rms}/v_{Y,rms}$?

   a. $1/12$
   b. $12/1$
   c. $\sqrt{12}/1$
   d. $1/\sqrt{12}$

2. Heat flow occurs between two bodies in thermal contact when they differ in what property?

   a. temperature
   b. mass
   c. specific heat
   d. density

3. Heat in the amount of $Q = 6 \times 10^4$ J is added to a piece of aluminum (with specific heat 900 J/kg·°C). The aluminum displays a change in temperature, $\Delta T = 5.0$°C. How much mass does the piece have?

   a. 19 kg
   b. 29 kg
   c. 39 kg
   d. 49 kg

4. On a sunny day at the beach, the reason the sand gets so hot and the water stays relatively cool is attributed to the difference in which property between water and sand?

   a. mass density
   b. temperature
   c. specific heat
   d. thermal conductivity

5. A waterfall is 92 m high. What is the increase in water temperature at the bottom of the falls if all the initial potential energy goes into heating the water? (g = 9.8 m/s^2, $c_w = 4,186$ J/kg·°C)

   a. 0.12°C
   b. 0.22°C
   c. 0.53°C
   d. 0.64°C

6. A hot piece of copper is placed in a container of water. The copper has initial temperture $T_C = 160$°C and mass $m_C = 250$g. The water is initially at $T_w = 20$°C with mass $m_w = 400$g. Determine the equilibrium temperature if no heat is lost from the mixture, given that $c_C =$ 0.10 cal/gi·°C, and $c_w = 1.00$ cal/gi·°C.

   a. 28.2°C
   b. 9.1°C
   c. 16.2°C
   d. 2.3°C

7. A 0.004-kg lead bullet is traveling at a speed of 300 m/s when it embeds in a block of ice at 0°C. If all the heat generated goes into melting ice, what quantity of ice is melted? ($L_f = 80$ kcal/kg, and 1 kcal = 4,186 J) Hint: kinetic energy is converted to heat.

   a. 24.1×10^{-4} kg
   b. 3.9×10^{-4} kg
   c. 5.4×10^{-4} kg
   d. 12.2×10^{-4} kg

8. Iced tea is made by adding ice to 2.4 kg of hot tea, initially at 70°C. How many kg of ice, initially at 0°C, are required to bring the mixture to 10°C? ($L_f = 3.33 \times 10^5$ J/kg, $c_w = 4,186$ J/kg·°C)

   a. 1.8 kg of ice
   b. 1.6 kg of ice
   c. 1.4 kg of ice
   d. 1.2 kg of ice

9. In cloud formation, water vapor turns into water droplets which get bigger and bigger until it rains. This will cause the temperature of the air in the clouds to:

   a. get warmer.
   b. get cooler.
   c. will not affect the temperature of the air in the clouds.
   d. There is no air in clouds.

10. If one's hands are being warmed by holding them to one side of a flame, the predominant form of heat transfer is what process?

    a. conduction
    b. convection
    c. vaporization
    d. radiation

11. A 2.0 m^2 Thermopane window is constructed, using two layers of glass that are each 4.0 mm thick, separated by an air space of width Δx. The temperature difference is 20°C from the inside of the house to the outside air, and the rate of heat flow through the window is $\mathcal{P} = 640$W. Determine the thickness of the air space. (Thermal conductivity for glass is 0.84 J/s·m·°C and for air 0.023 4 J/s·m·°C.)

    a. 0.38 mm
    b. 0.77 mm
    c. 1.22 mm
    d. 3.49 mm

12. Determine the total power of radiation emitted by the Moon if its cool night side has a temperature $T_C = -153$°C and its hot day side has a temperature of $T_H = 107$°C. Assume $e = 1$. The radius of the Moon 1,737 km. (Note: $\sigma = 5.67 \times 10^{-8}$ W/m^2·K^4).

    a. 2.5×10^{12} W
    b. 2.5×10^{14} W
    c. 2.5×10^{16} W
    d. 2.5×10^{18} W

13. Consider an ideal gas in which there is a change with work of $W = -12,000$ J at a constant pressure of $P = 2,000$ Pa. Determine the change in volume.

    a. compresses by 0.17 m^3
    b. expands by 0.17 m^3
    c. compresses by 6 m^3
    d. expands by 6 m^3

14. During an isobaric process which one of the following does not change?

    a. volume
    b. temperature
    c. internal energy
    d. pressure

15. Area on a P-V diagram has units associated with:

    a. energy.
    b. momentum.
    c. temperature.
    d. change in temperature.

16. In an isovolumetric process by an ideal gas, the change in internal energy for the gas equals the amount of

    a. temperature gain/loss.
    b. heat gain/loss.
    c. volume gain/loss.
    d. pressure gain/loss.

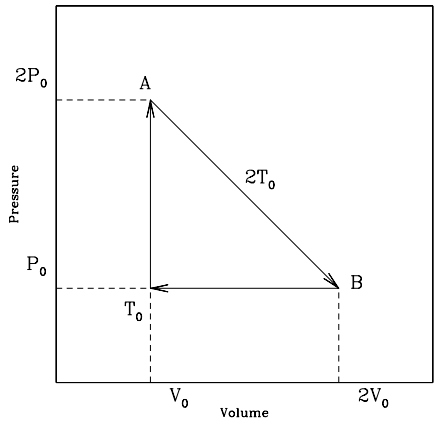

Figure 1:

17. Refer to Figure 1. An ideal gas at pressure, volume, and temperature, P_0, V_0, and T_0, respectively, is heated to point A, allowed to expand to point B also at temperature $2T_0$, and then returned to the original condition. The internal energy decreases by $(3P_0V_0/2)$ going from point B to point T_0. How much heat did the gas lose in the segment from point B to point T_0?

    a. $P_0V_0/2$
    b. $3P_0V_0/2$
    c. $5P_0V_0/2$
    d. 0

18. A heat engine operating between a pair of hot and cold reservoirs with respective temperatures of 550 K and 350 K will have what maximum efficiency?

    a. 16%
    b. 26%
    c. 36%
    d. 46%

19. The efficiency of a Carnot engine operating between 80°C and 10°C is most nearly:

    a. 3.2%.
    b. 19.8%.
    c. 81.2%.
    d. 96.8%.