

Name (printed) _____

Name (signature as on ID) _____ Lab Section Number _____

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

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

(5 pts) 1. The equation describing transverse waves on a certain string is

$$y(x, t) = (2.00 \text{ mm}) \sin[(200 \text{ s}^{-1})t - (30.0 \text{ m}^{-1})x].$$

The speed of these waves is

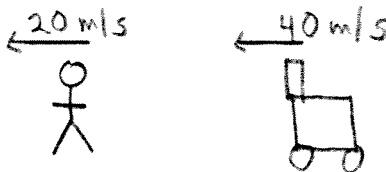
- (a) 6.67 m/s
- (b) 3.18 m/s
- (c) 2.12 m/s
- (d) 1.06 m/s
- (e) 0.15 m/s
- (f) 6000 m/s
- (g) none of the above answers

(5 pts) 2. A string is tied down at both ends. The second overtone standing wave has wavelength 0.60 m. The length of the string is

- (a) 0.20 m
- (b) 0.30 m
- (c) 0.40 m
- (d) 0.60 m
- (e) 0.80 m
- (f) 0.90 m
- (g) 1.20 m
- (h) none of the above

(5 pts) 3. A listener is moving to the left with a speed 20 m/s. A train to his right is moving to the left with a speed of 40 m/s. The train's whistle is emitting sound waves with a frequency of 400 Hz. The speed of the sound waves relative to the air is 340 m/s. What is the frequency of the sound heard by the listener?

- (a) 480 Hz
- (b) 427 Hz
- (c) 379 Hz
- (d) 337 Hz
- (e) 540 Hz
- (f) none of the above answers



(5 pts) 4. One mole of an ideal gas undergoes a reversible isothermal compression at a constant temperature of 27.0°C . During this compression, 1500 J of work is done on the gas. What is the entropy change of the gas as a result of this process?

- (a) 5.0 J/K
- (b) -5.0 J/K
- (c) 55.6 J/K
- (d) -55.6 J/K
- (e) zero
- (f) none of the above

(5 pts) 5. One mole of an ideal gas is heated at constant pressure from 30.0°C to 80.0°C . The gas has $C_V = 12.47$ J/(mol·K) and $C_p = 20.78$ J/(mol·K). In this process the change in the internal energy of the gas is

- (a) 374 J
- (b) 623 J
- (c) 873 J
- (d) 1039 J
- (e) 1455 J
- (f) zero
- (g) none of the above answers

(5 pts) 6. A Carnot heat engine operates between a high-temperature reservoir at $T_H = 800$ K and a low-temperature reservoir at $T_C = 300$ K. In one cycle the engine rejects 600 J of heat energy to the low temperature reservoir. How much work does the engine perform in one cycle?

- (a) 2200 J
- (b) 1600 J
- (c) 1000 J
- (d) 885 J
- (e) 375 J
- (f) 225 J
- (g) none of the above

(5 pts) 7. A refrigerator consumes 400 J of mechanical energy in one cycle. In one cycle the refrigerator expels 500 J of heat energy into the high-temperature reservoir. In one cycle the amount of that energy the refrigerator absorbs from the low-temperature reservoir is

- (a) 100 J
- (b) 200 J
- (c) 500 J
- (d) 900 J
- (e) 1000 J
- (f) 1300 J
- (g) none of the above answers

(5 pts) 8. A quantity of ideal gas is compressed adiabatically ($Q = 0$) to one-third of its original volume. In this process the temperature of the gas

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

(5 pts) 9. The temperature of 5.0 moles of an ideal gas is increased from 100°C to 300°C . If this is done at constant volume, $3.0 \times 10^4 \text{ J}$ of heat energy flows into the gas. If the same temperature change is carried out at constant pressure, the heat flow into the gas is

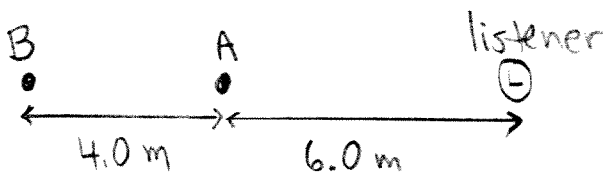
- (a) $3.0 \times 10^4 \text{ J}$
- (b) less than $3.0 \times 10^4 \text{ J}$
- (c) greater than $3.0 \times 10^4 \text{ J}$

(5 pts) 10. A round hole in a flat copper plate has a diameter of 2.000 cm when the plate is at a temperature of 40°C . When the temperature of the plate is raised to 80°C , the diameter of the hole is

- (a) less than 2.000 cm
- (b) 2.000 cm
- (c) greater than 2.000 cm

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

(16 pts) 11. Speaker A is 6.00 m to the left of a listener and speaker B is 4.00 m to the left of speaker A . The speakers emit sound waves that are in phase and that have the same frequency f . The speed of the waves in air is 340 m/s. What is the smallest value of f for which there will be destructive interference at the location of the listener?



Ans. _____

(16 pts) 12. In a container of negligible mass, 0.500 kg of liquid water and 0.080 kg of ice are in thermal equilibrium. A 2.0 kg piece of copper with an initial temperature of 180°C is placed into the ice-water mixture. If no heat is lost to the surroundings, what is the final temperature of the system?

(For ice, $c = 2010 \text{ J}/(\text{kg}\cdot\text{K})$. For water $c = 4190 \text{ J}/(\text{kg}\cdot\text{K})$, $L_f = 3.34 \times 10^5 \text{ J}/\text{kg}$ and $L_v = 2.26 \times 10^6 \text{ J}/\text{kg}$. For copper $c = 390 \text{ J}/(\text{kg}\cdot\text{K})$.)

Ans. _____

(18 pts) 13. One mole of ideal gas is slowly compressed to one-third of its original volume. In this compression, the work done on the gas has magnitude 600 J. For the gas, $C_p = 7R/2$.

a) If the process is isothermal ($\Delta T = 0$), what is the heat flow Q for the gas? Does the heat flow into the gas or out of the gas?

Ans. $Q =$ _____

into the gas or out of the gas? _____

b) If the process is isobaric ($\Delta p = 0$), what is the change in internal energy of the gas? Does the internal energy increase or decrease?

Ans. $\Delta U =$ _____

increase or decrease? _____