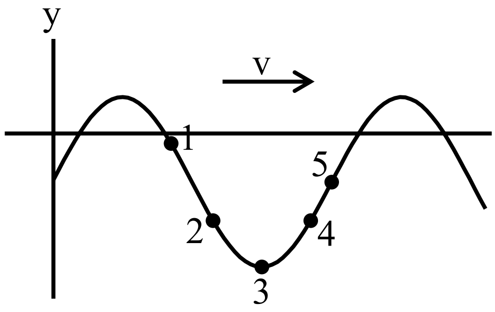
Q1.
Which statement is correct?



A) Particle 1 is moving upward.
B) Particle 3 has zero acceleration.
C) Particle 5 has zero velocity.
D) Particle 2 is moving downward.
E) Particle 4 is moving upward.

Sec# Wave - I - Transverse and Longitudinal Waves
Grade# 70

Q2.
A sinusoidal string wave traveling in the negative x direction has an amplitude of 0.20 mm and a frequency of 10 Hz. If the string has a linear mass density 0.50 kg/m and is under a tension of 10 N, what is the equation of the wave?

A) y = (0.20 mm) sin(14 x + 63 t).
B) y = (0.20 mm) sin(14 x – 63 t).
C) y = (0.10 mm) sin(14 x + 63 t).
D) y = (0.20 mm) sin(88 x – 63 t).
E) y = (0.20 mm) sin(88 x + 63 t).

Sec# Wave - I - Wavelength and Frequency
Grade# 45

Q3.
A sinusoidal string wave has an amplitude of 6.0 mm and a frequency of 20 Hz. If the string has a linear mass density of 100 g/m and is under a tension of 10 N, what is the average power transmitted by the wave?

A) 0.28 W.
B) 0.028 W.
C) 24 W.
D) 0.14 W.
E) 1.4 W.

Sec# Wave - I - Energy and Power of a Traveling String Wave
Grade# 60

Q4.
Standing waves are produced on a string at the two consecutive resonant frequencies 120 and 160 Hz. If the string has a length of 3.0 m, what is the distance between two adjacent nodes at the resonant frequency 240 Hz?

A) 0.50 m.
B) 1.0 m.
C) 1.5 m.
D) 0.25 m.
E) 0.75 m.

Sec# Wave - I - Standing Waves and Resonance
Grade# 50

Q5.
The sound intensity 5.0 m from a point source is 0.50 W/m^2. The power output of the source is

A) 160 W.
B) 79 W.
C) 31 W.
D) 10 W.
E) 310 W.

Sec# Wave - II - Intensity and Sound Level
Grade# 90

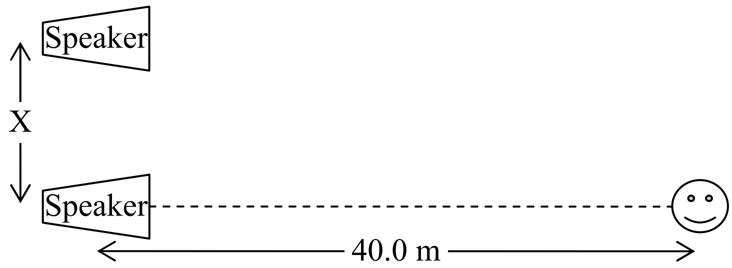
Q6.
A tube is open at one end and closed at the other. The shortest length of such a tube that will resonate with a 200 Hz tuning fork is 42.1 cm. The speed of sound in tube must be

A) 337 m/s.
B) 343 m/s.
C) 331 m/s.
D) 168 m/s.
E) 84 m/s.

Sec# Wave - II - Source of Musical Sound
Grade# 50

Q7.
Two small identical speakers are connected to the same sinusoidal source. At a distance 40.0 m in front of one speaker, the sound intensity is minimum at two consecutive frequencies 4500 Hz and 7500 Hz. What is the distance X between the speakers? The speed of sound in air is 343 m/s.

Fig#



A) 3.0 m.
B) 2.1 m.
C) 1.5 m.
D) 4.5 m.
E) 8.5 m.

Sec# Wave - II - Interference
Grade# 40

Q8.
An ambulance with speed v/8, where v is the speed of sound, emits a siren of frequency 700 Hz. What is the frequency heard by a stationary observer toward whom the ambulance is moving?

A) 800 Hz.
B) 622 Hz.
C) 788 Hz.
D) 612 Hz.
E) 700 Hz.

Sec# Wave - II - The Doppler Effect
Grade# 65

Q9.
The coefficient of linear expansion of steel is 11×10^{-6} per C^o. A steel ball has a volume of 100.00 cm^3 at 0^o C. When heated to 100^o C, its volume becomes

A) 100.33 cm^3.
B) 100.11 cm^3.
C) 100.22 cm^3.
D) 0.11 cm^3.
E) 0.33 cm^3.

Sec# Temerature, Heat, and the First Law of Thermodynamics - Thermal Expansion
Grade# 70

Q10.

Ten grams of ice at – 20^o C is to be changed to steam at 130^o C. The specific heat of water is 1 cal/g C^o, and the specific heats of both ice and steam are 0.5 cal/g C^o. The heat of fusion is 80 cal/g and the heat of vaporization is 540 cal/g. The entire process requires

A) 7450 cal.
B) 750 cal.
C) 1250 cal.
D) 6950 cal.
E) 7700 cal.

Sec# Temerature, Heat, and the First Law of Thermodynamics - The Absorption of Heat by Solids and Liquids
Grade# 45

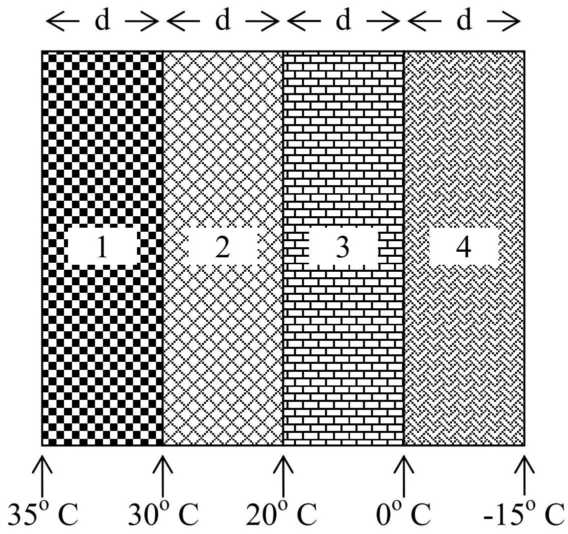
Q11.
According to the first law of thermodynamics, applied to a gas, the change in the internal energy during any process is

A) equal to the heat input plus the work done on the gas.
B) equal to the heat input plus the work done by the gas.
C) equal to the work done on the gas minus the heat input.
D) independent of the heat input.
E) independent of the work done on the gas.

Sec# Temerature, Heat, and the First Law of Thermodynamics - The First Law of Thermodynamics
Grade# 60

Q12.
The diagram shows four slabs of different materials with equal thickness and equal cross sectional area, placed side by side. Heat flows from left to right and steady-state temperatures of the interfaces are given. Rank the materials according to their thermal conductivities, smallest to largest.

Fig#



A) 3, 4, 2, 1.
B) 1, 2, 4, 3.
C) 3, 4, 1, 2.
D) 1, 2, 3, 4.
E) 4, 3, 2, 1.

Sec# Temerature, Heat, and the First Law of Thermodynamics - Heat Transfer Mechanisms
Grade# 65

Q13.
500 cm^3 of an ideal gas at 40 °C and 200 kPa is compressed to 250 cm^3 and cooled to 20 °C. What is the final pressure?

A) 374 kPa.
B) 748 kPa.
C) 200 kPa.
D) 100 kPa.
E) 512 kPa.

Sec# The kinetic Theory of Gases - Ideal Gases
Grade# 50

Q14.
An ideal gas that initially occupies 0.140 m^3 at a pressure of 204.0 kPa is expanded isothermally to a pressure of 202.3 kPa. The work done by the gas is

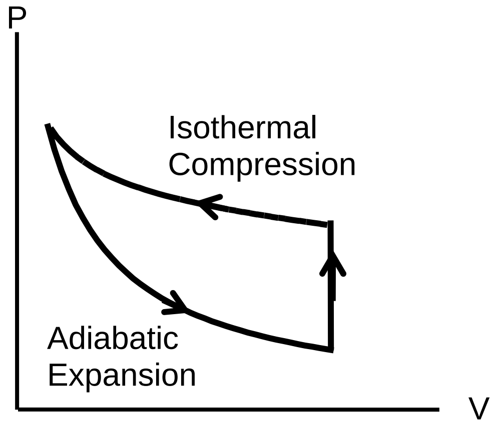
A) 239 J.
B) 140 J.
C) – 140 J.
D) 533 J.
E) Zero.

Sec# The kinetic Theory of Gases - Ideal Gases

Grade# 55

Q15.
For the cyclic process shown in the figure,

Fig#

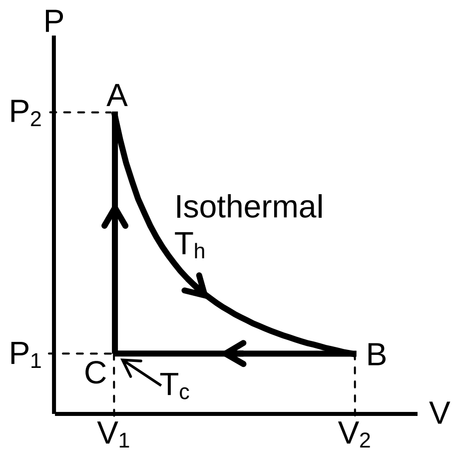


A) net thermal energy is transferred from the gas to the surroundings.
B) the net work done by the gas on the surroundings is positive.
C) the net work done by the gas on the surroundings is zero.
D) the internal energy of the gas increases.
E) the internal energy of the gas decreases.

Sec# The kinetic Theory of Gases - The Adiabatic Expansion of an Ideal Gas
Grade# 35

Q16.
Suppose one mole of an ideal gas undergoes the reversible cycle ABCA as shown in the figure, where AB is an isotherm and the temperature at point C is T_c. The net heat added to the gas during the cycle is equal to

Fig#



A) $RT_h \ln V_2 / V_1 - R(T_h - T_c)$.
B) $-C_p (T_h - T_c)$.
C) $-C_v (T_h - T_c)$.
D) $RT_h \ln V_2 / V_1 - C_p (T_h - T_c)$.
E) $RT_h V_2 / V_1$.

Sec# The kinetic Theory of Gases - The Molar Specific Heats of an Ideal Gas
Grade# 50

Q17.
A piece of metal at 80 ^{o}C is placed in 1.2 kg of water at 72 ^{o}C. The system is thermally isolated and reaches to a final temperature of 75 ^{o}C. Find the change in entropy for the metal. The specific heat of water is 4.19 kJ/kgK.

A) – 43.0 J/K.
B) + 43.0 J/K.
C) – 200 J/K.
D) – 194 J/K.
E) + 194 J/K.

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy
Grade# 35

Q18.
Two moles of an ideal gas undergo an adiabatic free expansion from an initial volume of 0.60 L to 1.2 L. Calculate the change in entropy of gas.

A) + 12 J/K.
B) – 24 J/K.
C) + 24 J/K.
D) – 12 J/K.
E) Zero.

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy
Grade# 45

Q19.
An ideal Carnot heat engine operates between 40 ^{o}C and 300 ^{o}C. If the engine absorbs heat at a rate of 40 kW, at what rate does it exhaust heat?

A) 22 kW.
B) 5.3 kW.
C) 73 kW.
D) 300 kW.
E) 35 kW

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World: Engines
Grade# 55

Q20.
An ideal refrigerator has a coefficient of performance of 5. If the temperature inside the refrigerator is -20^o C, what is the temperature at which it releases heat?

A) 31^o C.
B) -5^o C.
C) 20^o C.
D) 27^o C.
E) 42^o C.

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World: Refrigerators
Grade# 50

Test Expected Average = 54

Physics 102 Major1
Formula sheet
Summer Semester 2007-2008 (Term 073)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$PV = nRT = NkT$

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

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

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

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

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

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

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

$Q = mL$

$Q = mc\Delta T$

$Q = nc\Delta T$

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

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

$C_p - C_v = R$

$W = \int P dV$

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

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

$W = Q_H - Q_L$

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

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

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

Constants:

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

R = 8.31 J/mol K

$N_A = 6.02 \times 10^{23}$ molecules/mole

1 atm = 1.01×10^5 N/m^2

k = 1.38×10^{-23} J/K

1 calorie = 4.190 Joule

g = 9.8 m/s^2

for water:

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

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