First major (043)

1) The displacement of a string carrying a traveling sinusoidal wave is given by

$$y(x,t) = y_m \sin(kx - \omega t - \varphi).$$

At time t = 0 the point at x = 0 has a displacement of zero and is moving in the positive y direction. The phase constant φ is:

a) 180 degrees
b) 90 degrees
c) 135 degrees
d) 45 degrees
e) 270 degrees

2) The mathematical forms for three sinusoidal traveling waves are given by

Wave 1: y(x,t) = (2 cm) sin (3x – 6t)
Wave 2: y(x,t) = (3 cm) sin (4x – 12t)
Wave 3: y(x,t) = (4 cm) sin (5x – 11t)

Where x is in meters and t is in seconds. Which of the following statements is CORRECT?

a) wave 2 has the greatest wave speed and wave 3 has the greatest maximum transverse speed.
b) wave 1 has the greatest wave speed and the greatest maximum transverse speed.
c) wave 2 has the greatest wave speed and wave 1 has the greatest maximum transverse speed.
d) wave 3 has the greatest wave speed and the greatest maximum transverse speed.
e) wave 3 has the greatest wave speed and wave 2 has the greatest maximum transverse speed.

3) A stretched string, fixed at its ends, vibrates in its fundamental frequency. To double the fundamental frequency, keeping the length constant, one needs to increase the string tension by a factor of:

a) 4
b) 2
c) $\sqrt{2}$
d) $\frac{1}{2}$
e) $\frac{1}{\sqrt{2}}$

4) A string that is stretched between fixed supports separated by 80.0 cm has resonant frequencies of 300 and 400 Hz, with no intermediate resonant frequencies. Find the wave speed.

a) 160 m/s

b) 331 m/s
c) 221 m/s
d) 100 m/s
e) 310 m/s

5) The average power of a sound source is 1.00 W. Assume that the source is a point source which emits equally in all directions. At what distance the sound level will be 85.0 dB?

a) 15.9 m
b) 23.4 m
c) 10.7 m
d) 9.8 m
e) 31.0 m

6) Two transmitters, S1 and S2 shown in figure (1) emit identical sound waves of wavelength lambda. The transmitters are separated by a distance 6.0 m. An observer stands at a point X, 8.0 m in front of one of the speakers. The sound he hears will be maximum if the wavelength is:

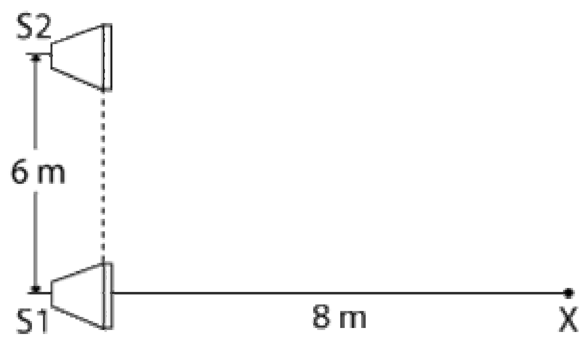

Figure 1

a) 2.0 m
b) 5.0 m
c) 8.0 m
d) 10 m
e) 15 m

7) Sound waves ARE NOT:

a) Transverse waves.
b) Pressure waves.
c) Compression and expansion waves.
d) Longitudinal waves.
e) Mechanical waves.

8) Two cars A and B are traveling towards each other. The speed of car A is twice the

speed of car B. Car A sounds a horn with frequency 400 Hz and the other car B hears the horn frequency as 500 Hz. What is the speed of Car B? Use 344 m/s as the speed of sound in air.

a) 24.6 m / s
b) 30.4 m / s
c) 10.0 m / s
d) 16.3 m / s
e) 29.8 m / s

9) What mass of steam at 100°C be mixed with 250 g of ice at 0°C in a thermally insulated container to produce liquid water at 40.0°C? [C_{water} = 4190 J/Kg. K, Latent heat of vaporization = 2256 x 10^3 J/Kg and Latent heat of Fusion = 333 x 10^3 J/Kg].

a) 49.9 gram
b) 35.0 gram
c) 62.3 gram
d) 11.5 gram
e) 100 gram

10) A copper rod of length 1.20 m, having a diameter of 20.0 mm, has one end in boiling water (100°C) and other end in ice (0°C). How much ice will melt in 120 s? [Take the thermal conductivity of copper as 401 W/(m.K) and the latent heat of fusion of water is 333 x 10^3 J/Kg].

a) 3.78 g
b) 10.0 g
c) 1.35 g
d) 15.0 g
e) 8.43 g

11) A system of an ideal gas goes through the cycle shown in Figure (2). Find the net work done after the system goes through the same cycle 15 times. Take P = 1.0 kPa and V = 1.0 m^3.

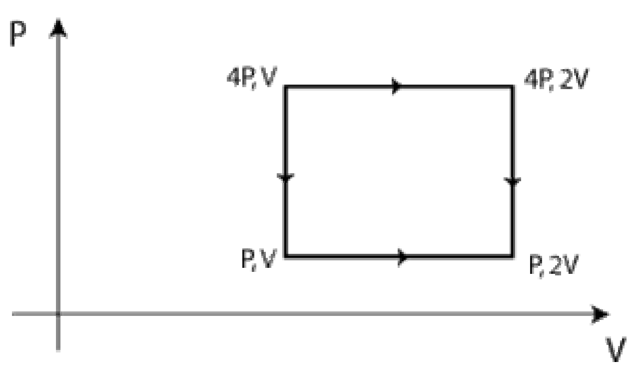

Figure 2

a) 45 kJ
b) 75 kJ
c) 60 kJ
d) 30 kJ
e) 0

12) Which of the following statements is NOT CORRECT?

a) If the temperature of a system is increased, the volume remains constant in an adiabatic process
b) In a cyclic process the internal energy remains constant
c) In an adiabatic process the transfer of heat energy is zero
d) The work done is zero in an isovolumetric (constant volume) process
e) Heat energy can be transferred only between bodies having different temperatures

13) Three moles of an ideal gas are initially at 20.0^{o}C and a pressure of 1.00 atmosphere. Find the work done by the gas if the volume is doubled isothermally.

a) 5.06 kJ
b) 7.27 kJ
c) 3.41 kJ
d) 4.31 kJ
e) 0

14) One mole of an ideal gas is first compressed isothermally at 350 K to 50 percent of its initial volume. Then 400 J of heat is added to it at constant volume. Find the total change in the internal energy after the gas has passed through the above two processes.

a) + 0.400 kJ
b) - 0.400 kJ
c) + 2.40 kJ
d) – 2.40 kJ
e) – 1.60 kJ

15) Two moles of an ideal gas initially at a temperature of 20.00^{o}C and a pressure of 150.0 kPa, expand adiabatically to twice its original volume. Find the work done by the gas given that gamma = 1.400 and C_V = 20.90 J/mol.K.

a) +2970 J
b) +3380 J
c) -3380 J
d) -2500 J
e) 0

16) Rank paths 1, 2, 3 and 4 in Fig. 3 according to the heat transfer to the gas, GREATEST FIRST.

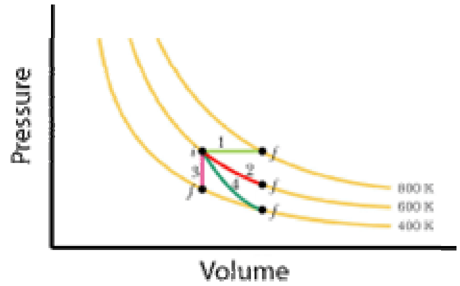

Figure 3

a) 1, 2, 4, 3
b) 2, 1, 3, 4
c) 3, 4, 1, 2
d) 4, 3, 2, 1
e) 1, 2, 3, 4

17) One mole of an ideal monatomic gas, initially at a pressure P and volume V is heated to a final state with a pressure 2P and volume 1.6 V. Calculate the change in entropy of the gas.

a) 18.4 J/K
b) -2.5 J/K
c) 35.0 J/K
d) -25.0 J/K
e) 5.0 J/K

18) An ideal refrigerator has a coefficient of performance of 5.0. If the outside temperature in the kitchen is 29^{o}C, find the lowest temperature that could be obtained inside the refrigerator.

a) 252 K
b) 230 K
c) 273 K
d) 200 K
e) 180 K

19) An ice-cube at 0^{o}C is converted into water at 15^{o}C. If the entropy of the ice-cube has increased by 10 J/K, find the mass of the ice cube (Latent heat of fusion of ice = 333 kJ/Kg, C_{water} = 4190 J/kg.K).

a) 6.9 g
b) 3.5 g
c) 1.3 g

d) 10 g
e) 20 g

20) If a heat engine absorbs 9.0 kJ from a hot reservoir at 600 K and rejects 6.0 kJ to outside at a temperature 300 K, find the difference between the efficiencies of the heat engine and a Carnot engine operating between the same temperatures.

a) 0.167
b) 0.333
c) 0.500
d) 0.830
e) 0.420

Physics 102 Major1
Formula sheet
Summer Sesion 2004-2005 (Term 043)

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

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

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

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

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

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

$$\beta = (10dB)\log\left(\frac{I}{I_o}\right)$$

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

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

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

$$f_n = \frac{nv}{2L},$$

$$f_n = \frac{nv}{4L},$$

$$\Delta L = \alpha L \Delta T$$

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

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

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

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

$$T_K = T_c + 273$$

$$Q = mL, \; Q = mc\Delta T$$

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

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

$$C_p - C_v = R$$

$$W = \int P dV$$

$$PV = nRT = NkT$$

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

$$\frac{m\overline{v^2}}{2} = (3/2)kT$$

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$Q = nc_p\Delta T, \quad Q = nc_v\Delta T$$

$$W = Q_H - Q_L$$

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

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

Constants:

Pi = π, lambda = λ

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

I_o = 10^{-12} W/m^2

1 calorie = 4.186 Joule

micro = 10^{-6}

for water: L_f = 333 kJl/kg

L_v = 2256 kJ/kg

c = 4.186 kJ/kg.K

$$a*b**c = a\,b^c$$