Q1. A vibrator having a frequency of 200 Hz generates a standing wave of six loops with amplitude of 2.0×10^{-3} m in a string clamped at both side. If the speed of the wave on the string is 100 m/s, what is the length of the string?

A) 1.5 m
B) 3.5 m
C) 0.75 m
D) 1.25 m
E) 2.0 m

Q2. For the superposition of the following two harmonic waves:

$$y_1 = (4.0\text{ m})\ \sin(2\pi x - 4\pi t)$$
$$y_2 = (4.0\text{ m})\ \sin(2\pi x + 4\pi t),$$

where x is in meter and t is in second, the distance between any two successive nodes will be:

A) 0.50 m
B) 0.25 m
C) 0.75 m
D) 1.30 m
E) 0.13 m

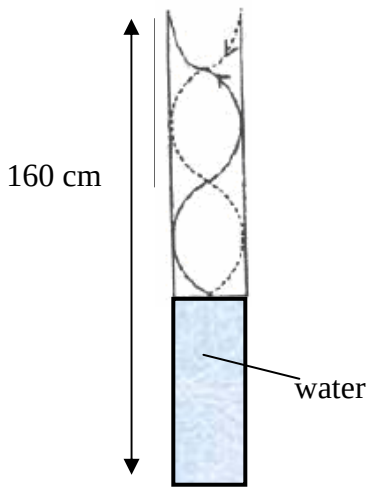
Q3. A particle of a string moves up and down as a traveling sinusoidal wave passes through it. If the time for that particle to move from maximum displacement to zero displacement is 0.2 s, what is the frequency of the wave?

A) 1.25 Hz
B) 2.00 Hz
C) 3.25 Hz
D) 4.00 Hz
E) 5.50 Hz

Q4. A string of length 50.0 m and mass of 25.0 grams is under tension of 75.0 N. An electric vibrator operating at 40.0 Hz is generating a harmonic wave in the string. The average power the vibrator can supply to the string is 500 W. What is the amplitude of the wave?

A) 0.29 m
B) 0.31 m
C) 2.70 m
D) 1.85 m
E) 0.20 m

Q5. Sound waves of frequency 340 Hz are sent into the top of a vertical tube containing water, as shown in the figure. If standing waves are produced, as shown, what is the height level of the water?. [Speed of sound in air = 340 m/s]



A) 35 cm
B) 1.2 m
C) 25 cm
D) 55 cm
E) 1.6 m

Q6. A man strikes one end of a long steel pipe of length *L*, filled with water, by a hammer. A detector attached to the other end of the pipe receives two sounds signals, one from the wave that travels through the pipe and the other from the wave that travels through the water. If the time difference between the two wave signals is 0.02 s, what is the length of the pipe? (Speeds of sound in steel and water are V_s = 5940 m/s and V_w = 1480 m/s, respectively).

A) 39 m
B) 30 m
C) 45 m
D) 21 m
E) 18 m

Q7. The intensity of a sound wave is 10^{-7} W/m^2 at a distance of 30.0 m from a speaker emitting sound waves at a the frequency of 2.0×10^3 Hz. What is the sound level at a distance of 50.0 m from the speaker?

A) 46 dB
B) 35 dB
C) 51 dB
D) 12 dB
E) 23 dB

Q8. A truck emits sound with a frequency of 620 Hz. A person is riding a bike that moves at a speed of 3.0 m/s and is following the truck. If the person hears a frequency of 560 Hz, how fast is the truck moving? (Take the speed of sound in air as 343 m/s).

A) 40 m/s
B) 35 m/s
C) 50 m/s
D) 25 m/s
E) 20 m/s

Q9. A steel rod is 4.000 cm in diameter at 35 ^{o}C. A brass ring has an inner diameter of 3.992 cm at 35 ^{o}C. At what common temperature will the brass ring slide onto steal rod? ($\alpha_{steel} = 11\times10^{-6}$ K^{-1}, $\alpha_{brass} = 19\times10^{-6}$ K^{-1})

A) 286 ^{0}C
B) 251 ^{0}C
C) 216 ^{0}C
D) 321 ^{0}C
E) 35 ^{0}C

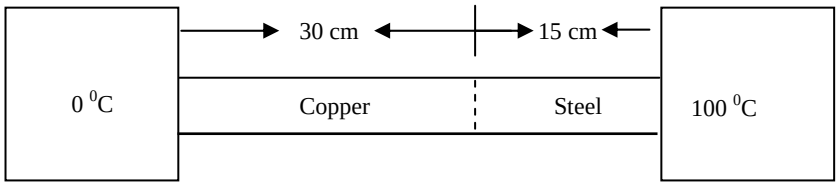
Q10. What mass of steam initially at 100 ^{o}C should be mixed with 160 g of ice at 0 ^{o}C in a thermally insulated container to produce liquid water at 40 ^{o}C.

A) 32 g
B) 16 g
C) 13 g
D) 36 g
E) 98 g

Q11. A 20-kg block of copper is dropped and falls 122 m. Calculate the raise in the temperature of the block if all the potential energy lost in the fall is converted to heat. [The specific heat of copper = 386 J/kg.K]

A) 3.1 K
B) 1.6 K
C) 1.3 K
D) 4.2 K
E) 9.8 K

Q12. The following figure shows a steel bar 15 cm long welded end to end to a copper bar 30 cm long. Each bar has a square cross section of 2.2 cm^2 on a side. The free end of steel is maintained at 100 ^{o}C and the free end of copper is maintained at 0.0 ^{o}C. Find the temperature at the junction of the two bars? $\left(\kappa_{steel} = 50.2 \text{ W/m.K}, \quad \kappa_{copper} = 385 \text{ W/m.K}\right)$



A) 21 ^{0}C
B) 26 ^{0}C
C) 50 ^{0}C
D) 35 ^{0}C
E) zero

Q13. Which of the following statements is INCORRECT?

A) If work is done on a system, the internal energy of the system decreases in an adiabatic process
B) In a cyclic process the change in internal energy of the system is zero.
C) In an adiabatic process, transfer of energy as heat is zero.
D) The internal energy of a system increases if energy is added as heat Q for an isochoric process.
E) Heat energy can be transferred only between bodies having different temperatures.

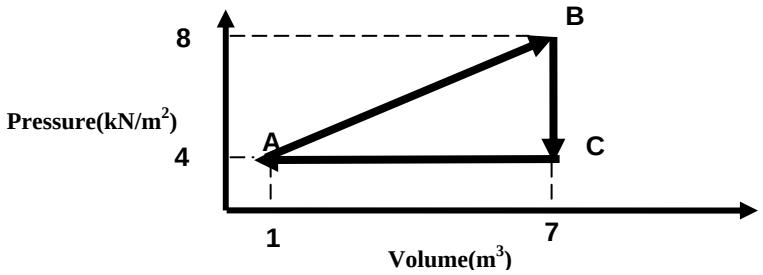
Q14. One mole of a diatomic ideal gas is initially at a temperature of 127 ^{o}C and has a volume of 0.090 m^3. The gas is compressed adiabatically to a volume of 0.045 m^3. What is the final temperature?

A) 528 K
B) 636 K
C) 105 K
D) 168 K
E) Zero

Q15. 6 moles of an ideal gas are kept at a constant temperature of 60 .0 ^{o}C while the pressure of the gas is increased from 1.00 atm to 4.00 atm. Find the heat involved during this process.

A) – 23 kJ
B) 23 kJ
C) 4.1 kJ
D) – 4.1 kJ
E) 8.3 kJ

Q16. A sample of one mole of an ideal gas is taken through the cyclic process ABCA as shown in the Figure. What is the net energy added to the gas as heat during the cycle?



A) 12 kJ
B) 24 kJ
C) 6 kJ
D) 9 kJ
E) 36 kJ

Q17. An ideal monatomic gas expands quasi-statically to twice its volume. If the process is isothermal, the work done by the gas is W_i . If the process is adiabatic, the work done by the gas is W_a . Which of the following is true?

A) $0 < W_a < W_i$
B) $W_a = W_i$
C) $0 = W_a < W_i$.
D) $0 = W_i < W_a$
E) $0 > W_a > W_i$

Q18. Liquid water having a mass of 50 grams was initially at 0 ^{o}C. Heat was added to the water so that its entropy increases by 94.0 J/K, what is the final temperature of the water?

A) 428 K
B) 175 K
C) 273 K
D) 478 K
E) Zero

Q19. A 2.50-mole sample of an ideal monatomic gas was initially at a temperature of 300 K. The gas is compressed isobarically to half of its original volume, what is the change of entropy of the gas?

A) – 36.0 J/K
B) + 36.0 J/K
C) + 21.6 J/K
D) – 21.6 J/K
E) – 104 J/K

Q20. A Carnot heat engine operates between two reservoirs at temperatures of 400 K and 500 K. What is the ratio of the work done by the engine to the heat expelled to the low-temperature reservoir?

A) 0.25
B) 0.35
C) 0.75
D) 2.25
E) 0.20