Q1. Two identical sinusoidal traveling waves are sent along the same string in the same direction. What should be the phase difference between the two waves so that the amplitude of the resultant wave is equal to the amplitude of each wave?

A) 120 degrees
B) 90 degrees
C) 60 degrees
D) 45 degrees
E) 30 degrees

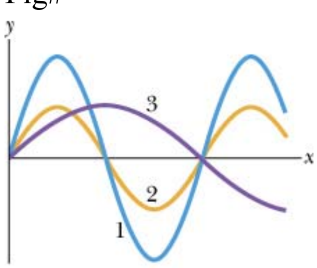
Q2. A stretched string is fixed at both ends. Two adjacent resonant frequencies of the string are 224 Hz and 256 Hz. What is the frequency of the third harmonic standing wave pattern?

A) 96 Hz
B) 75 Hz
C) 85 Hz
D) 64 Hz
E) 32 Hz

Q3. The figure shows three waves that are separately sent along a string that is stretched under a certain tension. Which of the following statement is CORRECT?

A) Wave 3 has lower frequency than waves 1 and 2.
B) Wave 3 has higher speed than waves 1 and 2.
C) Wave 3 has lower speed than waves 1 and 2.
D) Wave 3 has higher frequency than waves 1 and 2.
E) Wave 1 has higher speed than waves 2 and 3.

Fig#



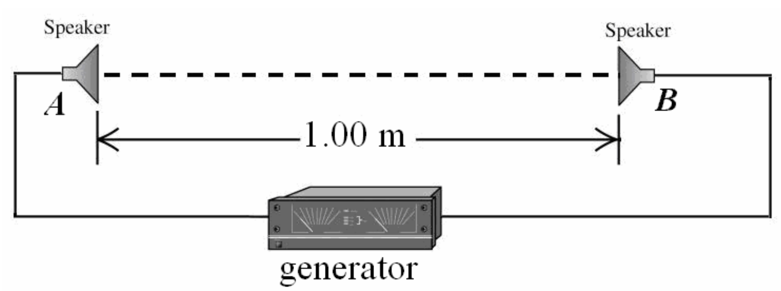
Q4. A wave with an amplitude of 1.0 cm and wavelength 2.5 m is generated on a string with a linear density of 20 g/m that is under a tension of 5.0 N. What is the maximum transverse speed of a point on the string?

A) 0.40 m/s
B) 0.16 m/s
C) 0.25 m/s
D) 0.56 m/s
E) 0.51 m/s

Q5. In the figure below, two speakers are driven by the same generator and are a distance of 1.0 m apart. The speakers emit sound waves at a frequency of 686 Hz that are in phase. A listener starts at A and moves toward B. What will be the distance from A of the first point at which he will observe constructive interference? The speed of sound in air is 343 m/s.

A) 0.25 m
B) 0.40 m
C) 0.60 m
D) 0.80 m
E) 0.15 m

Fig#



Q6. A standing wave is set up in an air-filled tube that is closed at one end. The standing wave has two nodes and the frequency of oscillation is 230 Hz. What is the length of the tube? Take the speed of sound to be 343 m/s.

A) 1.1 m
B) 2.0 m
C) 0.75 m
D) 3.0 m
E) 0.50 m

Q7. The average output power of a speaker is 550 watts. The sound level that reaches to a detector is 105 dB, how far is the detector from the source? (Take $I_o=10^{-12}$ W/m^2)

A) 37 m
B) 25 m
C) 26 m
D) 45 m
E) 32 m

Q8. A stationary policeman sends a sound wave of frequency 550 Hz towards a car approaching him. The reflected frequency detected by the policeman is 620 Hz. What is the speed of the car?

A) 20 m/s
B) 25 m/s
C) 30 m/s
D) 35 m/s

E) 40 m/s

Q9. A glass flask with volume 250 cm^3 is filled with mercury at 25 ^0C. How much mercury overflows when the temperature of the system is raised to 105 ^oC (the coefficient of linear expansion of glass is 4.0×10^{-6} K^{-1} and coefficient of volume expansion of mercury is 1.82×10^{-4} K^{-1}).

A) 3.4 cm^3
B) 1.1 cm^3
C) 6.5 cm^3
D) 8.5 cm^3
E) 7.5 cm^3

Q10. How much ice at -10.0 ^oC must be added to 4.0 kg of water at 20.0 ^oC to cause the resulting mixture to be liquid water at 0 ^oC ? (c_{ice} = 2220 J/kg.K)

A) 0.94 kg
B) 0.75 kg
C) 0.33 kg
D) 0.40 kg
E) 0.50 kg

Q11. One end of a steel bar is welded to one end of a copper bar. Both bars have the same length and cross sectional area. The free end of the steel bar is maintained at 100 ^oC and free end of the copper bar is maintained at 0.0 ^oC. Find the temperature of the junction at steady state.(k_{steel} = 50.2 W/m.K; k_{copper} = 385 W/m.K)

A) 11.5 ^oC
B) 8.5 ^oC
C) 25 ^oC
D) 30 ^oC
E) 5.5 ^oC

Q12. Which of the following statement is **INCORRECT**:

A) If the internal energy of the gas is decreased, the volume remains constant in an adiabatic process.
B) In an adiabatic process, transfer of energy as heat is zero.
C) The internal energy of the system increases if energy is added as heat Q for isochoric (constant volume) process
D) In a cyclic process the change in internal energy of the system is zero.
E) Heat energy can transfer only between bodies having different temperatures.

Q13. A gas initially at a temperature of 0 ^oC and a pressure of 100 kPa is compressed isothermally from 30 L to 20 L. What is the work required?

A) 1.2 kJ

B) 4.2 kJ
C) 0
D) 4.5 kJ
E) 3.0 kJ

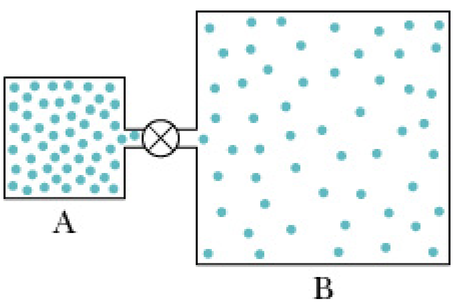
Q14. Specify the **WRONG** statement:

A) Work is a path-independent quantity.
B) One mole is the number of atoms in a 12 g of carbon 12.
C) The internal energy of an ideal gas is a function of gas temperature only.
D) The internal energy is a state function.
E) Kinetic theory of gasses relates the macroscopic properties of gasses to the microscopic properties of gas molecules.

Q15. Container A, of volume 1.0 L, holds 2.0 moles of oxygen. Container B, of volume 4.0 L, holds 2.0 moles of nitrogen. Both containers are isolated and are at the same temperature. The valve between the two containers is open and the molecules of each gas spread to fill the whole volume of the two containers. What is the total entropy change in the process?

A) 30 J/K
B) 27J/K
C) 3.7 J/K
D) 7.4 J/K
E) 53 J/K

Fig#



Q16. An ice cube of mass 400 g at temperature of 0 ^{o}C melts to water at 0 ^{o}C. The process takes place very slowly, so it is reversible. What is the change in entropy of the ice when it has all melted.

A) 488 J/K
B) -488 J/K
C) 1.3×10^{5} J/K
D) -1.3×10^{5} J/K
E) 0

Q17. A carnot heat engine operates between reservoirs at temperatures of 700 K and 300 K. In one cycle it absorbs 1500 J heat. How much work is done by the engine?

A) 857 J
B) 500 J
C) 1000 J
D) 1500 J
E) 750 J

Q18. A carnot refrigerator operating between -20 °C and +20 °C extracts heat from the cold reservoir at the rate 200 J/s. What is the rate at which work is done on the refrigerator?

A) 32 J/s
B) 6.3 J/s
C) 100 J/s
D) 50 J/s
E) 25 J/s

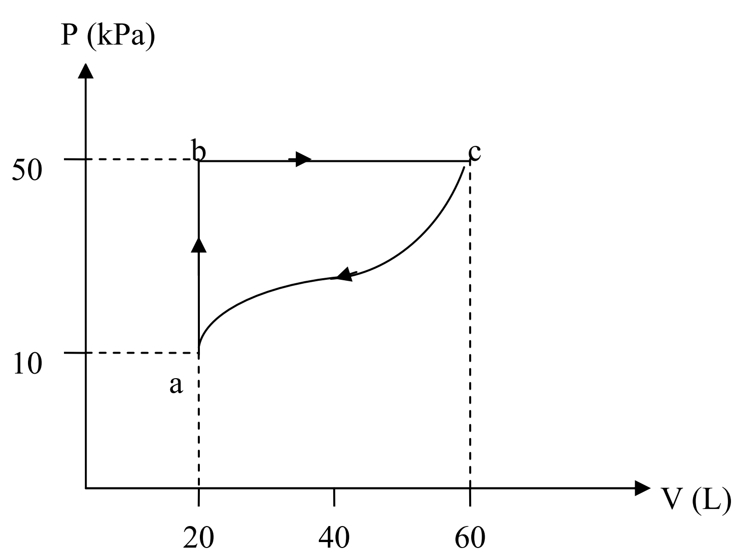
Q19. An ideal monoatomic gas, undergoes an adiabatic expansion to one-third of its initial pressure. Find the ratio of the final volume to the initial volume.

A) 1.9
B) 1.5
C) 2.5
D) 1
E) 3.0

Q20. A gas undergoes the cyclic process shown in the figure1. The net heat absorbed during the complete cycle is 1000 J. Find the work done by the gas for the process c to a.

A) -1000 J
B) 1000 J
C) -1500 J
D) 1500 J
E) -1200 J

Fig#



Physics 102 Major1
Formula sheet
Fall Semester 2007-2008 (Term 071)

$$v = \lambda f = \frac{\omega}{k}$$

$$v = \sqrt{\frac{\tau}{\mu}} \qquad v = \sqrt{\frac{B}{\rho}}$$

$$y = y_m \sin(kx \pm \omega t + \varphi)$$

$$P = \frac{1}{2}\mu\omega^2 y_m^2 v$$

$$S = S_m \cos(kx - \omega t)$$

$$\Delta P = \Delta P_m \sin(kx - \omega t), \Delta P_m = \rho v \omega S_m$$

$$I = \frac{1}{2}\rho(\omega S_m)^2 v$$

$$\beta = 10 \log\left(\frac{I}{I_o}\right), \qquad I_o = 10^{-12}\ W/m^2$$

$$I = \frac{Power}{Area}$$

$$f' = f\left(\frac{v \pm v_D}{v \mp v_s}\right)$$

$$y = \left(2y_m \cos\frac{\varphi}{2}\right)\sin\left(kx - \omega t + \frac{\varphi}{2}\right)$$

$$y = (2y_m \sin kx)\cos\omega t$$

$$f_n = \frac{nv}{2L}, \qquad n = 1,2,3,...$$

$$f_n = \frac{nv}{4L}, \qquad n = 1,3,5...$$

$$\Delta L = \alpha L \Delta T \qquad \Delta V = \beta V \Delta T$$

$$PV = nRT = NkT$$

$$\Delta L = \frac{\lambda}{2\pi}\varphi$$

$$\Delta L = m\lambda \qquad m = 0,1,2,....$$

$$\Delta L = \left(m + \frac{1}{2}\right)\lambda, \qquad m = 0,1,2,.....$$

$$PV^{\gamma} = \text{constant}; \quad TV^{\gamma-1} = \text{constant}$$

$$C_V = \frac{3}{2}R \text{ for monatomic gases,}$$

$$= \frac{5}{2}R \text{ for diatomic gases.}$$

$$T_F = \frac{9}{5}T_C + 32$$

$$Q = mL$$

$$Q = mc\Delta T$$

$$Q = nc\Delta T$$

$$\Delta E_{int} = Q - W$$

$$\Delta E_{int} = nC_V\Delta T$$

$$C_p - C_v = R$$

$$W = \int PdV$$

$$P_{cond} = \frac{Q}{t} = \kappa A \frac{T_H - T_C}{L}$$

$$\frac{m\overline{v^2}}{2} = (3/2)kT, \qquad v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$W = Q_H - Q_L$$

$$\varepsilon = \frac{W}{Q_H} = 1 - \frac{Q_L}{Q_H}$$

$$K = \frac{Q_L}{W}$$

$$\frac{Q_L}{Q_H} = \frac{T_L}{T_H}, \quad \Delta S = \int \frac{dQ}{T}$$

Constants:

1 Liter = 10^{-3} m^3

R = 8.31 J/mol K

N_A = 6.02 x 10^{23} molecules/mole

1 atm = 1.01 x 10^5 N/m^2

k = 1.38 x 10^{-23} J/K

1 calorie = 4.186 Joule

g = 9.8 m/s^2

for water:

$$c = 4190 \frac{J}{kg.K}$$

$$L_F = 333 \frac{kJ}{kg}, \quad L_V = 2256 \frac{kJ}{kg}$$