Q1.
A transverse wave on a string with a linear density of 0.200 kg/m is described by the following equation: $y = 0.005 \sin(419t - 21.0x)$, where x and y are in meters and t is in seconds. What is the tension in the string?

A) 79.6 N
B) 3.99 N
C) 42.1 N
D) 32.5 N
E) 65.8 N

Sec# Wave - I - The speed of a Traveling Wave
Grade# 61
Stat# A_87_DIS_0.34_PBS_0.39_B_5_C_3_D_3_E_1_EXP_61_NUM_464

Q2.
A stone is dropped into a lake; and it produces circular surface waves with a frequency of 0.25 Hz. When should a second stone be dropped, after the first, at the same place to produce destructive interference? Ignore the time it takes the stone to reach water.

A) 2.0 s
B) 1.0 s
C) 0.75 s
D) 0.50 s
E) 1.5 s

Sec# Wave - I - Interference of Waves
Grade# 44
Stat# A_32_DIS_0.47_PBS_0.41_B_15_C_20_D_19_E_14_EXP_44_NUM_464

Q3.
Which one of the following statements is **TRUE** concerning the points on a string that sustain a standing wave pattern?

A) The amplitude of oscillation is not the same for all points.
B) All points vibrate vertically with the same speed.
C) All points undergo the same displacements.
D) All points vibrate with different frequencies.
E) Some points undergo motion that is purely longitudinal.

Sec# Wave - I - Standing Waves
Grade# 45
Stat# A_28_DIS_0.27_PBS_0.27_B_32_C_22_D_9_E_9_EXP_45_NUM_464

Q4.
A string with a length of 2.5 m, fixed at both ends, has two successive resonances at frequencies of 112 Hz and 140 Hz. Determine the wavelength of the 140 Hz resonance.

A) 1.0 m
B) 0.50 m

C) 2.0 m
D) 0.75 m
E) 1.5 m

Sec# Wave - I - Standing Waves and Resonance
Grade# 50
Stat# A_45_DIS_0.63_PBS_0.46_B_14_C_16_D_12_E_12_EXP_50_NUM_464

Q5.
Two transmitters, S1 and S2, shown in **Figure 1**, emit identical sound waves at a frequency of 680 Hz. The transmitters are separated by a distance of 2.0 m. Consider a big circle of radius *R* with its center halfway between these transmitters. How many interference minima are there on this big circle? Take the speed of sound in air to be 340 m/s.

Fig#

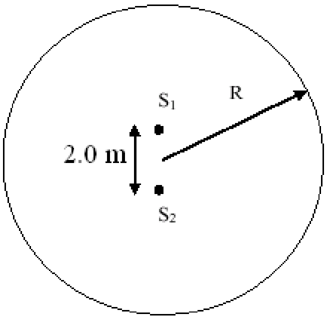

Figure 1

A) 16
B) 4
C) 8
D) 3
E) 12

Sec# Wave - II - Interference
Grade# 48
Stat# A_11_DIS_0.11_PBS_0.17_B_28_C_34_D_13_E_13_EXP_48_NUM_464

Q6.
During a typical workday of eight hours, the average sound intensity arriving at a human ear is 1.8×10^{-5} W/m^2. If the area of the human ear through which the sound passes is 2.1 cm^2, what is the total energy entering each ear during the workday?

A) 1.1×10^{-4} J
B) 1.8×10^{-5} J
C) 7.4×10^{-4} J
D) 4.1×10^{-3} J
E) 2.2×10^{-4} J

Sec# Wave - II - Intensity and Sound Level
Grade# 58

Stat# A_55_DIS_0.68_PBS_0.50_B_17_C_7_D_9_E_13_EXP_58_NUM_464

Q7.
A tube closed at one end resonates in the standing wave pattern shown in **Figure 2**. If the length of the tube is 0.500 m, and the speed of sound in air is 343 m/s, what is the frequency of the emitted sound?

Fig#

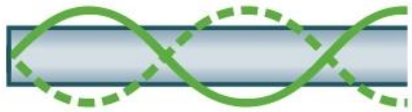

Figure 2

A) 858 Hz
B) 429 Hz
C) 515 Hz
D) 343 Hz
E) 172 Hz

Sec# Wave - II - Source of Musical Sound
Grade# 50
Stat# A_49_DIS_0.45_PBS_0.35_B_5_C_27_D_9_E_9_EXP_50_NUM_464

Q8.
Two cars are traveling in opposite directions at the same speed when one of the drivers sounds the horn of his car, which has a frequency of 544 Hz. The other driver hears the frequency as 563 Hz. If the speed of sound in air is 344 m/s, what is the speed of the cars?

A) 5.90 m/s
B) 8.19 m/s
C) 11.6 m/s
D) 7.24 m/s
E) 10.0 m/s

Sec# Wave - II - The Doppler Effect
Grade# 45
Stat# A_77_DIS_0.48_PBS_0.43_B_5_C_9_D_5_E_3_EXP_45_NUM_464

Q9.
At 20 ^{o}C, an aluminum cube has an edge length of 25 cm. What is the increase in the cube's total surface area when it is heated from 20 ^{o}C to 75 ^{o}C. The coefficient of linear expansion of aluminum is 23×10^{-6}/C°.

A) 9.5 cm^2
B) 1.6 cm^2
C) 6.3 cm^2
D) 13 cm^2
E) 4.7 cm^2

Sec# Temerature, Heat, and the First Law of Thermodynamics - Thermal Expansion
Grade# 55
Stat# A_29_DIS_0.32_PBS_0.28_B_37_C_16_D_3_E_14_EXP_55_NUM_464

Q10.
A 0.0400-kg ice cube at 0.00 °C is placed in an insulated box that contains 0.0750 kg of water at 100 °C. What is the equilibrium temperature reached by this closed system?

A) 37.6 °C
B) 65.2 °C
C) 50.7 °C
D) 33.6 °C
E) 22.7 °C

Sec# Temerature, Heat, and the First Law of Thermodynamics - The Absorption of Heat by Solids and Liquids
Grade# 48
Stat# A_38_DIS_0.54_PBS_0.45_B_29_C_16_D_9_E_8_EXP_48_NUM_464

Q11.
A wall has a thickness of 0.61 m and a thermal conductivity of 2.1 W/(m · C°). The temperature on one face of the wall is 3.2 °C, and 20.0 °C on the opposite face. How much heat is transferred in one hour through each square meter of the wall?

A) 2.1×10^5 J
B) 7.7×10^4 J
C) 58 J
D) 1.0×10^5 J
E) 1.8×10^3 J

Sec# Temerature, Heat, and the First Law of Thermodynamics - Heat Transfer Mechanisms
Grade# 63
Stat# A_49_DIS_0.49_PBS_0.38_B_23_C_13_D_6_E_9_EXP_63_NUM_464

Q12.
A system containing an ideal gas at a constant pressure of 1.22×10^5 Pa gains 2140 J of heat. During the process, the internal energy of the system increases by 2320 J. What is the change in the volume of the gas?

A) -1.48×10^{-3} m^3
B) $+1.48 \times 10^{-3}$ m^3
C) $+3.66 \times 10^{-3}$ m^3
D) zero
E) -3.66×10^{-3} m^3

Sec# Temerature, Heat, and the First Law of Thermodynamics - Some Special Cases of the First Law of Thermodynamics
Grade# 58
Stat# A_64_DIS_0.60_PBS_0.47_B_19_C_6_D_6_E_6_EXP_58_NUM_464

Q13.
Which one of the following properties of a gas is **NOT** consistent with the kinetic theory of gasses?

A) The average speed of the gas molecules is smaller at higher temperatures.
B) Gas molecules are widely separated.
C) Gases fill whatever space is available to them.
D) Gas molecules move rapidly in a random fashion.
E) Gas molecules make elastic collisions with the walls of the container.

Sec# The kinetic Theory of Gases - What is Physics
Grade# 60
Stat# A_72_DIS_0.35_PBS_0.31_B_7_C_8_D_5_E_8_EXP_60_NUM_464

Q14.
A container having 150 kg of an ideal gas has a volume of 8.00 m^3. If the gas exerts a pressure of 5.00×10^5 Pa, what is the *rms* speed of the molecules?

A) 283 m/s
B) 165 m/s
C) 354 m/s
D) 420 m/s
E) 397 m/s

Sec# The kinetic Theory of Gases - Pressure, Temperature and RMS Speed
Grade# 45
Stat# A_68_DIS_0.59_PBS_0.48_B_9_C_9_D_7_E_6_EXP_45_NUM_464

Q15.
An ideal gas is taken from state **A** to state **B** through the process shown on the P-V diagram in **Figure 3**. How much heat is added to the gas in this process?

Fig#

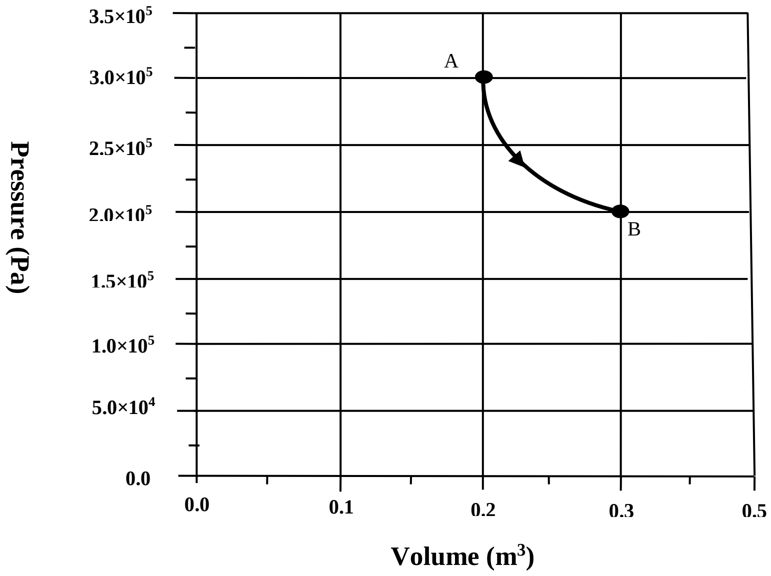

Figure 3

A) 2.4×10^4 J
B) 3.7×10^4 J
C) 1.0×10^4 J
D) 6.0×10^4 J
E) This cannot be determined since *n* and *T* are not specified.

Sec# The kinetic Theory of Gases - Ideal Gases
Grade# 43
Stat# A_30_DIS_0.34_PBS_0.31_B_10_C_14_D_7_E_39_EXP_43_NUM_464

Q16.
Four moles of a monatomic ideal gas, initially at 300 K, expand adiabatically to double the initial volume. Calculate the change in the internal energy of the gas.

A) –5.53 kJ
B) +5.53 kJ
C) zero
D) +8.79 kJ
E) –8.79 kJ

Sec# The kinetic Theory of Gases - The Adiabatic Expansion of an Ideal Gas
Grade# 41
Stat# A_39_DIS_0.43_PBS_0.36_B_15_C_21_D_10_E_14_EXP_41_NUM_464

Q17.
An ideal monatomic gas contains 5.00 moles. The pressure of the gas is doubled at constant volume. How much is the change in the entropy of the gas?

A) + 43.2 J/K

B) – 43.2 J/K
C) – 72 J/K
D) + 72 J/K
E) zero

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy
Grade# 45
Stat# A_51_DIS_0.60_PBS_0.46_B_14_C_5_D_10_E_19_EXP_45_NUM_464

Q18.
A heat engine operates between a hot reservoir at 1500 K and a cold reservoir at 500 K. During each cycle, 1.0×10^5 J of heat is removed from the hot reservoir and 5.0×10^4 J of work is performed. The actual efficiency of this engine is

A) 50 % of the maximum efficiency
B) 67 % of the maximum efficiency
C) 75 % of the maximum efficiency
D) 17 % of the maximum efficiency
E) 87 % of the maximum efficiency

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World: Engines
Grade# 45
Stat# A_10_DIS_0.12_PBS_0.21_B_40_C_39_D_8_E_4_EXP_45_NUM_464

Q19.
A Carnot refrigerator is placed in a kitchen. The temperature inside the refrigerator is 2.0 °C, and the temperature of the kitchen is 22 °C. The rate of heat flow from the refrigerator to the kitchen is 24.7 kW. What power is needed to operate this refrigerator?

A) 1.8 kW
B) 3.6 kW
C) 2.5 kW
D) 4.7 kW
E) 0.4 kW

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World: Refrigerators
Grade# 40
Stat# A_38_DIS_0.48_PBS_0.40_B_12_C_24_D_16_E_9_EXP_40_NUM_464

Q20.
A system consists of two thermal reservoirs in contact with each other, one at a temperature of 300 °C and the other at a temperature of 200 °C. If 6000 J of heat is transferred from the 300 °C reservoir to the 200 °C reservoir, what is the change in entropy of this system?

A) +2.2 J/K
B) +13 J/K
C) -10 J/K
D) +10 J/K

E) -2.2 J/K

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy
Grade# 49
Stat# A_27_DIS_0.37_PBS_0.35_B_14_C_14_D_29_E_17_EXP_49_NUM_464

Test Expected Average = 50
Test Actual Average = 45
