EXERCISE 02

SECTION : (A) - Single Correct Options

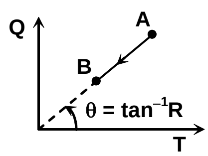
402. Which graph correctly represent variation of $B = \frac{-\partial v / \partial p}{v}$ with p for an ideal gas at constant temperature

403. An ideal gas is initially at temperature T, volume V, its volume is increased by Δv due to an increase in temperature ΔT, pressure remaining constant. The quantity $\delta = \frac{\Delta v}{v \Delta T}$ varies with temperature as

404. Gaseous hydrogen contained initially under standard condition in a sealed vessel of 5 litre was cooled by 55 K. The internal energy will change by

(A) 0.23 kJ (B) 0.5 kJ (C) 0.1 kJ (D) none of these

405. The heat input (Q) vs temperature (T) curve for a process for 1mole of monoatomic gas is



The corresponding PV equation for the process will be

(A) PV = constant (B) PV^3 = constant (C) $PV^{3/2}$ = constant (D) PV^5 = constant

406. The pressure and density of a diatomic gas is changed adiabatically from (p, d) to (p′, d′). If $\frac{d}{d'} = 32$. Find value of $\frac{P}{P'}$.

(A) $\frac{1}{128}$ (B) 32 (C) 128 (D) none of these

407. Two air column closed at one end with lengths 40 cm and 40.5 cm length are sounding their fundamental note at temperature of 36°C. They produce 14 beats in 5 seconds. The velocity of sound in air at 0°C is

(A) 340 m/s (B) 350 m/s (C) 360m/s (D) none

408. The explosion of a fire cracker in air at height of 40 m produces a 100 dB sound level at ground below. What is the instantaneous total radiated power assuming it radiates as point source.

(A) 151watt (B) 201 watt (C) 251 watt (D) 301 watt

409. A whistling train approaches a junction. An observer standing at junction observes frequency to be 2.2 kHz and 1.8 kHz of approaching and receding train. The speed of train is (speed of sound = 300 m/s)

(A) 25 m/s (B) 30 m/s (C) 35 m/s (D) 40 m/s

410. A spherical black body with radius 12 cm radiates 450 W power at 500 K. If radius were halved and temperature doubled power radiated in watt would be

(A) 225 (B) 450 (C) 900 (D) 1800

411. A closed cylinder contain acetylene at 27°C under pressure of 4.05 M pa. What will be the pressure in cylinder after half of mass of gas has been used up if temperature has there by fallen to 12°C.

(A) 1.94×10^6 Pa (B) 2.025×10^6 Pa (C) 1.025×10^6 Pa (D) 3.075×10^6 Pa

412. Apparent frequency is n_1, when a source approaches a stationary observer with speed u and is n_2 when observer approaches same stationary source with same speed. Then

(A) $n_2 > n_1$ (B) $n_1 > n_2$ (C) $n_1 = n_2$ (D) none of these

413. If R stands for the gas constant and C_p, C_v are specific heats per mole for a solid, then (for a solid) which of the following is correct?

(A) $C_p - C_v = R$ (B) $C_p - C_v < R$ (C) $C_p - C_v = 0$ (D) $C_p - C_v < 0$

414. If escape velocity from the earth is 11.1 km/s and the mass of one molecule of oxygen is 5.34×10^{-26} kg, the temperature at which the oxygen molecule will escape from earth, is

[Boltzmann constant k = 1.38×10^{-23} J/K]

(A) 1.6×10^5 K (B) 1.6×10^3 K (C) 1.6×10^2 K (D) none of these

415. Three resonant frequencies of a string are 75, 125 and 175 Hz. If the length of the string is 1 metre, the speed of transverse wave in the string is

(A) 50 m/s (B) 100 m/s (C) 150 m/s (D) none of these

416. An electric lamp draws a steady power P from a voltage source. If the emissivity of the filament is e and its surface area is A, Stefan's constant is σ, steady state temperature of the filament will be

(A) $\left(\frac{P}{Ae\sigma}\right)^{3/4}$ (B) $\left(\frac{P}{Ae\sigma}\right)^{5/4}$ (C) $\left(\frac{P}{Ae\sigma}\right)^{1/4}$ (D) $\left(\frac{P}{Ae\sigma}\right)^{1/2}$

SECTION : (B) - More Than One Correct Options

417. As a wave propagates :

(A) the wave intensity remains constant for a plane wave

(B) the wave intensity decreases as the inverse of the distance from the source for a spherical wave

(C) the wave intensity decreases as the inverse square of the distance from the source for a spherical wave.

(D) total power of the spherical wave over the spherical surface centered at the source remains constant at all times.

418. An ideal gas (γ = 1.5) undergoes a thermodynamic process in which temperature and density of the gas are related as $T\rho^2$ = constant. Choose the correct statement(s)

(A) Pressure is inversely proportional to volume during process

(B) Pressure is directly proportional to volume

(C) Molar specific heat capacity for the process is $2.5R$

(D) Molar specific heat capacity for the process is $3R$

419. The molar heat capacity for an ideal gas

(a) is zero for an adiabatic process

(b) is infinite for an isothermal process

(c) depends only on the nature of the gas for a process in which either volume or pressure is constant

(d) is equal to the product of the molecular weight and specific heat capacity for any process

420. For an ideal gas,

(a) the change in internal energy in a constant-pressure process from temperature T_1 to T_2 is equal to $nC_V(T_2-T_1)$. Where C_V is the molar heat capacity at constant volume and n is the number of moles of the gas

(b) the change in internal energy of the gas and the work done by the gas are equal in magnitude in an adiabatic process

(c) the internal energy does not change in an isothermal process

(d) no heat is added or removed in an adiabatic process

421. If the third harmonic of vibaration in an open air pipe equals the fifth harmonic of vibration in a closed pipe, then the possible values of the length of air colun in the closed pipe and open pipe, respectively, are:

(a) 100 cm, 120 cm (b) 60 cm, 72 cm (c) 120cm, 150 cm (d) 150 cm, 180 cm

422. The free ends of the rod of length (L= 0.5m) form anti-nodes while rod is clamped at distance L/4 from one free end. The density of metal of rod and its Young's modulus are $8x10^3$ kg/m^3 and 200x 10^9 N/m^2 respectively. Choose the correct statements

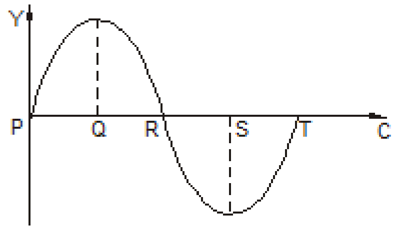
(a) There are three frequencies of longitudinal waves in rod in the range of 0 kHz to 50 kHz

(b) There are two frequencies of longitudinal waves in rod in the range of 0 kHz to 50 kHz

(c) Speed of longitudinal sound wave in rod is $4x10^3$ m/s

(d) Speed of longitudinal sound wave in rod is 5 x 10^3 m/s

423. A sound wave is travelling along positive x-direction. Displacement (y) of particles from their mean positions at anytime t is shown in the figure.



(a) Particle located at S has zero velocity.

(b) Particle located at T has its velocity in the negative direction

(c) Change in pressure at S is zero

(d) Particles located near R under compression

424. During an experiment, an ideal gas is found to obey a condition $\frac{P^2}{\rho}$ = constant [ρ = density of the gas]. The gas is initially at temperature T, pressure P and density ρ. The gas expands such that density changes to $\rho/2$.

(a) The pressure of the gas changes to $\sqrt{2}P$.

(b) The temperature of the gas changes to $\sqrt{2}T$.

(c) The graph of the above process on the P-T diagram is parabola.

(d) The graph of the above process on the P-T diagram is hyperbola.

425. A wave is represented by the equation:

$$y = (lmm)\sin\left[(50s^{-1})t + (2.0m^{-1})x\right] + (1mm)\cos\left[(50s^{-1})t - (2.0m^{-1})x\right]$$

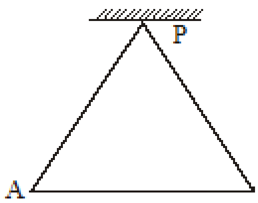
(a) The wave-velocity is zero, since it is a standing wave.

(b) A node is formed at $x = \frac{3\pi}{8}m$.

(c) The amplitude of the oscillation at the antinode is 2 mm.

(d) Energy transfer occurs along the positive x-axis.

426. A very light rod AB is initially hung from a point P by means of two identical copper wires of the same length as the rod as shown in the figure. Particles of masses 1 kg and 4 kg are then attached to the ends A and B of the rod. The ratio of the fundamental frequencies of vibration of the wires AB and BP, i.e., $\frac{f_A}{f_B} =$



(a) 4 (b) $\frac{1}{2}$ (c) 16 (d) 2

427. A metal cylinder of 5 kg is heated electrically by a 20 W heater in a room at 20ºC. The cylinder temperature rises uniformly to 30ºC in 5 minute and finally becomes constant at 45ºC. Assuming that the rate of heat loss is proportional to the excess temperature over the surroundings :

(A) The rate of loss of heat of cylinder to surrounding at 25ºC is 4W

(B) The rate of loss of heat of cylinder to surrounding at 45ºC is 20W

(C) The rate of loss of heat of cylinder to surrounding at 25ºC is 8W

(D) The rate of loss of heat of cylinder to surrounding at 45ºC is zero

428. Monoatomic , diatomic and triatomic gases whose initial volume and pressure are same, each is compressed till their pressure becomes twice the initial pressure. Then :

(A) if the compression is isothermal , then their final volumes will be same

(B) if the compression is adiabatic , then their final volumes will be different

(C) if the compression is adiabatic , then triatomic gas will have maximum final volume

(D) if the compression is adiabatic , then monoatomic gas will have maximum final volume

429. Standing waves are produced on a stretched string of length L with fixed ends . When there is a node at a distance L/3 from one end, then :

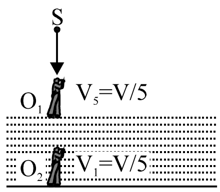
(A) minimum and next higher number of nodes excluding the ends are 2, 5 respectively

(B) minimum and next higher number of nodes excluding the ends are 2, 4 respectively

(C) frequency produced may be $\frac{V}{3L}$

(D) frequency produced may be $\frac{3V}{2L}$ [V = Velocity of waves in the string]

430. In the figure shown an observer O_1 floats (static) on water surface with ears in air while another observer O_2 is moving upwards with constant velocity V_1 = V/5 in water. The source moves down with constant velocity V_S = V/5 and emits sound of frequency 'f'. The velocity of sound in air is V and that in water is 4V. For the situation shown in figure.



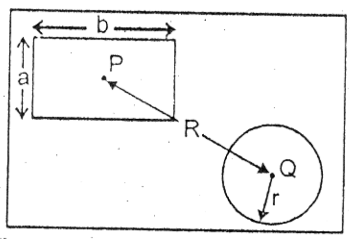
(A) The wavelength of the sound received by O_1 is $\frac{4V}{5f}$

(B) The wavelength of the sound received by O_1 is V/f

(C) The frequency of the sound received by O_2 is $\frac{21f}{16}$

(D) The wavelength of the sound received by O_2 is $\frac{16V}{5f}$

431. There is a rectangular metal plate in which two cavities in the shape of rectangle and circle are made, as shown with dimensions. P and Q are centres of these cavities. On heating the plate, which of the following quantities increase ?



(A) πr^2 (B) ab (C) R (D) b

432. Suppose that the volume of a certain ideal gas is to be doubled by one of the following processes

(1) isothermal expansion
(2) adiabatic expansion
(3) free expansion
(4) expansion at constant pressure

If E_1, E_2, E_3 and E_4 respectively are the changes in average kinetic energy of the molecules for the above four processes, then :

(A) $E_2 = E_3$
(B) $E_1 = E_3$
(C) $E_1 > E_4$
(D) $E_4 > E_3$

433. In Newton's law of cooling, $\frac{d\theta}{dt} = -k(\theta - \theta_0)$, the constant 'k' is proportional to :

(A) A, surface area of the body
(B) S, specific heat of the body
(C) $\frac{1}{m}$, m being mass of the body
(D) e, emmisivity of the body

434. A cube, a pyramid (with all four faces identical) and a sphere (all of them hollow) are made from the same material and have equal mass and bound equal volume. They are heated to the same temperature and then left to cool. After some time,

1. sphere will have the highest temperature
2. pryamid will have the highest temperature.
3. cube will have the lowest temperature.
4. sphere will have the lowest temperature.
5. pyramid will have the lowest temperature

Correct option will be :

(A) 2 and 3
(B) 3 and 1
(C) 1 and 5
(4) 2 and 4

435. Which of the following functions represent a stationary wave ? Here a, b and c are constants

(A) y = a cos (bx) sin (ct)
(B) y = a sin (bx) cos (ct)
(C) y = a sin (bx + ct)
(D) y = a sin (bx + ct) + a sin (bx – ct)

436. Y (x, t) = $\frac{0.8}{(4x+5t)^2+5}m$ represents a moving pulse, where x, y are in metre and t in second :

(a) It is a non-periodic travelling pulse
(b) It is traveling along –ve x-axis.
(c) Maximum displacement is 0.16m
(d) Velocity of motion of pulse is -1.25 ms^{-1}

437. A plane progressive wave of frequency 25 Hz, amplitude 2.5 x 10^{-5} m and initial phase zero moves along the negative x-direction with a velocity of 300 m/s. A and B are two points 6m apart on the line of propagation of the wave. At any instant the phase difference between A and B is ϕ. The maximum difference in the displacement of the particles at A and B is Δ, then

(a) $\phi = \pi$
(b) $\phi = 0$
(c) $\Delta = 0$
(d) $\Delta = 5\times10^{-5}m$

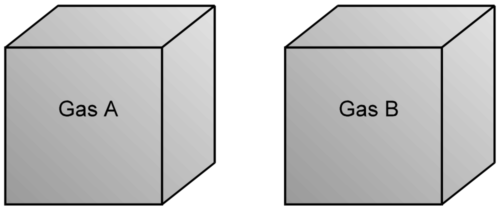
438. A heated body emits radiation which has maximum intensity at frequency υ_m. If the temperature of body is doubled:

(a) the maximum intensity radiation will be at frequency $2\upsilon_m$.
(b) the maximum intensity radiation will be at frequency $\upsilon_m/2$.
(c) the total emitted energy will increase by a factor 16.
(d) the total emitted energy will increase by a factor 2

SECTION : (C) -Passage Type Questions

PASSAGE 01:

Two closed identical conducting containers are found in the laboratory of an old scientist. For the verification of the gas some experiments are performed on the two boxes and the results are noted.



Experiment 1. When the two containers are weighed $W_A = 225$ g , $W_B = 160$ g and mass of evacuated container $W_C = 100$ g.

Experiment 2. When the two containers are given same amount of heat same temperature rise is recorded. The pressure change found are

$\Delta P_A = 2.5$ atm. $\Delta P_B = 1.5$ atm.

Required data for unknown gas :

Mono (molar mass)	He 4g	Ne 20g	Ar 40 g	Kr 84 g	Xe 131 g	Rd 222 g
Dia (molar mass)	H_2 2g	F_2 19 g	N_2 28g	O_2 32g	Cl_2 71 g	

439. Identify the gas filled in the container A and B.
(A) N_2, Ne (B) He, H_2 (C) O_2 , Ar (D) Ar, O_2

440. Total number of molecules in 'A' (here N_A = avagadro number)
(A) $\frac{125}{64}N_A$ (B) 3.125 N_A (C) $\frac{125}{28}N_A$ (D) 31.25 N_A

441. The initial internal energy of the gas in container 'A', If the containers were at room temperature 300K initially
(A) 1406.25 cal (B) 1000 cal (C) 2812.5 cal (D) none of these

PASSAGE 02:

A pulse is started at a time t = 0 along the +x direction on a long, taut string. The shape of the pulse at t = 0 is given by function f(x) with

$$f(x) = \begin{cases} \frac{x}{4}+1 & \text{for} \quad -4 < x \le 0 \\ -x+1 & \text{for} \quad 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

here f and x are in centimeters. The linear mass density of the string is 50 g/m and it is under a tension of 5N,

442. The shape of the string is drawn at t = 0 and the area of the pulse enclosed by the string and the x-axis is measured. It will be equal to
(A) 2 cm^2 (B) 2.5 cm^2 (C) 4 cm^2 (D) 5 cm^2

443 The vertical displacement of the particle of the string at x = 7 cm and t = 0.01 s will be
(A) 0.75 cm (B) 0.5 cm (C) 0.25 cm (D) zero

444. The transverse velocity of the particle at x = 13 cm and t = 0.015 s will be
(A) –250 cm/s (B) –500 cm/s (C) 500 cm/s (D) –1000 cm/s

PASSAGE 03:

The apparent frequency of sound detected by an observer depends on relative motion between source and observer. This effect is well known to you (known as Doppler effect). Consider a police Car moving on a straight road with a speed of 28 m/s emitting sound from its siren at 1200 Hz. This means that the siren is oscillating 1200 times a second. A man 'M' is standing on the road infront of the Car and another person 'N' is on the back side of the car. The siren sound is getting reflected from a building directly infront of the car. Man 'M' is standing between the car and the building. You may assume car, N,M and building all to lie on a straight line and take the speed of sound in air 340 m/s :

445. The wavelength of sound reaching M and N (directly from the car) respectively are :
(A) 0.260 m, 0.306 m (B) 0.260 m, 0.406 m (C) 0.306 m (D) 0.306 m, 0.206 m

446. What is the frequency of the sound reflected from the building as detected by man M ?
(A) 1208 Hz (B) 1111 Hz (C) 1308 Hz (D) 1415 Hz

447. The apparent frequency of the reflected sound as heard by the police in the car is :
(A) 1208 Hz (B) 1111 Hz (C) 1308 Hz (D) 1415 Hz

PASSAGE 04:

A metallic rod of length 1 m is rigidly clamped at its mid–point. Longitudinal stationary waves are set up in the rod in such a way that there are two nodes on either side of the mid–point . The amplitude of an antinode is 2 x 10^{-6}m. [Young's modulus = 2 x 10^{11} Nm^{-2}, density = 8000 Kg m^{-3}). Origin is at O which is mid-point of the rod. P is a point on the rod such that OP = 10 cm.

448. Velocity of wave in the rod is
(A) 5000 cm/s (B) 1000 m/s (C) 500 m/s (D) 5000 m/s.

449. Magnitude of maximum velocity of the point P is

(A) $\frac{\pi}{20}$ m/s (B) $\frac{\pi}{20}$ cm/s (C) $\frac{\pi}{40}$ m/s (D) none of these

450. Equation of constituent waves in the rod (in M.K.S. unit) are
(A) $y_1 = 10^{-6} \sin (5\pi x - 25000\,\pi t)$, $y_2 = 10^{-6} \sin (5\pi x + 25000\,\pi t)$
(B) $y_1 = 10^{-6} \sin (-5\pi x + 25000\,\pi t)$, $y_2 = 10^{-6} \sin (5\pi x + 25000\,\pi t)$
(C) $y_1 = 2 \times 10^{-6} \cos (5\pi x - 25000\,\pi t)$, $y_2 = 2\times10^{-6} \cos (5\pi x + 25000\,\pi t)$
(D) $y_1 = 2\times10^{-6} \sin (5\pi x - 25000\,\pi t)$, $y_2 = 2\times10^{-6} \sin (5\pi x + 25000\,\pi t)$

PASSAGE 05:

Two plane harmonic sound waves are expressed by the equations.

$$y_1(x, t) = A \cos (0.5\,\pi x - 100\,\pi t)$$
$$y_2(x, t) = A \cos (0.46\,\pi x - 92\,\pi t)$$

(All parameters are in MKS) :

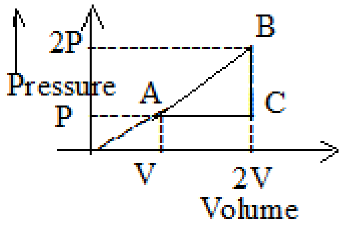
451. How many times does an observer hear maximum intensity in one second ?
(A) 4 (B) 10 (C) 6 (D) 8

452. What is the speed of the sound ?
(A) 200 m/s (B) 180 m/s (C) 192 m/s (D) 96 m/s

453. At x = 0 how many times the amplitude of $y_1 + y_2$ is zero in one second?
(A) 192 (B) 48 (C) 100 (D) 96

PASSAGE 06:

For a thermodynamic process, the work done can be given as the area under the curve on a P-V diagram. One mole of a monatomic idealgas taken along the cycle ABCA as shown in the diagram



454. Select the correct statement:

(a) since area with in the cycle of the graph is always positive so work done is also always positive.
(b) The area with in the cycle gives complete information of work done in a process.
(c) only magnitude of work done is decided by area with in the cycle and complete information can be deduced if cycle is known.
(d) none of the above.

455. The net heat absorbed by the gas in given the cycle is (If cycle is clockwise)

(a) PV (b) PV/2 (c) 2 PV (d) 4P/V

456. The ratio of specific heat (C_1) in the process CA to the specific heat (C_2) in the process BC is]

(a) 2 (b) 5/3 (c) 4 (d) none

PASSAGE 07:

A monoatomic ideal gas sample is given heat Q in a reversible process. One fourth of this heat is used as work done by the gas due to expansion and rest is used for increasing its internal energy.

457. The molar specific heat for the gas in this process is

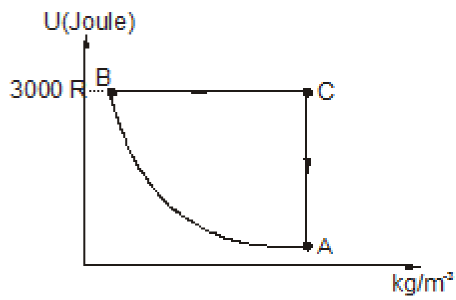
(a) $\frac{3}{2}R$ (b) $\frac{R}{2}$ (c) 2R (d) 3R

458. The equation of process in terms of volume and temperature is

(a) $\frac{V}{T} =$ constant (b) $\frac{V}{\sqrt{T}} =$ constant (c) VT = constant (d) $V\sqrt{T} =$ constant

PASSAGE 8:

The figure shows the variation of potential energy (U) of a 2 moles of Argon gas with its density in a cyclic process ABCA. The gas was initially in the state A whose pressure and temperature are P_A = 2 atm T_A = 300 K respectively. It is also stated that the path AB is a rectangular hyperbola and the internal energy of the gas at state C is 3000 R. Based on the above information answer the following questions.



459. The heat supplied to the gas in the process AB is

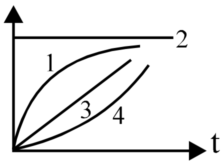
(a) 700 R (b) 3500 R (c) 4400 R (d) 1600 R

460. Heat supplied in the process CA is

(a) -1400 R (b) 1400 R (c) 2100 R (d) -2100 R

SECTION : (D) - Matrix Match

461. A ball has surface temperature T initially at time t = 0, that is less than surrounding constant temperature T_0. On the vertical axis of the graph shown has either thermal energy radiated/absorbed per unit time or total energy radiated/absorbed till time t by the ball. Correctly match the curves marked in the graph :



(A)	Thermal energy emitted per unit time	(P)	1
(B)	Thermal energy absorbed per unit time	(Q)	2
(C)	Total energy emitted till time t	(R)	3
(D)	Total energy absorbed till time t	(S)	4

462. Match the information given in **Column-I** with that given in **Column-II**. Note that any information in column-I may have more than one matching options in column-II

	Column I (Nature of wave)		**Column II (Properties)**
(A)	Transverse progressive wave	(P)	Amplitude of all particles are same
(B)	Longitudinal progressive wave	(Q)	Phase of all particles may be same
(C)	Transverse standing wave	(R)	May occur in gases
(D)	Longitudinal standing wave	(S)	KE and PE of a small element may be maximum simultaneously

463. A source is emitting a sound of frequency fs and moving with a velocity vs. An observer at some distance from the source has velocity v0 and heard sound of frequency f0. Velocity of medium is vm,, velocity of sound w.r.t to medium is V.

	COLUMN-I		**COLUMN-II**
P)	vs = v0 = 0 and vm has direction from source to observer	1)	fs > f0
Q)	vm has direction from source to observer and vs is towards observer v0 = 0	2)	fs < f0
R)	vm has direction from source to observer and at the time of generating pulse vs is perpendicular to the line joining source and observer v0 = 0	3)	fs = f0
S)	If vm = 0 and v0 & vs are moving in the same direction joining of the source and observer	4)	Whether f0 is greater than fs or less than fs will depend on magnitude of vs and v0 along the line

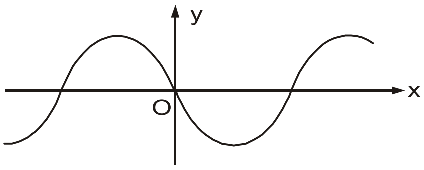
464.

	Column I		**Column II**
(A)	Pitch	(p)	Number of harmonics present in the sound
(B)	Loudness	(q)	Intensity
(C)	Quality	(r)	Frequency
(D)	wave front	(s)	Wave form
		(t)	locus of points vribrating in a phase

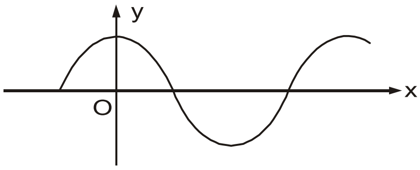
465.

	Column-I		**Column II**
(A)	$y = 4 \sin (5x - 4t) + 3 \cos (4t - 5x + \pi/6)$	(p)	Particles at every position are performing SHM
(B)	$y = 10 \cos\left(t - \frac{x}{330}\right) \sin(100)\left(t - \frac{x}{330}\right)$	(q)	Equation of travelling wave
(C)	$y = 10 \sin (2\pi x - 120t) + 10 \cos (120t + 2\pi x)$	(r)	Equation of standing wave
(D)	$y = 10 \sin (2\pi x - 120t) + 8 \cos (118t - 29/30\pi x)$	(s)	Equation of Beats

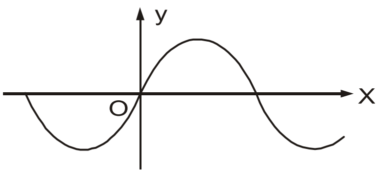
466. For four sine waves, moving on a string along positive x direction, displacement-distance curves (y – x curves) are shown at time t = 0. In the right column, expressions for y as function of distance x and time t for sinusoidal waves are given. All terms in the equations have general meaning. Correctly match y – x curves with corresponding equations.

(A) 

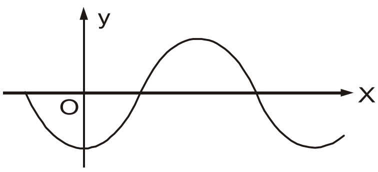
(p) $y = A\cos(\omega t - kx)$

(B) 

(q) $y = -A\cos(kx - \omega t)$

(C) 

(r) $y = A\sin(\omega t - kx)$

(D) 

(s) $y = A\sin(kx - \omega t)$

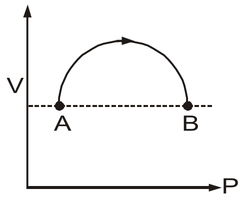
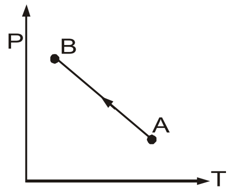
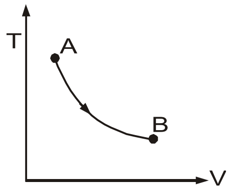
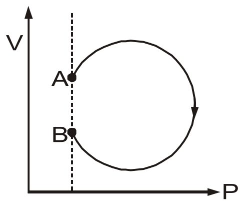
467.

	Column-I		**Column-II**
(A)	Atight string is fixed at both ends and sustaining standing wave	(p)	At the middle, antinode is formed in odd harmonic
(B)	Atight string is fixed at one end and free at the other end	(q)	At the middle, node is formed in even harmonic
(C)	A tight string is fixed at both ends and vibrating in four loops	(r)	The frequency of vibration is 300% more than its fundamental frequency
(D)	A tight string is fixed at one end and free at the other end, vibrating in 2nd mode of vibration.	(s)	Phase difference between SHMs of any two particles will be either π or zero.
		(t)	The frequency of vibration is 400% more than fundamental frequency.

468. An ideal monoatomic gas undergoes different types of processes which are described in column–I. Match the corresponding effects in column–II, The letters have usual meaning.

	Column-I		**Column-II**
(A)	$P = 2V^2$	(p)	If volume increases then temperature will also increase.
(B)	PV^2 = Constant	(q)	If volume increases then temperature will decrease.
(C)	$C = C_V + 2R$	(r)	For expansion, heat will have to be supplied to the gas.
(D)	$C = C_V - 2R$	(s)	If temperature increases then work done by gas is positive.

469. A sample of gas goes from state A to state B in four different manners, as shown by the graphs. Let W be the work done by the gas and ΔU be change in internal energy along the path AB. Correctly match the graphs with the statements provided.

Column–I		**Column–II**	
(A)		(p)	Both W and ΔU are positive
(B)		(q)	Both W and ΔU are negative
(C)		(r)	W is positive whereas ΔU is negative
(D)		(s)	W is negative whereas ΔU is positive

470. Match the information given in **Column-I** with that given in **Column-II**. Note that any information in column-I may have more than one matching options in column-II

Column I (Nature of wave)		**Column II (Properties)**	
(A)	Transverse progressive wave	(P)	Amplitude of all particles are same
(B)	Longitudinal progressive wave	(Q)	Phase of all particles may be same
(C)	Transverse standing wave	(R)	May occur in gases
(D)	Longitudinal standing wave	(S)	KE and PE of a small element may be maximum simultaneously

471. Match the phenomenon to its property

(A)	Beats	(P)	apparent change in pitch
(B)	Standing wave	(Q)	frequencies are in unison
(C)	Doppler effect	(R)	modification of intensities occur periodically when the waves interfere in same direction
(D)	Resonance	(S)	superposition of two similar waves travelling in opposite direction

472. For a cuboid made of a certain material, coefficient of expansion along it's length was found to be $2 \times 10^{-5}\ K^{-1}$. Then match the columns appropriately:

COLUMN I		**COLUMN II**	
(A)	Coefficient of expansion along breadth	(P)	$1 \times 10^{-5}\ K^{-1}$
(B)	Coefficient of expansion along height	(Q)	$2 \times 10^{-5}\ K^{-1}$
(C)	Coefficient of areal expansion	(R)	$4 \times 10^{-5}\ K^{-1}$
(D)	Coefficient of volume expansion	(S)	$6 \times 10^{-5}\ K^{-1}$
		(T)	$8 \times 10^{-5}\ K^{-1}$

473. Bowling point of water in a certain scale was found to be 300 units. Melting point of water in the same scale was found to be -200 units. Then match the temperatures in in celcius scale (in column I) with corresponding temperatures in that scale (in column II)

	COLUMN I		**COLUMN II**
(A)	20°C	(P)	50
(B)	75°C	(Q)	-100
(C)	60°C	(R)	175
(D)	50°C	(S)	100

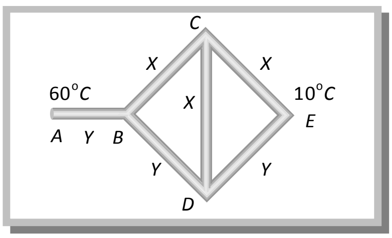
474. One mole of an ideal monoatomic gas undergoes a process $PV^{1/2} = C$, where C is a constant.

	COLUMN I		**COLUMN II**
(A)	Heat given to the gas to increase the temperature of the gas by 100°C	**(i)**	150 R
(B)	Work done on the gas to change the volume from V_0 to $2V_0$	**(ii)**	$\frac{7R}{2}$
(C)	Molar heat capacity of the gas	**(iii)**	350 R
(D)	Change in internal energy of gas when the temperature of the gas is increased by 100°C	**(iv)**	$2c\sqrt{v_0}[\sqrt{2}-1]$

475. For one mole of a monoatomic ideal gas match the following:

	COLUMN I		**COLUMN II**
(A)	Isothermal bulk modulus	**(i)**	$-\frac{RT}{V^2}$
(B)	Adiabatic bulk modulus	**(ii)**	$-\frac{5P}{3V}$
(C)	Slope of P–V graph in isothermal process	**(iii)**	$\frac{T}{V}$
(D)	Slope of PV graph in adiabatic process	**(iv)**	None of these

476. Three rods of material *X* and three rods of material *Y* are connected as shown in figure. All are identical in length and cross-sectional area. If end *A* is maintained at 60°*C*, end *E* at 10°*C*, thermal conductivity of *X* is 0.92 *cal/sec-cm-°C* and that of *Y* is 0.46 *cal/sec-cm-°C*, then match the columns appropriately (Assume steady state):



	COLUMN I		**COLUMN II**
(A)	T_B (in °C)	(P)	30
(B)	T_C (in °C)	(Q)	20
(C)	T_D (in °C)	(R)	10
(D)	Heat through CD (in Joules)	(S)	0

477. Column I gives some devic4es and column II gives some processes on which the functioning of these devices depend. Match the columns:

	Column I		Column II
(A)	Bimetallic Strip	(P)	Radiation from a hot body
(B)	Steam Engine	(Q)	Energy conversion
(C)	Incandescent lamp	(R)	Melting
(D)	Electric fuse	(S)	Thermal expansion of solids

478.

	Column I		Column II
(A)	A perfect reflecting body	(P)	absorbs radiation
(B)	A perfect black body	(Q)	reflects radiation
(C)	An ordinary smooth body	(R)	emits radiations
(D)	An ordinary rough body	(S)	transfers heat

479. When a wave is transmitted from denser to rarer medium:

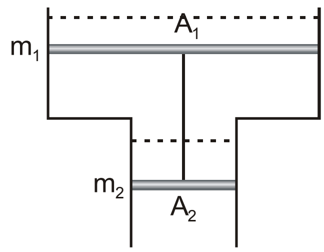
	Column I		Column II
(A)	amplitude of wave	(P)	will remain same
(B)	wavelength of wave	(Q)	will increase
(C)	speed of wave	(R)	will decrease
(D)	frequency	(S)	may increase or decrease

480. From state A (pressure P, volume V) an ideal gas is taken to the state B (pressure P, volume 2V) along a straight line path in P-V diagram.

	Column I		Column II
(A)	Workdone by gas in process A to B exceeds the workdone by it if system was taken from A to B along	(P)	isobar
(B)	In T-V diagram, path AB becomes part of	(Q)	parabola
(C)	In moving from A to B temperature T first	(R)	decreases and then increases
(D)	In moving B to A along an isotherm, temperature T first	(S)	none of these

SECTION : (E) - Integer Type

481. Consider a vertical tube open at both ends. The tube consists of two parts, each of different cross-sections and each part having a piston which can move smoothly in respective tubes. The two pistons are joined together by an inextensible wire. The combined mass of the two piston is 5 kg and area of cross-section of the upper piston is 10 cm^2 greater than that of the lower piston. Amount of gas enclosed by the pistons is one mole. When the gas is heated slowly, pistons move by 50 cm. Find rise in the temperature of the gas, in the form $\frac{X}{R}$K where R is universal gas constant. Use g = 10 m/s^2 and outside pressure = 10^5 N/m^2). Fill value of X in the answer sheet.



482. A straight line source of sound of length L = 10m, emitts a pulse of sound that travels radially outward from the source. What sound energy (in mW) is intercepted by an acoustic cylindrical detector of surface area 2.4 cm^2, located at a perpendicular distance 7m from the source. The waves reach perpendicularly at the surface of the detector. The total power emitted by the source in the form of sound is 2.2×10^4 W.
(Use π = 22/7)

483. A tuning fork produces 4 beats per second with another tuning fork of frequency 512 Hz. The first one is now loaded with a little wax and the beat frequency is found to increase to 6 per second. What was the original frequency of the tuning fork ?

484. Consider the three waves represented by

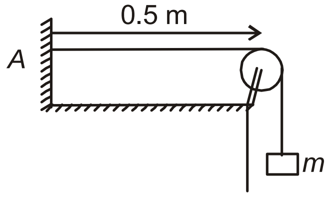
$y_1 = 3\sin(kx - \omega t)$

$y_2 = 3\sin\left(kx - \omega t + \frac{2\pi}{3}\right)$

and $y_3 = 3\sin\left(kx - \omega t + \frac{4\pi}{3}\right)$

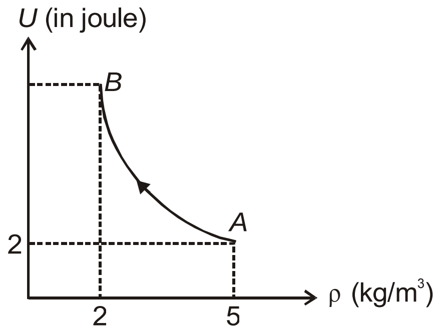
What is the amplitude of resultant of waves at x = 0?

485. A string having length 0.5 m fixed at one end and other end is connected to a block of mass m = 2 kg as shown in figure. The string is set into vibrations which is represented by $Y = 4\sin\left(\frac{\pi x}{5}\right)\cos(50\pi t)$ where x and y are in cm and t is in second. The number of antinodes between point A and the fixed pully is 2n, find n.



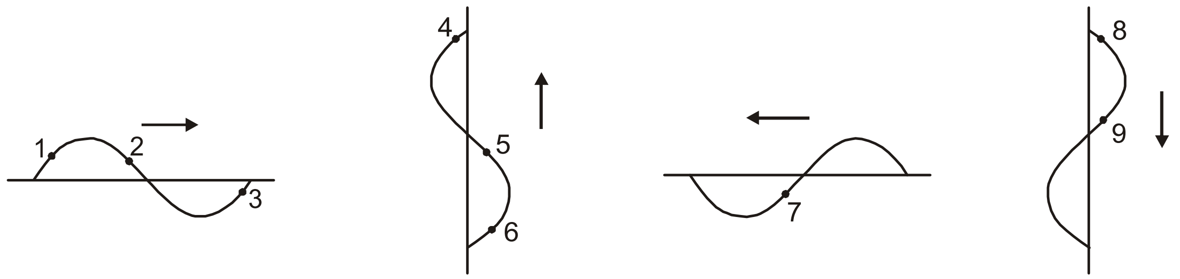
486. Figure shows the variation of the internal energy U with the density ρ of an ideal monoatomic gas for a thermodynamic process AB. Process AB is a part of rectangular hyperbola. Find the work done

(in joule) by gas in process AB.



487. The equation of a standing wave propagating along a string fixed at both ends is given by $y = (4\text{ cm})\sin(0.314\text{ cm}^{-1})x \cdot \cos(3.14\text{ s}^{-1})t$. The linear mass density of the string is 10 g/cm. The average power transmitted through the string is $n \times 10^{-4}$ W. Find n.

488. Consider the transverse mechanical waves shown in the figure. Points are marked on the wave. Arrow shows the direction of waves motion.

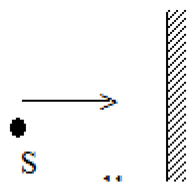


Out of the nine particles marked how many are moving towards their respective mean positions at this instant?

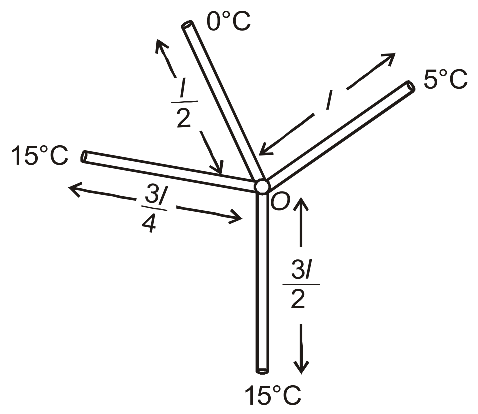
489. Three resonance frequencies of an organ pipe are at 1190, 1360 and 1530 Hz. If velocity of sound in the air is 340 m/s, Find the length of the pipe

490. One end of a uniform rod of length 1m is placed in bolling water while its other end is placed in melting ice. A point P ont he rod is maintained at a constant temperature of 800°C . The mass of steam produced per second is equal to the mass of ice melted per second. If specific latent heat of steam is 7 times the specific latent heat of ice, the distance of P from the steam chamber must be 1/x mtr.find the value of x.

491. A source s having a detector D moving towards a wall with a certain velocity detects 9 beats/s. On doubling the velocity of the source, thedetector D detects 20 beats /s . What is the original frequency (in Hz) of the sound emitted by thesource ? (Take speed of sound as 330 m/s)



492. All the rods in given arrangement are made up of same material and have same cross-section. Find the temperature of junction *O* (in °C). (Neglect the transfer of heat through radiations and convection)



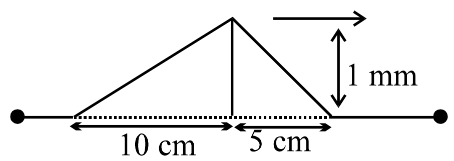
493. A source of sound emitting sound of frequency 10 kHz is moving towards a moving wall with speed 32 m/s. The wall is moving towards source with speed 64 m/s. Find the approximate wavelength (in cm) of wave reflected from the wall. Take speed of sound in air equal to 332 m/s

494. One mole of an ideal monoatomic gas is taken from state A to state B through the process $P = \frac{3}{2}T^{1/2}$. It is found that its temperature increases by 100 K in this process. Now it is taken from state B to C through a process for which internal energy is related to volume as $U = \frac{1}{2}V^{1/2}$. Find the total work performed by the gas (in Joule) , if it is given that volume at B is 100 m^3 and at C it is 1600 m^3. [Use R = 8.3 J/mol-K]

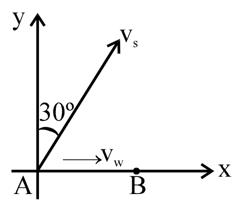
495. Assuming a particle to have the form of a sphere and to absorb all incident light, the radius (in μm) of a particle for which its gravitational attraction to the Sun is counterbalanced by the force that light exerts on it is X. Find 10X. The power of light radiated by the Sun equals $P = 4 \times 10^{26}$ W and the density of the particle is $\rho = 1.0$ g/cm^3 .

[Use $G = \frac{20}{3} \times 10^{-11}$ Nm^2/kg^2 ; $\pi = \frac{25}{8}$ and mass of the Sun = 2×10^{30} kg]

496. The kinetic energy of pulse travelling in a taut string is K mJ. Find the value of 100K. Given T = 10 N and μ = 0.1 kg/m.



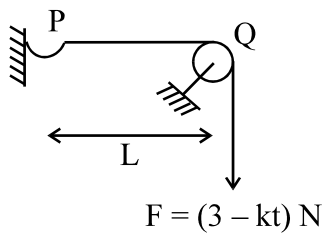
497. In the figure shown a source of sound of frequency 510 Hz moves with constant velocity v_s = 20 m/s in the direction shown. The wind is blowing at a constant velocity v_w = 20 m/s towards an observer who is at rest at point B. Find the frequency (in Hz) detected by the observer corresponding to the sound emitted by the source at initial position A.
[Speed of sound relative to air = 330 m/s]



498. We would like to increase the length of a 15 cm long copper rod of cross-section 4 mm^2 by 1 mm. The energy absorbed by the rod if it is heated is E_1. The energy absorbed by the rod if it is stretched slowly is E_2. Then find E_1/E_2.
[Various parameters of Copper are : Density = 9×10^3 kg/m^3 ; Thermal co-efficient of linear expansion = 16×10^{-6} K^{-1}, Young's modulus = 135×10^9 Pa , Specific heat = 400 J/kg-K]

499. A long uniform string of mass density 0.1 kg/m is stretched with a force of 40 N. One end of the string (x = 0) is oscillated transversely (sinusoidally) with an amplitude of 0.02 m and a period of 0.1 sec, so that travelling waves in the + x direction are set up.
(a) What is the velocity of the waves ?

500. In the given figure, a string of linear mass density 3×10^{-2} kg/m and length L = 1 m, is stretched by a force F = (3 – kt) N, where 'k' is a constant and 't' is time in sec. At the time t = 0, a pulse is generated at the end P of the string. Find the value of k (in N/s) if the value of force becomes zero as the pulse reaches point Q.



AnswerKey			
Qs.	**Ans.**	**Qs.**	**Ans.**
		451	A
402	A	452	A
403	C	453	C
404	A	454	C
405	B	455	A
406	C	456	B
407	A	457	C
408	B	458	B
409	B	459	B
410	D	460	D
411	A	461	A-(P),B-(Q),C-(S),D-(R)
412	B	462	A-(PS),B-(PRS),C-(CQ),D-(QR)
413	B	463	A-(3),B-(2),C-(3),D-(4)
414	A	464	A-(r),B-(q),C-(qs),D-(t)
415	A	465	A-(p,q),B-(s),C-(p,r),D-(s)
416	C	466	A-(r),B-(p),C-(s),D-(q)
417	ACD	467	A-(p,q,s),B-(r,s),C-(q,r,s),D-(r,s,t)
418	BC	468	A-(p,r,s),B-(q),C-(p,r,s),D-(q,r)
419	abcd	469	A-(s),B-(q),C-(r),D-(q)
420	ABCD	470	A-(P,S),B-(P,R,S),C-(Q),D-(Q,R)
421	ABD	471	A-(R),B-(S),C-(P),D-(Q)
422	AD	472	A-(Q),B-(Q),C-(R),D-(S)
423	ABCD	473	A-(Q),B-(R),C-(S),D-(P)
424	BD	474	A-(R),B-(P),C-(P),D-(R)
425	BC	475	A-(iv),B-(iv),C-(i),D-(ii)
426	D	476	A-(P),B-(Q),C-(Q),D-(S)
427	AB	477	A-(S),B-(Q),C-(P,Q),D-(Q,R)
428	ABD	478	A-(Q,S),B-(P,R,S),C-(P,Q,R,S),D-(P,Q,R,S)
429	AD	479	A-(Q),B-(Q),C-(Q),D-(P)
430	ACD	480	A-(S),B-(Q),C-(S),D-(S)
431	ABCD	481	75
432	BD	482	12
433	AC	483	508HZ
434	C	484	0
435	ABD	485	5
436	ABCD	486	2
437	AD	487	2
438	AC	488	4
439	D	489	1
440	B	490	9
441	C	491	41
442	B	492	7
443	C	493	2
444	A	494	435
445	A	495	6
446	C	496	15
447	D	497	525
448	D	498	500
449	A	499	20
450	A	500	20