Q1.
A uniform wire, having a mass of 0.4 kg and length of 6.5 m, is connected to a pulse generator. The tension is maintained in the wire by suspending a 3.5 kg mass on the other end. Find the time it takes a pulse to travel from a pulse generator to the other end.

A) 0.28 s
B) 0.35 s
C) 0.40 s
D) 0.15 s
E) 2.00 s

Q2.
Two identical traveling waves, with a phase difference ϕ, are moving in the same direction. If they are interfering and the combined wave has an amplitude 0.5 times that of the common amplitude of the two waves, calculate ϕ (in radians).

A) 2.64
B) 3.50
C) 0.75
D) 1.30
E) 0.13

Q3.
A string, fixed at its ends, vibrates according to the equation

$$y = 0.5 \sin(1.5\pi x)\cos(40\pi t)$$

where x and y are in meters and t is in seconds. What are the amplitude and velocity of the component waves whose superposition can give rise to this wave?

A) 0.25 m, 26.7 m/s
B) 0.50 m, 26.7 m/s
C) 0.25 m, 52.3 m/s
D) 0.50 m, 52.3 m/s
E) 0.15 m, 100 m/s

Q4.
When a wave travels through a medium, individual particles execute a periodic motion given by the equation:

$$y = 4.0 \sin\left[\frac{\pi}{4}\left(2t + \frac{x}{8}\right)\right]$$

where x and y are in meters and t is in seconds. The phase difference at any given instant between two particles that are 20.0 m apart is:

A) 112.5°

B) 65.6°

C) 130°

D) 134.2°

E) 224°

Q5.

A string is fixed at both ends. On increasing the tension in the string by 2.5 N, the fundamental frequency is altered in the ratio of 3 : 2. The original stretching force is:

A) 2 N
B) 4 N
C) 3 N
D) 5 N
E) 6 N

Q6.

A 2.5 m long tube, open at both ends, is filled with a gas. The frequency of a certain harmonic is 500 Hz and the frequency of the next harmonic is 600 Hz. What is the speed of sound in the tube?

A) 500 m/s
B) 400 m/s
C) 336 m/s
D) 999 m/s
E) 343 m/s

Q7.

The intensity of a sound wave of frequency 360 Hz is 1.6×10^{-6} W/m^2. If the speed of sound in air is 343 m/s, what is the displacement amplitude of the air molecules oscillation caused by this wave? (ρ_{air}=1.21 kg.m^3).

A) 3.88×10^{-8} m
B) 1.67×10^{-6} m
C) 8.1×10^{-6} m
D) 8.5×10^{-7} m
E) 18 m

Q8.

A person is listening to sounds from two different sources simultaneously. One source has sound level of 80 dB, while the other has 90 dB. What combined sound level will the person hear?

A) 90.4 dB
B) 94.0 dB

C) 85.3 dB
D) 12.0 dB
E) 230 dB

Q9.
Two trucks are heading straight toward each other with the same speed "U". The horn of one, with frequency $f_s = 3000$ Hz , is blowing, and is heard to have a frequency of 3200 Hz by the people in the other truck. Find "U" if the speed of sound is 340 m/s.

A) 11 m/s
B) 14 m/s
C) 31 m/s
D) 25 m/s
E) 20 m/s

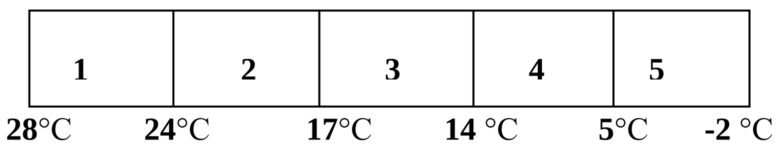
Q10.
A metal rod has a length of 7.30 m at 15 °C and a length of 7.40 m at 95 °C. What is the temperature of the rod when its length is 7.21 m?

A) -57 ^{o}C
B) -23 ^{o}C
C) 10 ^{o}C
D) 7 ^{o}C
E) 2 ^{o}C

Q11.
100 g of ice at 0 °C is mixed with 100 g of water at 70 °C, what is the final temperature of the mixture?

A) 0 ^{o}C
B) 100 ^{o}C
C) 22 ^{o}C
D) 36 ^{o}C
E) 15 ^{o}C

Q12.
The Figure shows five slabs of different materials with equal thickness and same cross sectional area, placed side by side. Heat flows from left to right and steady state temperatures are given at the interfaces. Which slab has largest thermal conductivity?



A) 3
B) 5
C) 4
D) 2
E) 1

Q13.
A temperature difference of 25 K is equal to:

A) a difference of 45 on the Fahrenheit Scale.
B) a difference of 30 on the Celsius Scale.
C) a difference of 30 on the Kelvin Scale.
D) a difference of 25 on the Fahrenheit Scale.
E) a difference of 45 on the Celsius Scale.

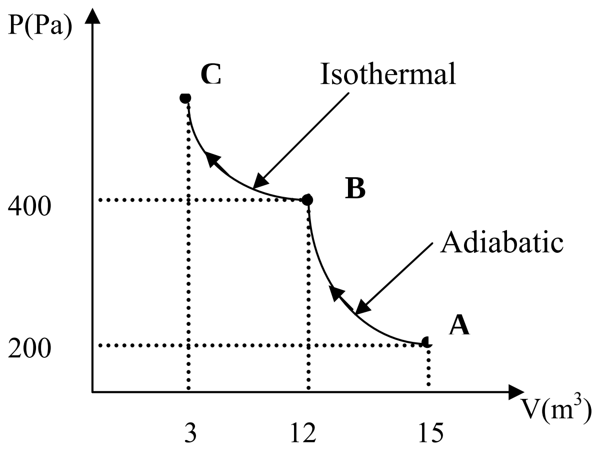
Q14.
One mole of an ideal monatomic gas, initially at 300 K, expands adiabatically to twice of its initial volume. The work done in this process is:

A) 1.4 kJ
B) −1.4 kJ
C) 2.9 kJ
D) − 2.9 kJ
E) 3.6 kJ

Q15.
One mole of a monatomic ideal gas absorbs heat at constant pressure and its temperature rises from 40 °C to 90 °C. The heat absorbed in the process is

A) 1.0 kJ
B) 2.4 kJ
C) 1.8 kJ
D) 3.3 kJ
E) 2.9 kJ

Q16.
Two moles of an ideal monatomic gas are compressed adiabatically from A to B and then further compressed isothermally from B to C as shown in the figure. Calculate the net heat transfer in the process from A to C.



A) -6.7 kJ
B) 6.7 kJ
C) -3.3 kJ
D) 3.3 kJ
E) 36 kJ

Q17.
If the internal energy of an ideal gas decreases by the same amount as the work done by the system, then

A) the process must be adiabatic
B) the process must be isothermal
C) the process must be isobaric
D) the process must be isochoric
E) the process must be cyclic

Q18.
A system consists of an equilibrium mixture of ice and water at constant pressure. On heating the system, **some** of the ice melts, then

A) the entropy increases
B) the entropy decreases
C) the temperature decreases
D) the internal energy decreases
E) the temperature increases

Q19.
The change in entropy for melting 6.0 kg of a solid which melts at 27 ^{o}C is:
[The latent heat of fusion of the solid is 2.5×10^{4} J/kg]

A) $+5.0\times10^{2}$ J/K

B) -5.0×10^{2} J/K

C) $+5.6\times10^{3}$ J/K

D) -5.6×10^{3} J/K

E) zero

Q20.

A Carnot heat engine operates between two reservoirs at temperatures of 500 K and 375 K. If the engine extracts 6.0×10^{7} J/cycle, find the heat rejected per cycle.

A) 4.5×10^{7} J/cycle

B) 1.5×10^{7} J/cycle

C) 2.5×10^{7} J/cycle

D) 7.5×10^{7} J/cycle

E) 1.0×10^{7} J/cycle

Physics 102 Major1
Formula sheet
Spring Semester 2006-2007 (Term 062)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$PV = nRT = NkT$$

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

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

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

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

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

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

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

$$Q = mL$$

$$Q = mc\Delta T$$

$$Q = nc\Delta T$$

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

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

$$C_p - C_v = R$$

$$W = \int P dV$$

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

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

$$W = Q_H - Q_L$$

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

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

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

Constants:

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

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

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