Q1.
A transverse sinusoidal wave, travelling in the positive *x* direction along a string, has an amplitude of 20 cm. The transverse position of an element of the string at $t = 0$, $x = 0$ is $y = + 3.0$ cm, and the element has negative velocity. What is the phase constant of this wave?

A) 0.15 rad
B) 6.1 rad
C) 1.4 rad
D) 0.29 rad
E) 0.14 rad

Sec# Wave - I - Wavelength and Frequency
Grade# 50
Stat# A_72_DIS_0.36_PBS_0.32_B_5_C_13_D_5_E_5_EXP_50_NUM_735

Q2.
A transverse sinusoidal wave on a string is described by the wave function
$y(x,t) = 0.15 \sin(0.80x - 50t)$, where *x* and *y* are in meters and *t* is in seconds. The mass per unit length of the string is 12 g/m. What is the average power transmitted by the wave?

A) 21 W
B) 42 W
C) 10 W
D) 14 W
E) 32 W

Sec# Wave - I - Energy and Power of a Traveling String Wave
Grade# 58
Stat# A_90_DIS_0.24_PBS_0.30_B_4_C_1_D_3_E_1_EXP_58_NUM_735

Q3.
Two identical sinusoidal transverse waves travel along a stretched string. Each wave has an amplitude y_m and wavelength λ. If the phase difference between the two waves is 0.20 λ, what is the amplitude of the resultant?

A) 1.6 y_m
B) 0.80 y_m
C) 0.45 y_m
D) 3.5 y_m
E) 4.8 y_m

Sec# Wave - I - Interference of Waves
Grade# 51
Stat# A_62_DIS_0.54_PBS_0.43_B_15_C_11_D_6_E_6_EXP_51_NUM_735

Q4.
A standing wave, having three nodes, is set up on a string fixed at both ends. If the frequency of the wave is doubled, how many **antinodes** will there be?

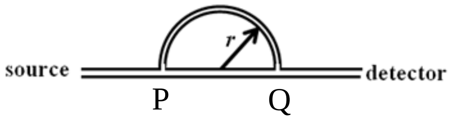
A) 4

B) 3
C) 5
D) 6
E) 7

Sec# Wave - I - Standing Waves and Resonance
Grade# 51
Stat# A_47_DIS_0.49_PBS_0.41_B_9_C_21_D_16_E_7_EXP_51_NUM_735

Q5.
A sound wave enters a tube at the source end, as shown in figure 1. At point P, the sound wave splits into two waves that recombine at point Q. The radius of the semicircle is varied until the first minimum is observed at the detector when r = 50.0 cm. What is the wavelength of sound?

Fig#



A) 114 cm
B) 228 cm
C) 456 cm
D) 152 cm
E) 304 cm

Sec# Wave - II - Interference
Grade# 48
Stat# A_33_DIS_0.33_PBS_0.29_B_21_C_11_D_19_E_16_EXP_48_NUM_735

Q6.
A source emits sound with equal intensity in all directions. If the displacement amplitude is doubled, the sound level increases by

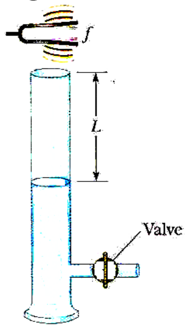
A) 6 dB
B) 3 dB
C) 2 dB
D) 4 dB
E) 5 dB

Sec# Wave - II - Intensity and Sound Level
Grade# 41
Stat# A_40_DIS_0.74_PBS_0.57_B_12_C_11_D_33_E_4_EXP_41_NUM_735

Q7.
A tuning fork with a frequency of 512 Hz is placed near the top of the tube shown in figure 2. The water level is lowered, by opening the valve, so that the length L slowly increases from

an initial value of 20.0 cm. Determine the next value of L that corresponds to a resonance. Take the speed of sound in air to be 343 m/s.

Fig#

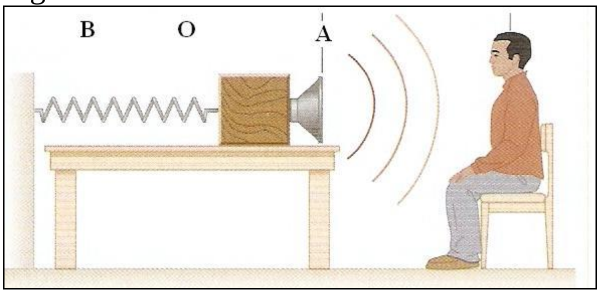


A) 50.2 cm
B) 16.7 cm
C) 83.7 cm
D) 117 cm
E) 33.5 cm

Sec# Wave - II - Source of Musical Sound
Grade# 40
Stat# A_36_DIS_0.38_PBS_0.31_B_16_C_12_D_7_E_29_EXP_40_NUM_735

Q8.
A block, with a speaker attached to it, is connected to a spring and oscillates on a frictionless table between points A and B, as shown in figure 3. The speaker emits sound that is received by a person. The closest point of the block to the person is A, the farthest point is B, and O is the equilibrium point of the spring (neither stretched nor compressed). What position of the speaker corresponds to the highest frequency observed by the person?

Fig#



A) Point O travelling to the right.
B) Point O travelling to the left.
C) Point A.
D) Point B.
E) The frequency is the same everywhere.

Sec# Wave - II - The Doppler Effect
Grade# 48
Stat# A_45_DIS_0.54_PBS_0.43_B_9_C_22_D_6_E_19_EXP_48_NUM_735

Q9.

A block of ice, with a mass of 6.30 kg at 0.00 °C, is added to a certain amount of water. The water is cooled from 100 to 0.00 °C. What is the mass of water used? Assume that all the ice melted.

A) 5.01 kg
B) 2.04 kg
C) 3.42 kg
D) 1.50 kg
E) 6.05 kg

Sec# Temerature, Heat, and the First Law of Thermodynamics - The Absorption of Heat by Solids and Liquids
Grade# 58
Stat# A_76_DIS_0.56_PBS_0.52_B_7_C_9_D_4_E_4_EXP_58_NUM_735

Q10.
Consider a copper slab of thickness 19 cm and cross sectional area 5.0 m^2. Heat is conducted from the left to the right of the slab at a rate of 1.2 MW. If the temperature on the left of the slab is 102 °C, what is the temperature on the right of the slab? (The thermal conductivity of copper is 400 W/m·K)

A) –12 °C
B) +12 °C
C) –20 °C
D) +20 °C
E) +42 °C

Sec# Temerature, Heat, and the First Law of Thermodynamics - Heat Transfer Mechanisms
Grade# 59
Stat# A_54_DIS_0.77_PBS_0.59_B_18_C_7_D_13_E_8_EXP_59_NUM_735

Q11.
Consider benzene liquid filling completely a steel container of volume 100 cm^3 at 20.0 °C. Calculate the coefficient of volume expansion of benzene when 0.372 cm^3 of benzene spills over from the tank as its temperature is raised to 50.0 °C. (Neglect the thermal expansion of the container)

A) 1.24×10^{-4} /C°
B) 3.68×10^{-4} /C°
C) 5.32×10^{-4} /C°
D) 2.34×10^{-5} /C°
E) 4.33×10^{-4} /C°

Sec# Temerature, Heat, and the First Law of Thermodynamics - Thermal Expansion
Grade# 61
Stat# A_77_DIS_0.54_PBS_0.50_B_11_C_3_D_4_E_5_EXP_61_NUM_735

Q12.
Which of the following statements are **WRONG**?
1. Two objects are in thermal equilibrium if they have the same temperature.

2. In an isothermal expansion, the work done by the gas is equal to the change in its internal energy.
3. In an adiabatic process, heat lost by the gas is equal to the work done on the gas.
4. In an isochoric process, heat exchanged is equal to the change in internal energy of the gas.

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

Sec# Temerature, Heat, and the First Law of Thermodynamics - The First Law of Thermodynamics
Grade# 45
Stat# A_75_DIS_0.50_PBS_0.44_B_5_C_7_D_4_E_10_EXP_45_NUM_735

Q13.
Consider an isothermal compression of an ideal gas at a temperature of 0.00 ºC. The initial pressure of the gas is 1.0 atm and the final volume is 1/5 the initial volume. Find the number of moles of the gas if it loses 365 J of heat during the process.

A) 0.10 moles
B) 0.63 moles
C) 2.0 moles
D) 3.4 moles
E) 1.5 moles

Sec# The kinetic Theory of Gases - Ideal Gases
Grade# 55
Stat# A_60_DIS_0.65_PBS_0.51_B_11_C_10_D_9_E_10_EXP_55_NUM_735

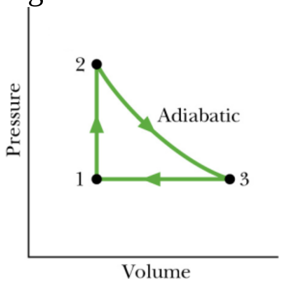
Q14.
For a temperature increase of ΔT, a certain amount of a monatomic ideal gas requires 50 J of heat when heated at constant volume, and 83 J of heat when heated at constant pressure. How much work is done by the gas in the second situation?

A) 33 J
B) 130 J
C) 67 J
D) 90 J
E) 50 J

Sec# The kinetic Theory of Gases - The Distribution of Molecular Speeds
Grade# 44
Stat# A_65_DIS_0.48_PBS_0.40_B_7_C_12_D_6_E_9_EXP_44_NUM_735

Q15.
Figure 4 shows a cycle undergone by 1.0 mole of an ideal diatomic gas. The temperatures are T_1 = 400 K, T_2 = 700 K, and T_3 = 555 K. Calculate the net work done in one cycle.

Fig#



A) 1.7 kJ by the gas
B) 1.7 kJ on the gas
C) 3.8 kJ on the gas
D) 3.8 kJ by the gas
E) 0.52 kJ by the gas

Sec# The kinetic Theory of Gases - The Adiabatic Expansion of an Ideal Gas
Grade# 44
Stat# A_42_DIS_0.55_PBS_0.43_B_19_C_12_D_17_E_10_EXP_44_NUM_735

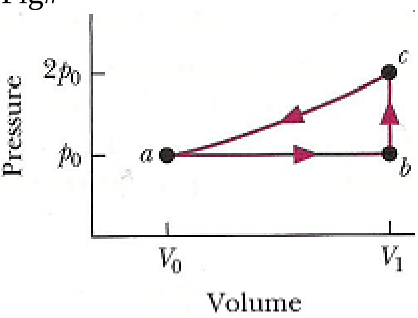
Q16.
The temperature of an ideal gas is reduced from 100 ^{o}C to 20 ^{o}C. The rms speed of its molecules decreases by:

A) 11%
B) 22%
C) 47%
D) 55%
E) 71%

Sec# The kinetic Theory of Gases - Pressure, Temperature and RMS Speed
Grade# 44
Stat# A_39_DIS_0.58_PBS_0.47_B_19_C_15_D_19_E_8_EXP_44_NUM_735

Q17.
Two moles of a monatomic ideal gas are taken through the cycle shown in figure 5. The change in entropy in going from *b* to *c* is:

Fig#

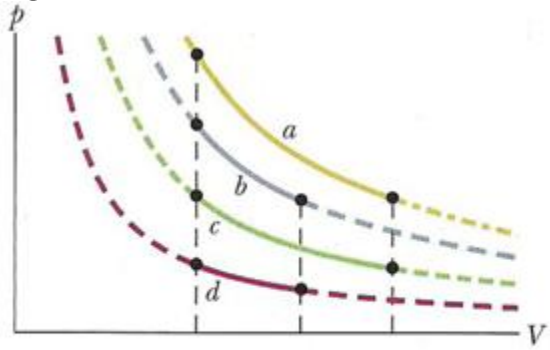


A) + 17.3 J/K
B) – 17.3 J/K
C) – 2.17 J/K
D) – 34.6 J/K

E) + 34.6 J/K

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy
Grade# 53
Stat# A_50_DIS_0.59_PBS_0.45_B_22_C_5_D_11_E_12_EXP_53_NUM_735

Q18.
In four experiments, 3 moles of an ideal gas undergo **reversible isothermal expansions**, starting from the same volume but at different temperatures. The corresponding *p*-*V* plots are shown in figure 6. Rank the four situations *a*, *b*, *c*, and *d* according to the change in the entropy of the gas, **greatest first**.

Fig#


A) ***(a* and *c)*** tie, then ***(b* and *d)*** tie.
B) ***a***, then ***b***, then ***c***, then ***d***.
C) ***d***, then ***c***, then ***b***, then ***a***.
D) ***(b* and *d)*** tie, then ***(a* and *c)*** tie.
E) ***(a* and *d)*** tie, then ***(b* and *c)*** tie

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy
Grade# 55
Stat# A_58_DIS_0.45_PBS_0.34_B_14_C_11_D_12_E_5_EXP_55_NUM_735

Q19.
A Carnot engine whose cold reservoir is at 15 ^{o}C has an efficiency of 34%. Then, the temperature of the hot reservoir is fixed while that of the cold reservoir is decreased. What should the temperature of the cold reservoir be in order to make the efficiency of this engine equal to 36%?

A) 6.3 ^{o}C
B) 280 ^{o}C
C) 160 ^{o}C
D) 7.2 ^{o}C
E) 12 ^{o}C

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World: Engines
Grade# 45
Stat# A_54_DIS_0.70_PBS_0.55_B_9_C_6_D_12_E_19_EXP_45_NUM_735

Q20.

A Carnot air conditioner takes heat from a room at 21 °C and transfers it to the outdoors, which is at 35 °C. For each two joules of electric energy required to operate the air conditioner, how many joules are removed from the room in the form of heat?

A) 42 J
B) 21 J
C) 1.7 J
D) 3.3 J
E) 2.0 J

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World: Refrigerators
Grade# 48
Stat# A_44_DIS_0.71_PBS_0.53_B_17_C_12_D_15_E_12_EXP_48_NUM_735

Test Expected Average = 50
Test Actual Average = 55.9
