Q1.
The equation of a transverse sinusoidal wave traveling along a stretched string is:
y (x,t) = 0.035 sin (0.020x + 4.0t) ,where x and y are in meters and t is in seconds.
What is the transverse speed of the particle at x = 0.035 m when t = 0.26 s?

A) 7.1 cm/s
B) 14 cm/s
C) 200 cm/s
D) -14 cm/s
E) 1.8 cm/s

Q2.
A standing wave is set up on a string that is fixed at both ends. The standing wave has four loops and a frequency of 600 Hz. The speed of waves on the string is 400 m/s. What is the length of the string?

A) 1.3 m
B) 0.75 m
C) 0.33 m
D) 3.0 m
E) 2.5 m

Q3.
If you set up the fifth harmonic on a string that is fixed at both ends, which of the following statements is CORRECT?

A) There is an antinode at the middle of the string.
B) There is a node at the middle of the string.
C) There are five nodes.
D) There are four nodes.
E) There are four antinodes.

Q4.
Two identical sinusoidal waves, each having amplitude y_m, are traveling in the same direction on the same stretched string. What phase difference between them will give a resultant wave whose amplitude is 0.5 y_m?

A) 151 degrees
B) 76 degrees
C) 60 degrees
D) 120 degrees
E) 45 degrees

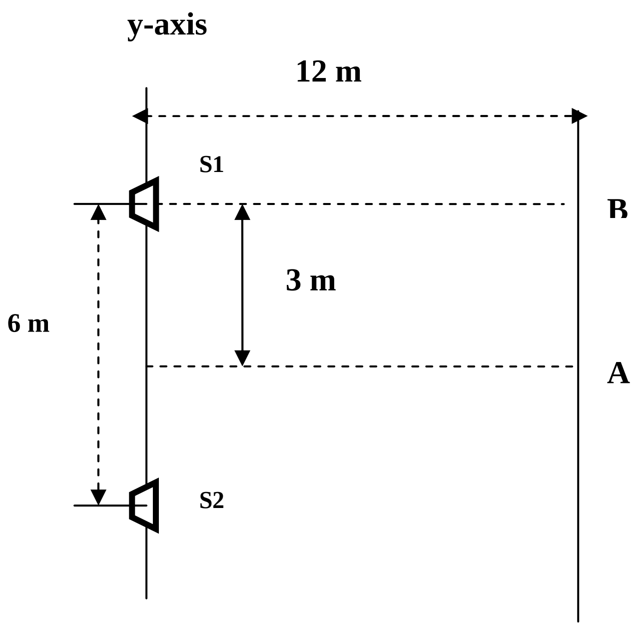
Q5.
A stretched string is 2.70 m long, has a mass of 0.260 kg, and is under a tension of 36.0 N. A wave of amplitude 8.50 mm is traveling on this string. What must be the frequency of the wave for the average power to be 85.0 W?

A) 179 Hz
B) 1120 Hz

C) 795 Hz
D) 127 Hz
E) 193 Hz

Q6.
Two speakers S1 and S2 are placed on the y-axis as shown in figure 1. The speakers are in phase and emit identical sound waves with a given frequency. An observer, standing at point A, hears a sound of maximum intensity. As the observer moves along a straight line parallel to the y-axis and reaches point B, he hears first minimum of sound intensity. The frequency of sound emitted by the speakers is? (speed of sound in air = 343 m/s).

Fig#



A) 121 Hz
B) 520 Hz
C) 250 Hz
D) 100 Hz
E) 370 Hz

Q7.
A stationary train passenger hears a frequency of 520 Hz as a train approaches a bell on a trackside safety gate. After the train passes the gate the passenger hears a frequency of 480 Hz for the bell sound. The speed of the train is : (speed of sound in air = 343 m/s)

A) 13.7 m/s
B) 10.0 m/s
C) 9.0 m/s
D) 15.0 m/s
E) 20.0 m/s

Q8.

The intensity of a certain sound wave is 6 mW/cm^2. If its sound level is raised by 10 decibels, the new intensity (in mW/cm^2) is:

A) 60
B) 6.6
C) 1.0
D) 10
E) 20

Q9.
If the speed of sound is 340 m/s, the two lowest resonance frequencies of a 0.5 m organ pipe, closed at one end, are approximately:

A) 170 and 510 Hz
B) 170 and 340 Hz
C) 340 and 680 Hz
D) 340 and 1020 Hz
E) 57 and 170 Hz

Q10.
A square hole 8.00 cm along each side is cut in a sheet of metal. If the temperature of the sheet is increased by 50 K, the area of the hole increases by 0.11 cm^2. Find the coefficient of **linear expansion** α of the metal

A) 17.2 x10^{-6} ^{o}C^{-1}
B) 10.1 x10^{-6} ^{o}C^{-1}
C) 20.2 x10^{-6} ^{o}C^{-1}
D) 17.2 x10^{-5} ^{o}C^{-1}
E) 19.2 x10^{-5} ^{o}C^{-1}

Q11.
Helium condenses into the liquid phase at approximately 4 K. What temperature in degrees Fahrenheit, does this correspond to?

A) -452
B) -269
C) -118
D) -182
E) -484

Q12.
A gas is compressed from 600 cm^3 to 200 cm^3 at a constant pressure of 400 kPa. At the same time, 100 J of heat energy is transferred out of gas. What is change in the internal energy of the gas during this process?

A) 60 J
B) 100 J
C) - 60 J
D) -100 J

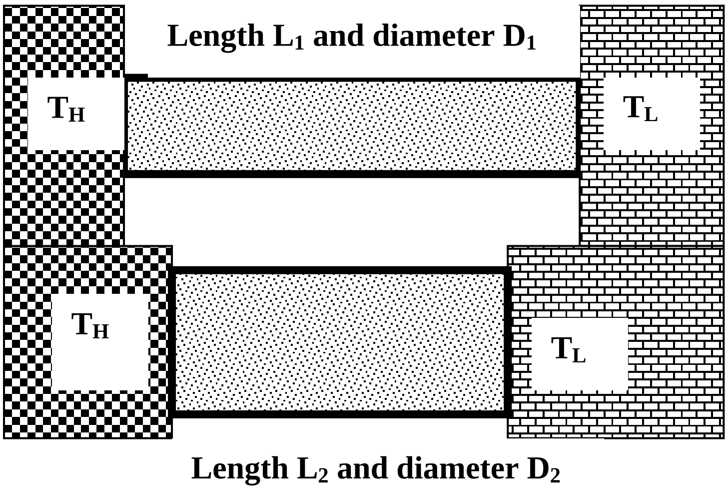
E) 33 J

Q13.
A 15 g ice cube at 0 °C is placed in an aluminum cup whose initial temperature is 70 °C. The system comes to an equilibrium temperature of 20 °C. What is the mass of the cup? (c_{Al} = 900 J/kg.K; $L_{fusion\text{-}ice}$= 333 kJ/kg.K)

A) 140 g
B) 100 g
C) 75 g
D) 50 g
E) 120 g

Q14.
Two cylindrical copper rods with different length L_1 and L_2 and different diameters D_1 and D_2 are connected across two heat reservoirs with temperatures T_L= 0 °C and T_H=100 °C. In the steady state the heat conduction rate through the rod L_1 is half of that through L_2. If L_1=40 cm and D_2 = 1.2 D_1 , the length L_2 is: (κ_{copper} = 385 W/m.K)

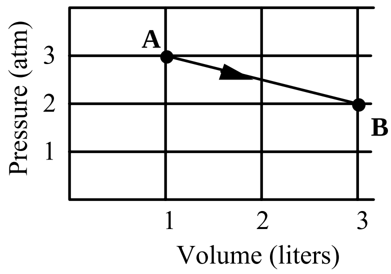
Fig#



A) 29 cm
B) 20 cm
C) 35 cm
D) 11 cm
E) 40 cm

Q15.
An ideal monatomic gas expands from state A to state B along the straight line path shown below. Calculate the heat absorbed by the gas in the process.

Fig#



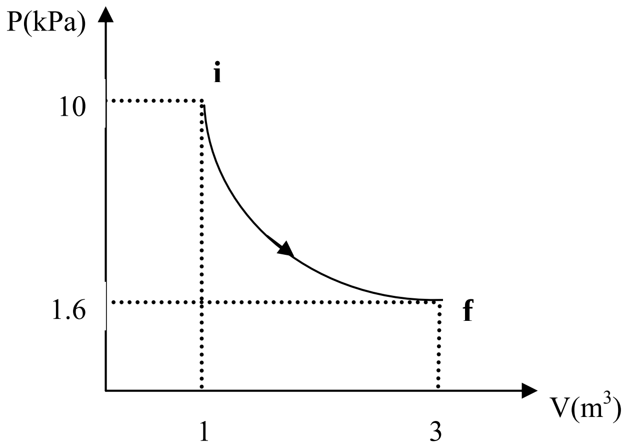
A) +962 J
B) – 56 J
C) + 864 J
D) + 575 J
E) – 575 J

Q16.
An ideal gas is initially at a pressure of 1.40 atm and has a volume of 3.50 L. It expands isothermally to a final pressure of 0.600 atm. What is the work done in the process?

A) + 420 J
B) – 420 J
C) + 300 J
D) – 300 J
E) Zero

Q17.
One mole of an ideal monatomic gas is taken through an adiabatic process, as shown in the figure. Calculate the work done in this process.

Fig#



A) 7.8 kJ
B) 5.5 kJ
C) 4.5 kJ
D) 6.2 kJ
E) 4.2 kJ

Q18.

In an isolated container, a 0.10 kg block of aluminum initially at 600 K is brought into thermal contact with a very large block of iron at 200 K until thermal equilibrium is reached. The iron block is so large that we can assume that its temperature does not change. What is the change in entropy of the iron block? (specific heat of iron is 0.11 kcal/kg.K and specific heat of aluminum is 0.22 kcal/kg.K)

A) 44 cal/K
B) 22 cal/K
C) 15 cal/K
D) Zero
E) 7.0 cal/K

Q19.
A carnot engine completes 4 cycles per second. In every cycle, it delivers a power 120 W and discharges 40 J. what is the efficiency of the engine?

A) 43%
B) 75%
C) 33%
D) 10%
E) 8.3%

Q20.
A refrigerator converts 7.0 kg of water at 0 ^{o}C inti ice at 0 ^{o}C in one hour. What is the coefficient of performance of the refrigerator if its power input is 300 W? Heat of fusion for water is 333 kJ/kg.

A) 2.2
B) 7.7
C) 6.0
D) 1.7
E) 1.2

Test Expected Average = 67

Physics 102 Major1
Formula sheet
<u>Spring Semester 2007-2008 (Term 072)</u>

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$PV = nRT = NkT$

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

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

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

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

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

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

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

$Q = mL$

$Q = mc\Delta T$

$Q = nc\Delta T$

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

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

$C_p - C_v = R$

$W = \int PdV$

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

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

$W = Q_H - Q_L$

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

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

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

<u>Constants:</u>

1 Liter = 10^{-3} m^3
R = 8.31 J/mol K
$N_A = 6.02 \times 10^{23}$ molecules/mole
1 atm = 1.01×10^5 N/m^2
k = 1.38×10^{-23} J/K
1 calorie = 4.186 Joule
g = 9.8 m/s^2
for water:

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

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