SECTION A

1 When a molecule (or an elastic ball) hits a (massive) wall, it rebounds with the same speed. When a ball hits a massive bat held firmly, the same thing happens. However, when the bat is moving towards the ball, the ball rebounds at a different speed. Does the ball move faster or slower?
1. faster
2. slower
3. speed of ball does not changes
4. none of these

2 The longitudinal strain of a string is equal to twice the magnitude of lateral strain. Poisson's ratio of the material of string is:
1. 0.4
2. 0.5
3. 0.1
4. 0.2

3 Water enters through end A with a speed v_1 and leaves through end B with a speed v_2 of a cylindrical tube AB. The tube is always completely filled with water. In case I the tube is horizontal, in case II it is vertical with the end A upward and in case III it is vertical with the end B upward. We have $v_1 = v_2$ for:
1. case I
2. case II
3. case III
4. each one

4 The ratio of the specific heats $\frac{\mathrm{C_p}}{\mathrm{C_v}} = \gamma$ in terms of degrees of freedom(n) is given by:
1. $(1 + \frac{1}{n})$
2. $(1 + \frac{n}{3})$
3. $(1 + \frac{2}{n})$
4. $(1 + \frac{n}{2})$

5 A flask contains argon and chlorine in the ratio of $2 : 1$ by mass. The temperature of the mixture is 27° C. The ratio of root mean square speed v_{rms} of the molecules of the two gases is: (Atomic mass of argon = 39.9 u; Molecular mass of chlorine = 70.9 u)
1. 2.33
2. 1.33
3. 0.5
4. 2

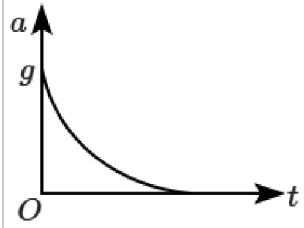
6 A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half-submerged in a liquid of density σ at the equilibrium position. The extension x_0 of the spring when it is in equilibrium is:
(Here k is spring constant)
1. $\frac{Mg}{k}\left(1 - \frac{LA\sigma}{2M}\right)$
2. $\frac{Mg}{k}\left(1 + \frac{LA\sigma}{M}\right)$
3. $\frac{Mg}{k}$
4. $\frac{Mg}{k}\left(1 - \frac{LA\sigma}{M}\right)$

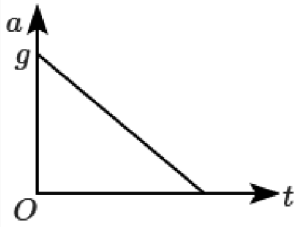
7 During the melting of a slab of ice at 273 K at atmospheric pressure:

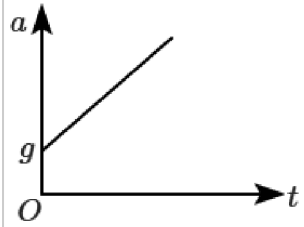
1.	positive work is done by the ice-water system on the atmosphere
2.	positive work is done on the ice-water system by the atmosphere
3.	internal energy of ice-water system decreases
4.	none of the above

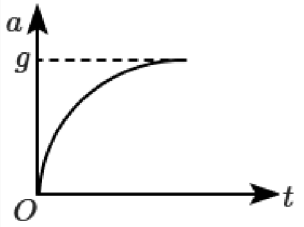
8 When volume changes from V to $2V$ at constant pressure(P), then the change in internal energy will be:
1. PV
2. $3PV$
3. $\frac{PV}{\gamma - 1}$
4. $\frac{RV}{\gamma - 1}$

9 A raindrop started falling in static air. Which of the following represents its acceleration 'a' versus time 't' graph?

1. 

2. 

3. 

4. 

10 In a room containing air, heat can go from one place to another:
1. by conduction only
2. by convection only
3. by radiation only
4. by all three modes.

11 A liquid can easily change its shape but a solid can not because:

1.	the density of a liquid is smaller than that of a solid.
2.	the forces between the molecules is stronger in solid than in liquids.
3.	the atoms combine to form bigger molecules in a solid.
4.	the average separation between the molecules is larger in solids.

12 What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity?
1. 100 s^{-1}
2. zero
3. 150 s^{-1}
4. none of these

13 A steam engine delivers 5.4×10^8 J of work per minute and extracts 3.6×10^9 J of heat per minute from its boiler. The efficiency of the engine is:
1. 15%
2. 18%
3. 13%
4. 11%

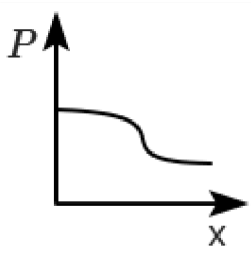
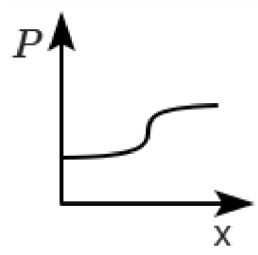
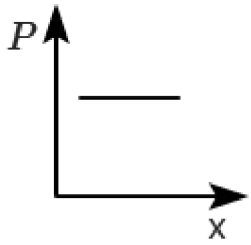
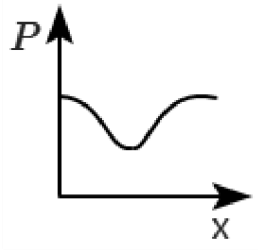
14 An infinite number of bodies, each of mass 2 kg are situated on the $x-$axis at distances $1\text{ m}, 2\text{ m}, 4\text{ m}, 8\text{ m}, \ldots\ldots$ respectively, from the origin. The resulting gravitational potential due to this system at the origin will be:
1. $-\frac{8}{3}\text{G}$
2. $-\frac{4}{3}\text{G}$
3. -4G
4. $-\text{G}$

15 How much should the pressure on a litre of water be changed to compress it by 0.10%?
(Given Bulk modulus of water, $B = 2.2 \times 10^9$ N-m^{-2})
1. 4.8×10^6 N/m^2
2. 2.2×10^6 N/m^2
3. 5.1×10^6 N/m^2
4. 3.3×10^6 N/m^2

16 One mole of an ideal gas at an initial temperature of T K does $6R$ joules of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is $5/3$, the final temperature of the gas will be:
1. $(T - 2.4)$ K
2. $(T + 4)$ K
3. $(T - 4)$ K
4. $(T + 2.4)$ K

17 During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its temperature. The ratio of $\frac{C_P}{C_V}$ for the gas is:
1. 2
2. $5/3$
3. $3/2$
4. $4/3$

18 Water flows through a frictionless duct with a cross-section varying as shown in the figure. Pressure P at points along the axis is represented by:

1.		2.	
3.		4.	

19 Given below are two statements:

Assertion (A):	Identical springs of steel and copper are equally stretched. More work will be done on the steel spring.
Reason (R):	Steel is more elastic than copper.

1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

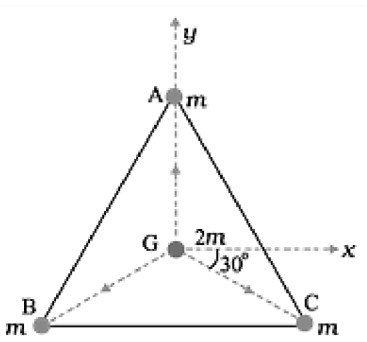
20 Streamline flow is more likely for liquids with,

(a)	high density.
(b)	high viscosity.
(c)	low density.
(d)	low viscosity.

Choose the correct option:

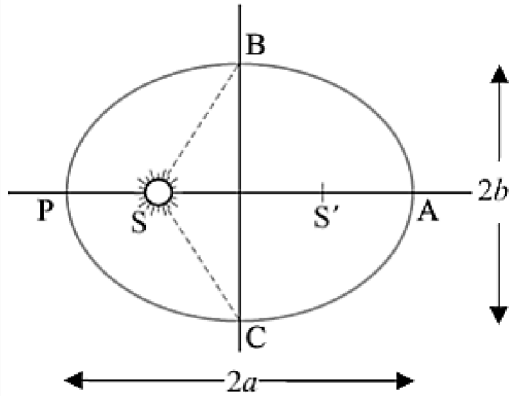
1.	(a, b)
2.	(c, d)
3.	(b, c)
4.	(a, d)

21 Three equal masses of m kg each are fixed at the vertices of an equilateral triangle ABC. What is the force acting on a mass $2m$ placed at the centroid G of the triangle?
(Take $AG = BG = CG = 1$ m.)



1. $Gm^2(\hat{i} + \hat{j})$
2. $Gm^2(\hat{i} - \hat{j})$
3. zero
4. $2Gm^2(\hat{i} + \hat{j})$

22 Let the speed of the planet at the perihelion P in the figure shown below be v_p and the Sun-planet distance SP be r_p. Will the planet take equal time to traverse BAC and CPB?



1.	no
2.	yes
3.	depends on the mass of the planet
4.	we can't say anything

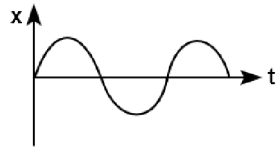
23 The height from the surface of the earth at which the value of g becomes one-fourth of that on the earth's surface will be:
(R is the radius of the earth)
1. $2.45R$
2. $1.45R$
3. R
4. $\frac{5}{6}R$

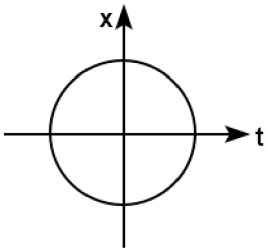
24 Given below are two statements:

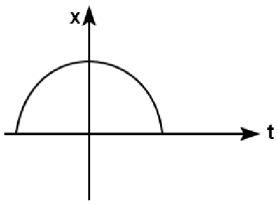
Assertion (A):	The temperature of the surface of the sun is approximately 6000 K. If we take a big lens and focus the sun rays, we can produce a temperature of 8000 K.
Reason (R):	This is the highest temperature that can be produced according to the second law of thermodynamics.

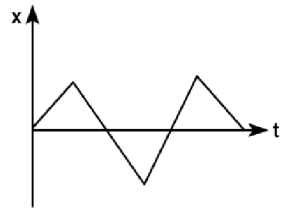
1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

25 A particle moves on a circular path with uniform speed about the origin. The $(x-t)$ graph will be:
(x : value of $x-$coordinate; $t-$time)

1. 

2. 

3. 

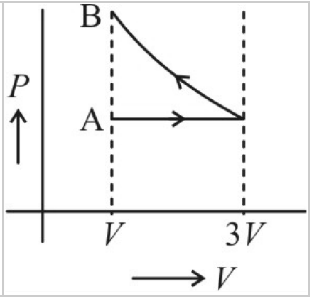
4. 

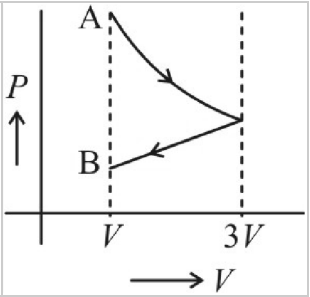
26 The equation of motion of a particle that starts moving at $t = 0$ s is given by $\mathrm{x} = 5\sin\left(\frac{\pi t}{2} + \frac{\pi}{3}\right)$ where x is in cm and time t is in second. The time, when the particle first comes to rest, is:
1. $\frac{1}{3}$ s
2. $\frac{7}{6}$ s
3. $\frac{2}{3}$ s
4. $\frac{13}{6}$ s

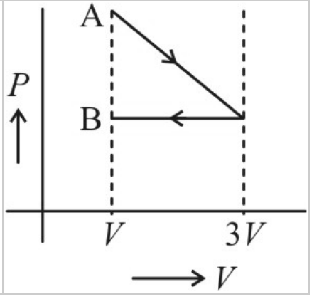
27 If Q, E, and W denote respectively the heat added, the change in internal energy, and the work done in a closed cycle process, then:
1. $W = 0$
2. $Q = W = 0$
3. $E = 0$
4. $Q = 0$

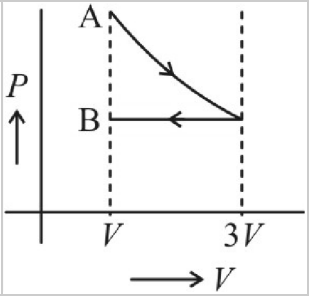
28 The velocity of a small ball of mass m and density ρ, when dropped in a container filled with glycerine of density σ, becomes constant after some time. The viscous force acting on the ball in the final stage is:
1. $\mathrm{mg}\left(\frac{\sigma}{\rho}\right)$
2. $\mathrm{mg}\left(1+\frac{\sigma}{\rho}\right)$
3. $\mathrm{mg}\left(1-\frac{\sigma}{\rho}\right)$
4. mg

29 One mole of an ideal gas goes from an initial state A to the final state B with two processes. It first undergoes isothermal expansion from volume V to $3V$ and then its volume is reduced from $3V$ to V at constant pressure. The correct $(P-V)$ diagram representing the two processes is:

1. 

2. 

3. 

4. 

30 For an ideal liquid,

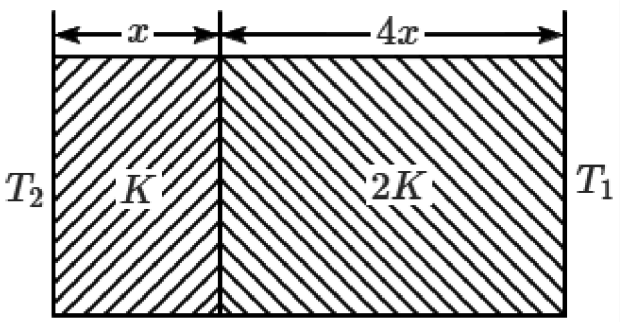
(a)	the bulk modulus is infinite.
(b)	the bulk modulus is zero.
(c)	the shear modulus is infinite.
(d)	the shear modulus is zero.

Choose the correct option:

1.	(a, d)
2.	(b, d)
3.	(b, c)
4.	(c, d)

31 A liquid does not wet the solid surface if the angle of contact is:
1. equal to 45°
2. equal to 60°
3. greater then 90°
4. zero

32 The temperature of the two outer surfaces of a composite slab, consisting of two materials having coefficients of thermal conductivity K and $2K$ and thickness x and $4x$, respectively are T_2 and T_1 ($T_2 > T_1$). The rate of heat transfer through the slab, in a steady state, is $\left(\frac{A(T_2-T_1)K}{x}\right)f$, with f equal to:



1. 1
2. $\frac{1}{2}$
3. $\frac{2}{3}$
4. $\frac{1}{3}$

33 On observing light from three different stars P, Q, and R, it was found that the intensity of the violet colour is maximum in the spectrum of P, the intensity of the green colour is maximum in the spectrum of R and the intensity of the red colour is maximum in the spectrum of Q. If T_P, T_Q, and T_R are the respective absolute temperatures of P, Q, and R, then it can be concluded from the above observations that:
1. $T_P > T_Q > T_R$
2. $T_P > T_R > T_Q$
3. $T_P < T_R < T_Q$
4. $T_P < T_Q < T_R$

34 A spherical black body with a radius of 12 cm radiates 450 W power at 500 K. If the radius were halved and the temperature is doubled, the power radiated in watts would be:
1. 450
2. 1000
3. 1800
4. 225

35 Suppose that the average kinetic energy (translational & rotational) of random molecular motion of helium (He) at temperature T_{He} is equal to that of hydrogen (H_2) at temperature T_{H_2}. Then,

1. $T_{H_2} = T_{He}$
2. $\frac{T_{H_2}}{2} = \frac{T_{He}}{4}$
3. $5T_{H_2} = 3T_{He}$
4. $\frac{T_{H_2}}{5} = \frac{T_{\text{He}}}{3}$

SECTION B

36 For a wave $y = y_0 \sin(\omega t - kx)$, for what value of λ is the maximum particle velocity equal to two times the wave velocity?

1. πy_0
2. $2\pi y_0$
3. $\pi y_0/2$
4. $4\pi y_0$

37 The speed of sound in a gas is v and the r.m.s. velocity of the gas molecules is c. The ratio of v to c is:

1. $\frac{3}{\gamma}$
2. $\frac{\gamma}{3}$
3. $\sqrt{\frac{3}{\gamma}}$
4. $\sqrt{\frac{\gamma}{3}}$

38 When two waves with same frequency and constant phase difference interfere,

1.	there is a gain of energy
2.	there is a loss of energy
3.	the energy is redistributed and the distribution changes with time
4.	the energy is redistributed and the distribution remains constant in time

39 A body describes simple harmonic motion with an amplitude of 5 cm and a period of 0.2 s. What is the velocity of the body when the displacement is 3 cm?

1. 0.4π cm/s
2. 0
3. 0.5π cm/s
4. 0.3π cm/s

40 In the case of forced vibration, the resonance wave becomes very sharp when the:

1.	quality factor is small
2.	damping force is small
3.	restoring force is small
4.	applied periodic force is small

41 A spring of force constant k is cut into lengths of ratio $1 : 2 : 3$. They are connected in series and the new force constant is k'. Then they are connected in parallel and force constant is k''. Then $k' : k''$ is:

1. 1 : 9
2. 1 : 11
3. 1 : 14
4. 1 : 6

42 Given below are two statements:

Assertion (A):	Ocean waves hitting a beach are always found to be nearly normal to the shore.
Reason (R):	Ocean waves are longitudinal waves.

1.	Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
2.	Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.
3.	**(A)** is true but **(R)** is false.
4.	Both **(A)** and **(R)** are false.

43 A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. When fork A is filed, the beat frequency decreases to 2 beats/s. What is the original frequency of fork A?

1. 342 Hz
2. 345 Hz
3. 335 Hz
4. 338 Hz

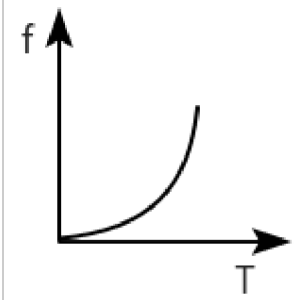
44 An elastic ball is projected vertically upward with a speed u, and it returns to the ground and rebounds, the motion is periodic with a period T. A simple pendulum, having a length equal to maximum altitude attained by this ball, would have a time period of:

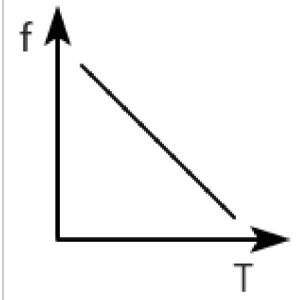
1. T
2. πT
3. $\pi\sqrt{2}T$
4. $\frac{\pi}{\sqrt{2}}T$

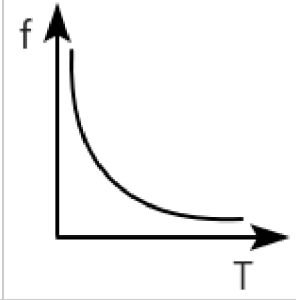
45 A train, standing at the outer signal of a railway station blows a whistle of frequency 400 Hz in still air. What is the frequency of the whistle for a platform observer when the train approaches the platform with a speed of 10 m/s?
(Speed of sound= 340 m/s)

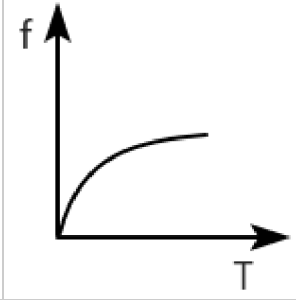
1. 512 Hz
2. 312 Hz
3. 412 Hz
4. 400 Hz

46 The graph between fundamental frequency (f) and corresponding tension (T) in a sonometer wire is best-represented by:

1. 

2. 

3. 

4. 

47 The amplitude of an S.H.M. reduces to $1/3$ in first 20 s, then in first 40 s its amplitude becomes:

1. $\frac{1}{3}$
2. $\frac{1}{9}$
3. $\frac{1}{27}$
4. $\frac{1}{\sqrt{3}}$

48 A mass attached to a spring is free to oscillate, with angular velocity ω, in a horizontal plane without friction or damping. It is pulled to a distance x_0 and pushed towards the centre with a velocity v_0 at time $t = 0$. The amplitude of the resulting oscillations is:

1. $\sqrt{\left(2x_0^2 + \frac{v_0^2}{\omega^2}\right)}$
2. $\sqrt{\left(x_0^2 + \frac{v_0^2}{\omega^2}\right)}$
3. $\sqrt{\left(x_0^2 + \frac{v_0^2}{2\omega^2}\right)}$
4. $\sqrt{\left(x_0^2 + \frac{v_0^2}{\pi\omega^2}\right)}$

49 The equation of vibration of a taut string, fixed at both ends, is given by:
$y = (4\text{ mm})\ cos\left(\frac{\pi x}{30\text{ cm}}\right)\ sin\left(400\pi\ s^{-1}t\right)$
The speed of waves on the string is:

1. 30 m/s
2. 60 m/s
3. 90 m/s
4. 120 m/s

50 Two identical springs are joined end-to-end to form a single spring and a block is suspended from the combination. The time period of oscillation is T_1. Alternatively, if the springs were joined in parallel, the time period is T_2. Then:

1.	$T_1 = T_2$
2.	$T_1 = 2T_2$
3.	$T_2 = 2T_1$
4.	none of the above is true.

Fill OMR Sheet*

*If above link doesn't work, please go to test link from where you got the pdf and fill OMR from there. After filling the OMR, you would get answers and explanations for the questions in the test.