PHYSICS
PART - II
TOPIC: WAVES & THERMODYNAMICS
EXERCISE # 01

SECTION : (A) - Single Correct Options

301. Three one dimensional mechanical waves in a medium given as:

y_1 = 3A sin (ωt – kx), y_{-2} = A sin (ωt – kx +π) and y_3 = 2A sin (ωt + kx) are superposed with each other. The maximum displacement amplitude of the medium particle would be

(A) 4 A (B) 3A (C) 2 A (D) A

302. A string of length 0.3 m and mass 10^{-2} kg is clamped at its ends. The tension in the string is 1.2 N. When a pulse travels along the string, the shape of the string is found to be the same at times t and t + Δt. The minimum value of Δt is

(A) 0.1 sec (B) 0.2 sec (C) 0.3 sec (D) 0.4 sec

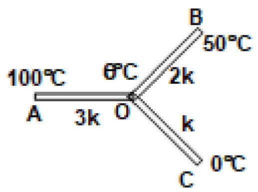
303. A sound wave is propagating unidirectionaly in a gaseous medium of bulk modulus 2×10^5 N/m^2 having displacement equation S (mm) = (2×10^{-5}m) sin (800 π t - 8πx). Find the density change amplitude of the medium.

(A) 2×10^{-5} m (B) 0.032 π kg/m^3 (C) 0.016 π kg/m^3 (D) can't be calculated.

304. One mole of an ideal diatomic gas is expanded. During expansion, volume and temperature of gas vary such that $\frac{V}{T^2}$ = constant. Find heat transfer during expansion if temperature of the gas increases by 50 K.

(A) 225 R (B) 125 R (C) 100 R (D) None of the above

305. Three rods of same dimensions having thermal conductivity as 8k, 2k and k are arranged as shown in the figure. The value of θ



(A) 60°C (B) (100/3)°C (C) (200/3)°C (D) None of these

306. A wave of frequency 1000 Hz has a wave velocity of 400 m/s. The distance between two consecutive points. Which are 60° out of the phase is

(A) $\frac{1}{15}$ m (B) $\frac{2}{15}$ m (C) $\frac{7}{3}$ m (D) $\frac{2}{3}$ m

307. The graphs of fall of temperature of a liquid (250 g) and water (200 g) (cooled under identical conditions having equal volumes) are shown in figure. Then the specific heat of the liquid (mass of the calorimeter is 100 gm and specific heat = 0.1)

(A) 0.24 (B) 2.24 (C) 1.24 (D) 0.14

308. A metal cylinder of inner radius R_1 and outer radius R_2 having length L carries a constant flow of hot water maintained at a temperature θ_1. The outer temperature of the surrounding is θ_2. If k is the thermal conductivity of the metal then the rate of heat loss through the walls of the cylinder in cal/s is

(A) $\frac{\pi kL(\theta_2 - \theta_1)}{Ln(R_2/R_1)}$ (B) $\frac{2\pi kL(\theta_2 - \theta_1)}{Ln(R_2/R_1)}$ (C) $\frac{\pi kL(\theta_2 - \theta_1)}{2Ln(R_2/R_1)}$ (D) $\frac{4\pi kL(\theta_2 - \theta_1)}{Ln(R_2/R_1)}$

309. A spherical black body with a radius of 10 cm radiates 450 watt power at 500 K. If the radius were halved and temperature doubled, the power radiated in watts would be

(A) 225 (B) 450 (C) 1200 (D) 1800

310. A tuning fork vibrates at 220 Hz. The length of the shortest closed organ pipe that will resonate with the tuning fork will be (Speed of sound in air = 340 m/s)

(A) 39 cm (B) 34 cm (C) 30 cm (D) 36 cm.

311. A balloon whose volume is 500 m^3 is to be filled with hydrogen at atmosphere pressure. If hydrogen is stored in cylinders of volume 0.05 m^3 at an absolute pressure of 15×10^5 Pa, then how many cylinders are required ($P_{atm} = 1.013 \times 10^5$ N/m^2, ρ_{air} = 1.3 kg/m^3 and $\rho_H = 9 \times 10^{-2}$ kg/m^3)

(A) 575 (B) 675 (C) 775 (D) 600

312. An organ pipe of cross sectional area 100 cm^2 resonate with a tuning fork of frequency 1000 Hz in fundamental tone. The minimum volume of water to be drain out so that the pipe again resonate with the same tuning fork is (take velocity of wave = 320 m/s)

(A) 800 cm^3 (B) 1200 cm^3 (C) 1600 cm^3 (D) 2000 cm^3

313. A wall of width ℓ and cross sectional area A is having variable coefficient of thermal conductivity given by $k = k_0 + \alpha x$ (where k_0 and α are positive constant) and x is measured from outer surface of wall. If the temperature of surroundings is T_0°C and the temperature of the room is maintained at T_r°C($T_0 > T_r$). The temperature of the wall at $x = \ell/2$ is (given $\propto\ell/K_0$ = 1 S.I. unit, T_0 = 45°C, and T_r = 20°C)

(A) 20°C (B) 25°C (C) 28°C (D) 30.37°C

314. A gaseous mixture has 0.5 gm of nitrogen and 1 gm of oxygen and is enclosed in a cylinder of 15 litre capacity at 27°C. The total pressure of mixture is

(A) 0.08054 atm (B) 0.05 atm (C) 0.03 atm (D) 0.02 atm

315. The volume of an air bubble is doubled as it rises from bottom to surface. The atmospheric pressure is H m of mercury and density of mercury is n times that of lake water the depth of lake is (assuming temperature of air to be constant)

(A) H/n (B) (nH)/2 (C) nH (D) 2nH

SECTION : (B) - Multiple Correct Options

316. The free ends of the rod of length (L = 0.5 m) 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 8×10^3 kg/m^3 and 200×10^9 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 4×10^3 m/s

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

317. The solar constant for the earth is S. The surface temperature of sun is T K. The sun subtends an angle θ at the earth then

(A) $S \propto T^4$ (B) $S \propto T^2$ (C) $S \propto \theta^2$ (D) $S \propto \theta^4$

318. A plane progressive wave of frequency 25 Hz, amplitude 2.5×10^{-5} m and initial phase zero moves along the –x direction with 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 magnitude maximum difference in the displacements at A and B is x.

(A) $\phi = \pi$ (B) $\phi = 0$ (C) x = 0 (D) $x = 5 \times 10^{-5}$ m

319. A one litre of perfect gas at a pressure of 72 cm of Hg, is compressed isothermally to a volume of 900 cc, then

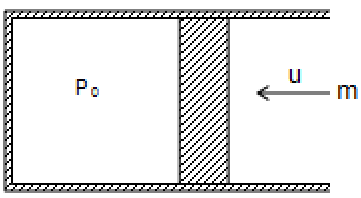
(A) Stress of the gas is 10.88×10^3 N/m^2

(B) Strain of the gas is 0.1

(C) Bulk modulus of gas at constant temperature is 10.88×10^3 N/m^2

(D) Bulk modulus of gas at constant temperature is 10.88×10^4 N/m^2

320. A horizontal piston cylinder arrangement encloses a gas at a pressure P_0. The atmospheric pressure is also P_0. Now a particle of mass m strikes the piston of identical mass m with a horizontal speed u and sticks to it. Subsequently the piston moves without friction and compresses the gas. The process of compression an be assumed to be adiabatic. In this process



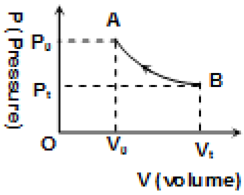
(A) when the piston comes to rest at maximum compression, the internal energy of gas would have increased by $\frac{1}{4}mu^2$

(B) During the time interval starting from the mass striking the piston to the maximum compression of the enclosed, gas the work done by the gas is $-\frac{1}{4}mu^2$.

(C) When the piston comes to rest after compressing the gas, the internal energy of the gas would have increased by the amount move than $\frac{1}{4}mu^2$.

(D) During the compression of the gas till the time when piston comes to rest, work done by the gas is less than $-\frac{1}{4}mu^2$.

321. The slope of the PV curve shown in the figure is P, where P is the pressure at the point on which slope is to be calculated. The value of slope of T-V curve between points A and B will be (Assume the gas undergoing compression to be ideal and n = number of moles of the gas)



(A) $\frac{P_0 e^{v_0 - v}}{nR}[1-v]$ (B) $\frac{P_0 e^{v_0 - v}}{nR}\left[v^2 - 3v + 1\right]$ (C) $\frac{P_0 e^{v_0}}{nR}$ (D) None of these.

322. A furnace X at temperature θ_0 is connected to a body Y of heat capacity C, at an initial temperature of θ_1, with the help of a rod of uniform cross-section A, uniform thermal conductivity K and length L. In some time interval temperature of body Y increases to θ_2 from θ_1 such that $\theta_1 < \theta_2 < \theta_0$. Then choose the correct option(s).

(A) Rate of heat flow through the rod is not constant.

(B) Temperature of the body Y increases exponentially.

(C) Rate of change of temperature of body Y increases with time.

(D) Rate of change of temperature of body Y decreases with time.

323. The rates of fall of temperature of two identical solid spheres of different materials(behaves as black body) are equal at a certain temperature.

(A) Their specific heat capacities are equal.

(B) Their heat capacities are equal

(C) Their specific heat capacities are proportional to their densities.

(D) Their specific heat capacities are inversely proportional to their densities

324. A perfectly black body:

(A) absorbs radiations of all wavelengths and does not transmit any radiations.

(B) absorbs and transmit radiations of all wavelengths.

(C) when heated, emits radiations of more wavelengths than it absorbs.

(D) when heated still absorbs and emits radiations of all wavelengths.

325. Select the correct statements(s):

(A) In an adiabatic process, the heat gain is equal to heat loss and hence, there is no heat exchange

(B) An ideal black body absorbs and emits radiations of all wavelength.

(C) During melting of ice, the heat given to ice goes in increasing the internal energy

(D) All of the above

326. A black body kept in sunlight is maintained at constant temperature, then the block body

(A) absorbs all but emits radiations of a few wavelengths

(B) absorbs a few but emits radiations of all wavelengths.

(C) absorbs and emits radiations of all wavelengths.

(D) is in thermal equilibrium

327. The equation of a process of diatomic gas is $P^2 = \alpha^2 v$ where α is +ve constant. Then choose

(A) Work done by gas for a temperature change T is $\frac{2}{3}\alpha nRT$

(B) The change in internal energy is $\frac{5}{2}nRT$ for temperature change T

(C) The specific heat for the process is $\frac{19}{6}R$

(D) The change in internal energy for temperature change T is $\frac{5}{2}\alpha nRT$

328. Two spheres having temperature T_1 and T_2 touch each other and are kept in a room. Then heat transfer between the spheres takes place through

(A) conduction if $T_1 \neq T_2$

(B) convection

(C) radiation

(D) no heat transfer takes place if $T_1 = T_2$.

329. Plane harmonic waves of frequency 500 Hz are produced in air with displacement amplitude of 10μm. Given density of air is 1.29 kg/m^3 and speed of sound in air is 340 m/s

(A) Pressure amplitude is 13.8 N/m^2

(B) Energy density is 0.22×10^{-4} J/m^3

(C) The energy flux is 6.4×10^{-2} J/m^2-s

(D) None of these.

330. For a certain stretched string, three consecutive resonance frequencies are observed as 105, 175, 245 Hz respectively. The select the correct alternative.

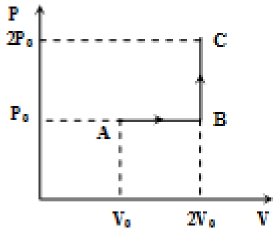
(A) The string is fixed at both ends.

(B) The string is fixed at one end

(C) The fundamental frequency is 35 Hz

(D) The fundamental frequency is 52.5 Hz

331. One mole of an ideal monoatomic gas is taken from A to C along the path ABC. The temperature of the gas at A is T_0. For the process ABC



(A) work done by the gas is RT_0

(B) change in internal energy of the gas is $\frac{11}{2}RT_0$

(C) heat absorbed by the gas is $\frac{11}{2}RT_0$

(D) heat absorbed by the gas is

(where R = universal gas constant)

332. A uniform rope of mass m and length ℓ hangs vertically from a rigid support. A transverse pulse of wavelength λ_0 is produced at the lower end. Here the speed of the pulse is v_0. At any time t, the pulse speed is v and wavelength of the pulse is λ. Then

(A) $\frac{v_0}{\lambda_0} = \frac{v}{\lambda}$

(B) acceleration of the wave pulse along the string is g/2.

(C) Acceleration of the wave pulse is independent of wavelength.

(D) None of the above.

333. It is usually more convenient to describe a sound wave in terms of pressure wave as compared to displacement wave because

(A) Two waves of same intensity but different frequencies have different displacement amplitude but same pressure amplitude.

(B) The human ear responds to the change in pressure and not to the displacement wave.

(C) The electronic detector does respond to the change in pressure but not to the displacement wave.

(D) None of the above

334. Which of the statements are correct about the nodes in a standing wave?

(A) The energy never propogates through nodes.

(B) At a time, when all particles pass through mean position, the energy can propagate in the form of kinetic energy.

(C) The nodes remain fixed because the two waves pass through simultaneously in opposite direction.

(D) The nodes remain fixed because the two waves pass through simultaneous in opposite phase.

335. The rate of heat energy emitted by a body at an instant depends upon

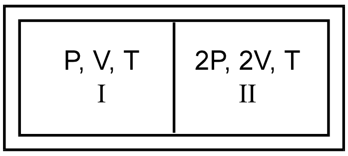
(A) area of the surface

(B) difference of temperature between the surface and its surroundings

(C) nature of the surface

(D) None of these

336. A partition divides a container having insulated walls into two compartments I and II. The same gas fills the two compartments whose initial parameters are given. The partition is a conducting wall which can move freely without friction. Which of the following statements is/are correct, with reference to the final equilibrium position?



(A) The Pressure in the two compartments are equal.

(B) Volume of compartment I is $\frac{3V}{5}$

(C) Volume of compartment II is $\frac{12V}{5}$

(D) Final pressure in compartment I is $\frac{5P}{3}$

337. The length, tension, diameter and density of a wire B are double than the corresponding quantities for another stretched wire A. Then (both are fixed at the ends)

(A) Fundamental frequency of B is $\frac{1}{2\sqrt{2}}$ times that of A.

(B) The velocity of wave in B is $\frac{1}{\sqrt{2}}$ times that of velocity in A.

(C) The fundamental frequency of A is equal to the third overtone of B.

(D) The velocity of wave in B is half that of velocity in A.

338. In a stationary wave,

(A) all the particles of the medium vibrate in phase

(B) all the antinodes vibrate in phase

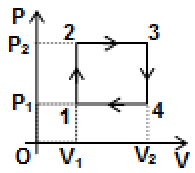
(C) the alternate antinodes vibrate in phase

(D) all the particles between consecutive nodes vibrate in phase

SECTION : (C) -Passage Type Questions

Passage 01:

An ideal monatomic gas [1 mole] is taken through a cyclic process, whose p-v graph is shown in the figure. If $P_2 = P_0$ and efficiency of cycle is 10%. If $v_2 = 2v_1$ and $v_1 = v_0$, now answer the following questions



339. The maximum temperature of the gas in the process is

(A) $\frac{P_0V_0}{R}$ (B) $\frac{P_0V_0}{2R}$ (C) $\frac{2P_0V_0}{R}$ (D) $\frac{4P_0V_0}{2R}$

340. The net heat supplied to gas in one cycle is

(A) $\frac{12P_0V_0}{17}$ (B) $\frac{5P_0V_0}{17}$ (C) $\frac{P_0V_0}{17}$ (D) $\frac{3P_0V_0}{17}$

341. The value of P_1 is

(A) $\frac{12P_0}{17}$ (B) $\frac{5P_0}{17}$ (C) $\frac{P_0}{17}$ (D) $\frac{3P_0}{17}$

PASSAGE 02:

The air column in a pipe closed at one end is made to vibrate in its third over tone by tuning fork of frequency 220 Hz. The speed of sound in air is 330 m/sec. End correction may be neglected. Let P_0 denote the mean pressure at any point in the pipe and ΔP_0 the maximum amplitude of pressure vibration.

342. Find the length of the air column

(A) 3.2 m (B) 2.625 m (C) 4.23 m (D) 1.16 m

343. What is the amplitude of pressure variation at the middle of the column

(A) $\frac{P_0}{\sqrt{2}}$ (B) $\frac{\sqrt{3}\Delta P_0}{2}$ (C) ΔP_0 (D) $\frac{\Delta P_0}{2}$

PASSAGE 03:

A cubical box of side 2 metre contains oxygen gas (atomic weight 32) at a pressure of 100 N/m^2. During an observation time of one second, an atom travelling with the root-mean square speed parallel to one of the edges of the cube, was found to make 500 hits with a particular wall, without any collision with the other atoms. ($R = \frac{25}{3}$ J/mol–K and $K = 1.38 \times 10^{-23}$ J/K)

344. What is the temperature of the gas

(A) 500 K (B) 4520 K (C) 5120 K (D) 3600 K

345. What is the average translational kinetic energy per atom

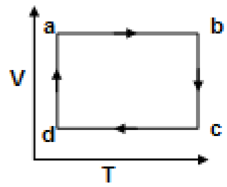
(A) 106×10^{-21} J (B) 96×10^{-21} J (C) 116×10^{-21} J (D) 112×10^{-21} J

346. Find the total mass of oxygen gas in the box.

(A) 30×10^{-4} kg (B) 2.4×10^{-4} kg (C) 6×10^{-4} kg (D) 15×10^{-4} kg

PASSAGE 04:

V–T graph of a monoatomic ideal gas is as shown in figure.



347. Sum of work done by the gas in process abcd is

(A) zero (B) Positive (C) negative (D) data is insufficient

348. Heat is supplied to the gas in process(s)

(A) da, ab and bc (B) da and ab only (C) da only (D) ab and bc only

349. Change in internal energy of the gas is zero in process

(A) da, ab and bc (B) da and bc only (C) da only (D) da and ab only

PASSAGE 05:

Internal energy: Every system (solid, liquid or gas) processes a certain amount of energy. This energy is called the internal energy and is usually denoted by the symbol U. The internal energy of a solid, liquid or gas consists of two parts (i) kinetic energy due to the motion (translational, rotational and vibrational) of the molecules, and (μ) potential energy due to the configuration of the molecules.

The internal energy of homogenous system depends on its thermodynamic state i.e., on its thermodynamic coordinates P, V and T. each definite state of the system possesses a define quantity of internal energy. A change in the internal energy can occur only if a transfer of energy between the system and surroundings is permitted. This can take place if (i) some work is performed on or by the system, and (ii) some heat is observed or given out by the system

350. In a given process on an ideal gas $dW = 0$ and $dQ > 0$. Then

(A) the temperature of the gas will decrease. (B) the temperature of the gas will remain constant.

(C) the internal energy of the gas will decrease. (D) the internal energy of the gas will increase.

351. The internal energy of an ideal gas consists of

(A) Kinetic energy of the particle of the gas.

(B) Potential energy of the particle of the gas.

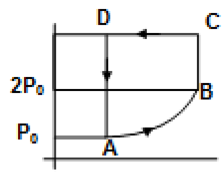
(C) Kinetic and potential energy of the particle of the gas.

(D) none of these.

PASSAGE 06:

A sample of ideal monatomic gas is expanded according to P = Δ v^2 with initial volume 100m^3 & temp 300k where ? = 3atm/m^6 in AB. Then at constant volume (BC) till pressure becomes twice of pressure at B. CD is at constant pressure till initial volume and finally DA at constant volume as shown

352. What is molar heat capacity in process AB.



(A) $\frac{3R}{2}$ (B) $\frac{R}{2}$ (C) 13R (D) $\frac{13R}{6}$

353. Total work done in cyclic process ABCDA by Gas

(A) 65×10^6J (B) -65×10^6J (C) -72×10^6J (D) None

354. Heat absorbed by gas in DA process.

(A) -1.035×10^8J (B) Zero (C) -1.035×10^6J (D) None

PASSAGE 07:

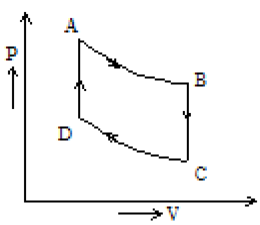
2 moles of an ideal monatomic gas undergoes in a cyclic process through the following changes

(i) Isothermal expansion from A to B from a volume 0.04 m^3 to 0.10 m^3 at 87^0 C

(ii) at constant volume from B to C cooling to 27^0 C.

(iii) Isothermal compression from C to D at 27^{0}C to 0.04 m^3

(iv) at constant volume from D to A heating to original pressure volume and temperature [In 2.5 = 0.92]



355. Heat supplied in the A B process is

(A) 5483.25 J (B) 1496.5 J (C) 6979.75 J (D) 913.85 J

356. Work done by the gas during the cyclic process is

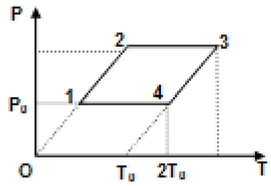
(A) 5483.25 J (B) 1496.5 J (C) 6979.75 J (D) 913.85 J

357. Heat absorbed by the gas during the cyclic process is

(A) 5483.25 J (B) 1496.5 J (C) 6979.75 J (D) 913.85 J

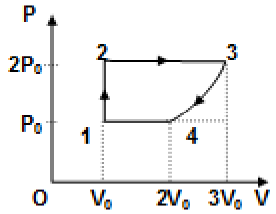
PASSAGE 08:

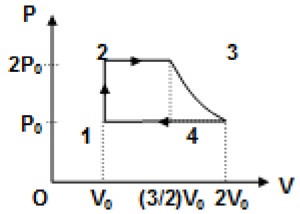
One mole of an ideal monoatomic gas is taken through the cycle process 1–2–3–4–1 as shown in the figure. The initial volume of gas is V_0.

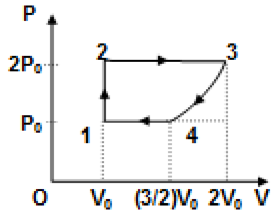


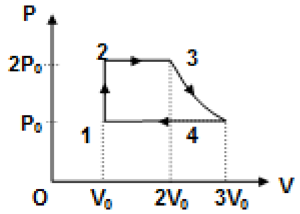
Now answer the following questions

358. The P–V diagram of the cyclic process will be

(A)


(B)


(C)


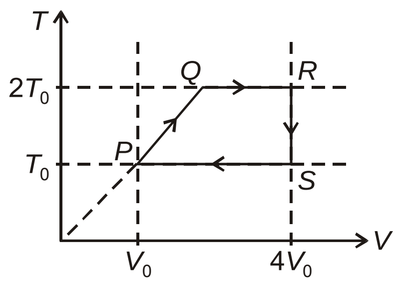
(D)


359. The work done by the gas in one cycle is

(A) $RT_0(3 - \ln 2)$ (B) $RT_0 \ln 2$ (C) $\frac{RT_0}{2}\ln 2$ (D) $\frac{RT_0}{2}(3 - \ln)$

PASSAGE 09:

n moles of argon are undergoing a cyclic process *PQRSP* as shown by the *T-V* diagram here. *T* and *V* represent thermodynamic gas temperature and volume occupied by the gas respectively. Considering argon to be behaving ideally, answer the following questions.



360. Heat supplied to the gas during the cycle is

(A) nRT_0 (B) $1.5nRT_0$ (C) $2nRT_0$ (D) $2.5nRT_0$

361. Efficiency of the cycle is

(A) $\frac{1}{5 + \ln 4}$ (B) $\frac{2}{5 + \ln 16}$ (C) $\frac{4}{5 + \ln 4}$ (D) $\frac{1}{5 + \ln 2}$

SECTION : (D) - Matrix Match

362. Match the processes in column I with the possibilities in column II, where ΔQ and W are heat change and work done respectively

	Column A		**Column B**
(A)	Isobaric	(i)	$\Delta Q > O$
(B)	Isothermal	(ii)	$\Delta Q < O$
(C)	Isochoric	(iii)	$W > O$
(D)	Adiabatic	(iv)	$W < O$

363. For a organ pipe closed at one end. Match the following:

	Column A		**Column B**
(A)	Third overtone frequency is x times the fundamental frequencies. Here x is equal to	(i)	3
(B)	Number of nodes in second overtone	(ii)	4
(C)	Number of antinodes in second overtone	(iii)	5
(D)	Fifth harmonic frequency is x′ times the fundamental frequency. Here x′ is equal to	(iv)	none of these

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

	Column A		**Column B**
(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

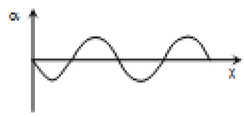
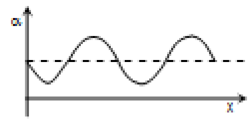
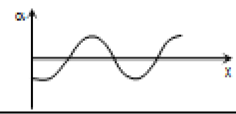
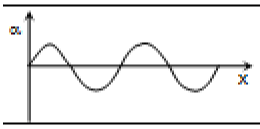
365. One mole of an ideal monoatomic gas undergoes a process $PV^{1/2} = C$, where C is a constant.

Match the following:

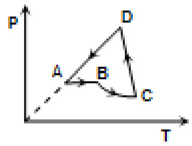
	Column – I		Column – II
(A)	Heat given to the gas to increase the temperature of the gas by 100°C.	(i)	150 R
(B)	Work done on the gas to change the volume from V_0 to $2V_0$.	(ii)	$\frac{7R}{2}$
(C)	Molar heat capacity of the gas	(iii)	350 R
(D)	Change in internal energy of gas when the temperature of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

366. The displacement equation of a standing wave in a homogeneous elastic medium is given by y = a cos (kx) cos (ωt)

Match the physical quantities α in the List (I) to the correct plot(s) in the List (II)

	List – I		List – II
(A)	Displacement y of the particles at t = (T/2)	(i)	
(B)	Velocity of the particles at t = (T/4)	(ii)	
(C)	Change in pressure of the medium at t = 0	(iii)	
(D)	Density of the medium at t = (T/2)	(iv)	

367. A hypothetical heat engine working with an ideal gas passes through the cycle A→B→C→D→A as shown in an P-T indicator diagram, where BC is an adiabatic process.



For the heat engine, match the physical quantities in List-II with the correct sign in List-I

	List – I		List – II
(A)	x > 0	(i)	W_{DA}
(B)	x = 0	(ii)	W_{CD}
(C)	x < 0	(iii)	W_{BC}
		(iv)	ΔQ_{BC}
		(v)	ΔQ_{CD}
		(vi)	ΔQ_{BC}

368. Source has frequency f. Source and observer both have same speed along same line. For the apparent frequency observed by observer

	List – I		List – II
A.	Observer is approaching the source but source is receding from the observer	(i)	More than f
B.	Observer and source both approaching towards each other	(ii)	Less than f
C.	Observer and source both receding from each other	(iii)	Equal to f
D.	Source is approaching but observer is receding		

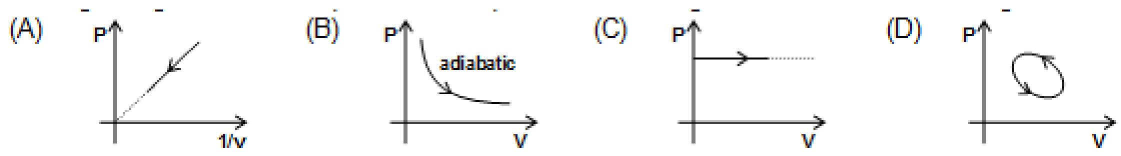
369. Match the processes in list I with the possibilities in list II, where, ΔQ and W are heat gained and work done by the system respectively

	List – I		List – II
(A)	Isobaric	(i)	$\Delta Q > O$
(B)	Isothermal	(ii)	$\Delta Q < O$
(C)	Isochoric	(iii)	$W > O$
(D)	Adiabatic	(iv)	$W < O$

370.

	List – I		List – II
(A)	Longitudinal waves	(i)	May be formed by two waves of same frequency
(B)	Transverse wave	(ii)	)May be formed by two waves of different frequency
(C)	Standing waves	(iii)	Cannot travel in free space
		(iv)	Can travel in free space

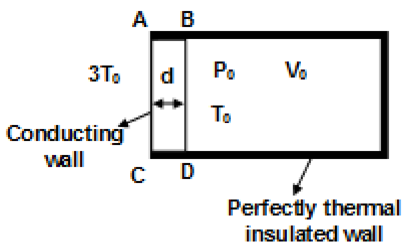
371. The figures given below depict different processes for a given amount for an ideal gas



	List – I		List – II
(A)	In Fig(i)	(i)	Heat is absorbed by the system
(B)	In Fig(ii)	(ii)	work is done on the system
(C)	In Fig(iii)	(iii)	Heat is rejected by the system
(D)	In Fig(iv)	(iv)	Work is done by the system

372. One mole of a monoatomic ideal gas is kept in a container of volume V_0. the conducting wall has surface area A, thickness surface area A, thickness d and thermal conductivity K. Assume that surrounding B at a constant temperature $3T_0$.

[given $\frac{2kA}{3Rd} = 1\ \text{sec}^{-1}$ and $T_0 = 100$ K]



	List I		List II
(A)	Rate of flow of heat in the gas	1.	$\frac{3KA}{d}(3T_0 - T)$
(B)	Rate of change of internal energy of gas	2.	$\frac{3}{2}R\frac{dT}{dt}$
(C)	Ratio of temperature of gas at t = ln2 sec to the temperature at t = 2 ln2 sec	3.	$\frac{4}{5}$
(D)	Ratio of change in internal energy of gas in the interval 0 to ln2 sec to change in the internal energy in the internal 0 to 2 ln2 sec.	4.	(2/3)

373. **List I** **List II**

	List I		List II
(A)	A mechanical wave propagates in a medium along the x-axis. The particles of the medium may move along	(i)	x-axis
(B)	A transverse wave travels along the z-axis. The particles of the medium may move along	(ii)	y-axis
(C)	A wave moving in a solid may be	(iii)	Transverse
(D)	A wave moving in a gas must be	(iv)	Longitudinal

374. For transverse wave on a string.

	Column I		Column II
(a)	If amplitude increases	(p)	maximum instantaneous power increases
(b)	If frequency increases	(q)	average power increases
(c)	If amplitude decreases,	(r)	maximum instantaneous power decreases
(d)	If frequency decreases,	(s)	average power decreases

375. Suppose a wave pulse has been created at free end of a taut string by moving the hand up and down once. The string is attached at its other end to distant wall.

	Column I		ColumnII
(a)	Moving hand more quickly but still up and down once by the same amount in different time,	(p)	the amplitude changes
(b)	Moving hand more quickly, but still up and down once changes by more amount in same time	(q)	time width of the pulse
(c)	Moving hand at same speed, but still up and down once by more amount	(r)	the wave speed changes
(d)	Moving hand more quickly, but still up and down once by less amount,	(s)	the particle speed changes

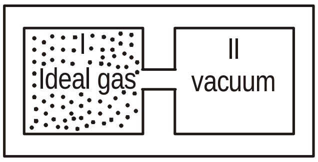
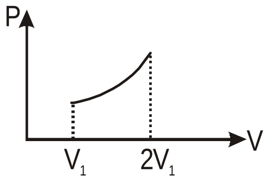
376.

	Column A		Column B
(A)	Temperature of a gas	(P)	Internal energy increases
(B)	Work done by the gas	(Q)	Intermolecular force decreases
(C)	Thermal expansion	(R)	Path function
(D)	Mechanical compression	(S)	State function

377. Two identical speakers emit sound waves of frequency 680 Hz uniformly in all directions with a total output of 1m W each. The speed of sound in air is 340 m/s. A point P is at a distance 2m from one speaker and 3m from the other. Match the following

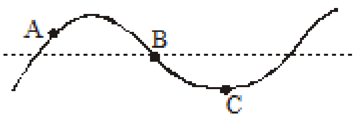
	Column-I		Column-II
(a)	The intensity due to a speaker at point P which is 2 m from point P	(p)	5.6×10^{-5} W/m^2
(b)	If the speakers are driven coherently and in phase, the intensity at point P will be due to both speakers	(q)	2.7×10^{-6} W/m^2
(c)	If they are driven coherently but out of phase by 180^{0}C, the intensity at point P will be due to both speakers	(r)	2.9×10^{-5} W/m^2
(d)	If the speakers are incoherent, the intensity(s) 2×10^{-5} w/m^2 at point P will be due to both speakers		

378. Column I contains a list of processes involving expansion of an ideal gas. Match this with Column II describing the thermodynamic change during this process. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS.

	Column-I		**Column-II**
(A)	An insulated container has two chambers separated by a valve Chamber I containsan ideal gas and the Chamber II has vacuum. The valve is opened. 	(P)	The temperature of the gas decreases
(B)	An ideal monoatomic gas expands to twice its original volume such that such that its pressure $p \propto (1/V^2)$, where V is the volume of the gas.	(Q)	The temperature of or remains constant
(C)	An ideal monoatomic gas expands to twice its original volume such that its pressure $p \propto (1/V^{4/3})$, where V is the volume.	(R)	The gas loses heat
(D)	An ideal monoatomic gas expands such that its pressure p and volume V follows the behaviour shown in the graph. 	(S)	The gas gains heat

379.

The figure shows a string at a certain moment as a transverse wave passes through it. Three particles A, B and C of the string are also shown. Match the physical quantities in the left column with the description in the column on the right.

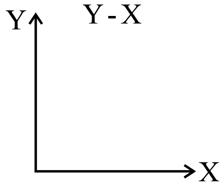


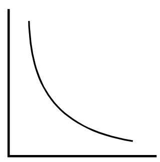
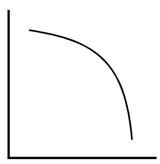
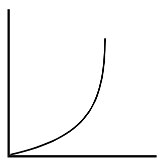
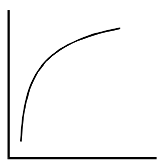
	Column A		**Column B**
(a)	Velocity of A	(p)	Downwards, if the wave is travelling towards right.
(b)	Acceleration of A	(q)	Downwards, if the wave is travelling towards left.
(c)	Velocity of B	(r)	Downwards, no matter which way the wave is travelling.
(d)	Velocity of C	(s)	Zero.

380. **List – I** **List – II**

	List – I		List – II
(A)	Conduction	(i)	Through partial transfer of medium
(B)	Convection	(ii)	Without transfer of medium
(C)	Radiation	(iii)	Even in absence of medium.

381. Respective graphs for adiabatic process taking first term on Y-axis



Column I		**Column II**	
(A)	Pressure - Temperature	(P)	
(B)	Volume - Temperature	(Q)	
(C)	Pressure - Volume	(R)	
(D)	Pressure - Internal Energy	(S)	

SECTION : (E) - Integer Type

382. At very low temperature, the molar heat capacity of rock salt varies with temperature according to $C = K\frac{T^3}{Q^3}$ where K is 1940 J $mol^{-1}K^{-1}$ and Q = 281 K. Then how much heat (in Joules) is required to raise the temperature of 2 moles of rock salt from 10 K to 50 K?

383. A sonometer wire fixed at one end has a solid mass M hanging from its other end to produce tension in it. It is found that 70 cm length of the wire produces a certain fundamental frequency when plucked. When the same mass is hanging in water, completely submerged in it, it is found that the length of the wire has to be changed by 5 cm if it is to produce the same fundamental frequency. The density (in in g/cc) of the material of the mass M hanging from the wire is $\frac{196}{X}$. The value of X is:

384. The equation of a transverse wave produced in a taut wire of length 64 cm and mass 50 gm is given as y = 2cm sin[200π (s^{-1})t–π/4 (cm^{-1})x]. What is the tension in the string?

385. A body cools down from 80°C to 70°C in 5 minute and from 70°C to 60°C in another 10 minutes. What is the temperature of the surrounding (in °C)?

386. Two wires are fixed on a sonometer. Their tensions are in the ratio 8 : 1, their lengths are in the ratio 36 : 35, the diameters are in the ratio 4 : 1 and densities are in the ratio 1 : 2. Find the frequencies of the beats produced (in per second) if the note of the higher pitch has a frequency of 360 per second.

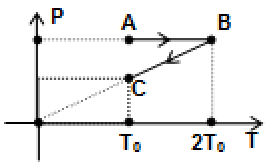
387. Air is filled in a bottle at atmospheric pressure and it is corked at 35°C. If the cork can come out at 4 atmospheric pressure. Then upto what temperature in °C should the bottle be heated in order to remove the cork (in °C)?

388. A steel wire of length 1.0 m and radius 1.0 mm is stretched without tension between two rigid supports at a temperature of 30°C. The tension in Newton in wire when the temperature falls to 20°C is X/2. Find the value of X. The coefficient of linear expansion and the Young's modules of steel are 1.1×10^{-5}/°C and 2.1×10^{11}N/m^2 respectively

389. A set of 65 tuning forks is so arranged that each gives 3 beats per second with the preceding one. If the last fork is the active of the first, find the frequency in Hz of the first tuning fork

390. A body of mass 10 kg is pulled on a rough horizontal surface with a constant speed of 1 m/s for 4 seconds. The rise in temperature of the body if 50% of the heat generated is absorbed by the body is: (Take, coefficient of friction = 0.5, specific heat of the body = 1J/kg/k and g = 10 m/s^2).

391. The P-T diagram for 1 mole of an ideal diatomic gas is as shown. Then the total work done (in KJ) during ABC is X/10. The value of X is: (Take, T_0 = 100 K, R = 8 J/mol/K)

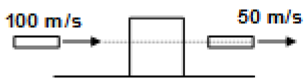


392. An ice cube of mass 0.1 kg at –10°C is kept in an isolated container. 90 gm of water at 10°C is poured into the container. Assume there is no heat gain or loss by the container. Find the equilibrium temperature of the mixture

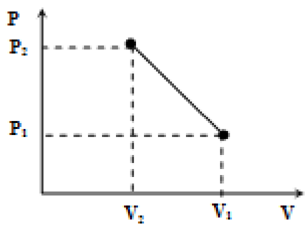
393. The heat added to a monoatomic ideal gas in a process is equal to the loss in its internal energy. When the temperature doubles then the volume becomes $\frac{n}{32}$ times its initial value. Find the value of n.

394. Two Strings S_1 & S_2 are made of silver & are kept under same tension. If S_1 has a radius twice that of S_2, what should be the length of S_2 in m. If first over tone of S_1 is equal fourth harmonic of S_2 & length of S_1 = 0.5 m.

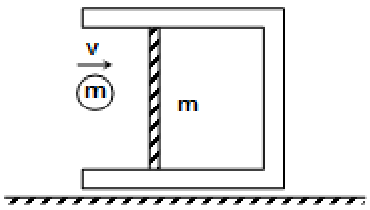
395. A bullet of mass 100 g moving with velocity 100 m/s hits an ice block of same mass at 0°C kept on a smooth horizontal surface. The bullet just comes out of the ice block and its velocity becomes 50 m/s. After some time 0.5g of the block melts. Assume all the energies are in the forms of kinetic and thermal energies. Given $L_{fusion} = 80$ cal/g, S_{water} = 1 cal/gK, mechanical equivalent of heat = 4.2 J/cal. Estimate the thermal energy in Joule going into the bullet



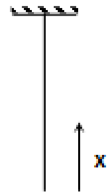
396. 20gm of helium in a cylinder under piston is transferred infinitely slowly from a state with a volume of v_1 = 30 litre and pressure P_1 = 5 atm to a state with volume v_2 = 10 litre and pressure P_2 = 15 atm. What maximum temperature in K (closest integer value) will the gas reach in this process if it is depicted on PV diagram as a straight line? [Given R = 0.082 line atm/mole-k



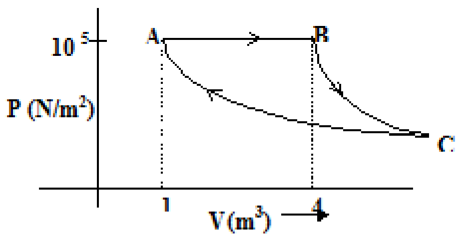
397. An adiabatic chamber has frictionless insulated piston of mass m. Mass of the remaining chamber is 4m. An ideal monoatomic gas is present inside the chamber in very small quantity i.e. the mass of gas is very small compared to the system (Take n mole) at atmospheric temperature and pressure. Piston is in relaxed state and confined to move horizontally along the length of chamber. A block of mass m moving horizontally with speed v, strikes elastically with the piston. The change in temperature of the gas is ΔT, when the compression of the piston is maximum. Then change in temperature of gas is $\frac{Kmv^2}{15nR}$, then the value of K is ....(R is gas constant)



398. A rope of length L hangs vertically from a rigid support. The linear mass density varies as $\mu = \alpha x$ from the lower end, where x is the distance from lower end. A wave pulse is generated at the lower end. The time taken by the pulse to reach the upper end is $K\sqrt{\frac{2L}{g}}$, then the value of K is ....



399. A fixed mass of gas is taken through a process $A \rightarrow B \rightarrow C \rightarrow A$. Here $A \rightarrow B$ is isobaric. $B \rightarrow C$ is adiabatic and $C \rightarrow A$ is isothermal. The work done in the process is 4.9×10^n J, then the value of n is ....(take $\gamma = 1.5$)



400. A uniform rope of length 12 m and mass 6 kg hangs vertically from a rigid support. A block of mass 2kg is attached to the free end of the rope. A transverse pulse of wavelength 0.06 m is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of rope is _____________ centimeter.

401. A body at temperature 40ºC is kept in a surrounding of constant temperature 20ºC. It is observed that its temperature falls to 35ºC in 10 minutes. Find how much time (in min) will it take for the body to attain a temperature of 30ºC by approximate method & report your answer in the nearest whole number.

AnswerKey					
Qs.	Ans.	Qs.	Ans.	Qs.	Ans.
301	A	351	A	401	14
302	A	352	D		
303	B	353	B		
304	A	354	A		
305	C	355	A		
306	A	356	D		
307	A	357	C		
308	B	358	A		
309	D	359	B		
310	A	360	A		
311	B	361	B		
312	C	362	A-(i),(ii),(iii),(iv),B-(i),(ii),(iii),(iv),C-(i),(ii),D-		
313	D	363	A-(iv),B-(i),C-(i),D-(iii)		
314	A	364	A-(iv),B-(iv),C-(i),D-(ii)		
315	C	365	A-(iii),B-(iv),C-(ii),D-(i)		
316	AD	366	A-(iii),B-(iii),C-(iv),D-(ii)		
317	AC	367	A-(iv),B-(I,iv),C-(ii,iii,iv)		
318	AD	368	A-(iii),B-(i),C-(ii),D-(iv)		
319	ABD	369	A-(i),(ii),(iii),(iv),B-(i),(ii),(iii),(iv),C-(i),(ii),D-		
320	CD	370	A-(iii),B-(iv),C-(i)		
321	A	371	A-(I,iv),B-(iv),C-(i,iv),D-(ii,iii)		
322	ABD	372	A-(i,ii),B-(i,ii),C-(iii),D-(iv)		
323	BD	373	A-(i,ii),B-(i,ii),C-(iii,iv),D-(iv)		
324	BD	374	A-(p,q),B-(p,q),C-(r,s),D-		
325	BC	375	A-(q,s),B-(p,s),C-(p,q),D-		
326	CD	376	A-(s),B-(r),C-(q),D-(p)		
327	BC	377	A-(s),B-(p),C-(q),D-(r)		
328	ABC	378	A-(Q),B-(P,R),C-(P,S),D-(S)		
329	A	379	A-(p),B-(r),C-(q),D-(s)		
330	BC	380	A-(ii),B-(i),C-(iii)		
331	AC	381	A-(R),B-(P),C-(P),D-(R)		
332	ABC	382	273		
333	ABC	383	24		
334	AC	384	5		
335	AC	385	55		
336	ABCD	386	10		
337	CD	387	959		
338	CD	388	145		
339	C	389	192		
340	B	390	10		
341	A	391	8		
342	B	392	0		
343	A	393	4		
344	C	394	2		
345	A	395	82		
346	C	396	488		
347	C	397	4		
348	B	398	2		
349	B	399	5		
350	D	400	12		