Physics 201 MWF 9:10 Fall 2006 (Ford)

Name (printed)_____

Name (signature as on ID)_____

Lab Section Number_____

Exam IV Chapts. 12,14-16 in Young/Geller

Multiple Choice questions. Circle the correct answer. No work needs to be shown.

(5 pts) 1. A person listening to a siren from a stationary police car observes the frequency and wavelength of that sound. The car now drives rapidly away from the person. Compared to the wavelength and frequency when the car was at rest, once the car is moving

(a) the wavelength will be shorter and the frequency will be lower
(b) the wavelength will be longer and the frequency will be higher
d (c) the wavelength will be shorter and the frequency will be higher
(d) the wavelength will be longer and the frequency will be lower

(5 pts) 2. The first overtone standing wave for a sound wave in a pipe that is open at one end and closed at the other end has wavelength 2.4 m. The length of the pipe is

(a) 0.6 m
c (b) 1.2 m
(c) 1.8 m
(d) 2.4 m
(e) none of these

(5 pts) 3. An insulated box contains a mixture of argon and helium gas. For helium the atomic mass is $M = 4.0 \times 10^{-3}$ kg/mol and for argon it is 40.0×10^{-3} kg/mol. If the two gases are in thermal equilibrium and therefore at the same temperature, how does the average translational kinetic energy of an argon atom compare to the average translational kinetic energy of a helium atom?

a (a) It is the same for both gases.
(b) It is greater for argon.
(c) It is less for argon.

(5 pts) 4. In an adiabatic compression of an ideal gas, where the volume decreases, the temperature of the gas

a (a) increases
(b) decreases
(c) stays the same

On the following problems show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(16 pts) 5. Two small speakers, A and B, operate from the same amplifier and emit coherent sound waves of frequency 500 Hz. The speed of the sound waves is 340 m/s. These speakers both start out 8.0 m to the left of the listener, and then speaker A is slowly moved to the left. At what distance d of A from B will the sound from the speakers first produce destructive interference at the location of the listener?

Ans. 0.34 m

(14 pts) 6. In an isothermal process at a constant temperature of 27°C, a monatomic ideal gas is compressed and the work done on the gas is 600 J. What is the change in the entropy of the gas? (Be sure to indicate the sign of your answer.)

Ans. -2 J/K

(14 pts) 7. A Carnot heat engine operates between a high-temperature reservoir at 800 K and a low-temperature reservoir at 200 K. In each cycle the engine performs 1200 J of work. In each cycle, what is

(a) the magnitude of the heat energy received by the engine from the high-temperature reservoir?

Ans. 1600 J

(b) the magnitude of the heat energy given up to the low-temperature reservoir?

Ans. 400 J

(16 pts) 8. An insulated container of negligible mass holds 0.200 kg of water and 0.050 kg of ice in thermal equilibrium at atmospheric pressure. A 0.800 kg piece of metal at an initial temperature of 400°C is placed into the ice-water mixture. The final temperature of the system is 30°C. Assume no heat is lost to the surroundings and calculate the specific heat capacity c of the metal.

(For ice, $c = 2010$ J/(kg·C°). For water $c = 4190$ J/(kg·C°), $L_f = 3.34 \times 10^5$ J/kg and $L_v = 2.26 \times 10^6$ J/kg.)

Ans. 163 J/kg·K

(20 pts) 9. A quantity of helium gas expands slowly to three times its original volume. For helium, $C_V = 3R/2$. In the expansion, the work done by the helium gas is 800 J. The gas can be treated as an ideal gas.

(a) If the process is isothermal ($\Delta T = 0$), what are the heat flow Q and the change in internal energy ΔU for the gas? (In each case, be sure to indicate the sign of your answers.)

Ans. $Q =$ +800 J

$\Delta U =$ 0

(b) If the process is adiabatic ($Q = 0$), what is the change in internal energy ΔU for the gas? (Be sure to indicate the sign of your answer.)

$\Delta U =$ −800 J

(c) If the process is isobaric ($\Delta p = 0$), what are the heat flow Q and the change in internal energy ΔU for the gas? (In each case, be sure to indicate the sign of your answers.)

Ans. $Q =$ + 2000 J

$\Delta U =$ +1200 J