

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

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

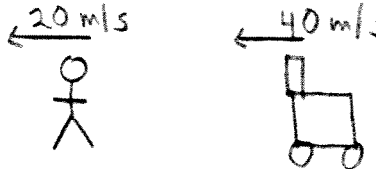
The speed of these waves is

- a
- (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

- f
- (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?

- b
- (a) 480 Hz
 - (b) 427 Hz
 - (c) 379 Hz
 - (d) 337 Hz
 - (e) 540 Hz
 - (f) none of the above answers
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- The diagram shows a stick figure representing a listener on the left, with an arrow above it pointing left and the label '20 m/s'. To the right of the listener is a train, represented by a rectangle on wheels, with an arrow above it pointing left and the label '40 m/s'.

(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 (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 $C_V = 12.47\text{ J}/(\text{mol}\cdot\text{K})$ and $C_p = 20.78\text{ J}/(\text{mol}\cdot\text{K})$. In this process the change in the internal energy of the gas is

- (a) 374 J
- b (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 $T_H = 800\text{ K}$ and a low-temperature reservoir at $T_C = 300\text{ K}$. 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 (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 (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

- b (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

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

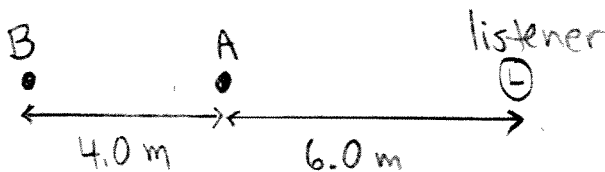
(5 pts) 10. A round hole in a flat copper plate has a diameter of 2.000 cm when the plate is at a temperature of 40°C . When the temperature of the plate is raised to 80°C , the diameter of the hole is

- c (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. 42.5 Hz



(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. 35.4 $^{\circ}\text{C}$

(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. $Q = \underline{-600 \text{ J}}$

into the gas or out of the gas? out

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. $\Delta U = \underline{-1500 \text{ J}}$

increase or decrease? decrease