PART-I_PHYSICS **Max Marks : 60**

Section-1
(One or More options Correct Type)

This section contains 10 multiple choice equations. Each question has four choices (**A**) (**B**),(**C**) and (**D**) out of which **ONE** or **MORE THAN ONE** are correct.

1. A body of mass m is attached to a spring of spring constant k which hangs from the ceiling of an elevator at rest in equilibrium. Now the elevator starts accelerating upwards with its acceleration varying with time as a = pt + q, where p and q are positive constants. In the frame of elevator.

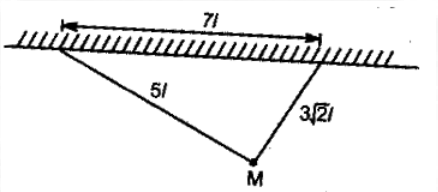
A) The block will perform S.H.M for all value of p and q

B) The block will not perform S.H.M in general for all value of p and q expect p =0

C) The block will perform S.H.M in general for all value of p and q expect p = 0

D) The velocity of the block will vary simple harmonically for all value of p and q

2. A particle is suspended by two ideal strings as shown in the figure. Now mass m is given a small displacement perpendicular to the plane of triangle formed. Choose the correct statement(s).



A) The period of oscillation of the system is $2\pi\sqrt{\frac{3\sqrt{3}\ell}{g}}$

B) The period of oscillation of the system is $2\pi\sqrt{\frac{3\ell}{g}}$

C) The period of oscillation of the system is independent of M

D) If the distance between the suspension points was kept constant and the length of the strings were quadrupled then the period of the system will be double.

3. The potential energy of a particle of mass 2 kg moving along the x-axis is given by

U(x) = $16(x^2 - 2x)$ joule. Its velocity at x =1 m is 2m/s. Then:

A) The particle describes uniformly accelerated motion

B)The particle describes oscillatory motion from $x_1 = 0.5m \; to \; x_2 = 1.5m$

C) The particle executes simple harmonic motion

D) The period of oscillation of the particle is $\pi/2$ second

4. A simple pendulum has a time period T. The bob is now given positive charge:

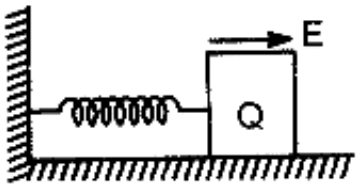
A) If some positive charge is placed at the point of suspension, T will increase

B) If some positive charge is placed at the point of suspension, T will not change

C) If a uniform downward electric field is switched on, T will increase

D) If a uniform downward electric field is switched on, T will decrease

5. A spring block system undergoes S.H.M on a smooth horizontal surface. The block is given some positive charge and a uniform electric field to the right is switched on. As a result.



A) the time period of oscillation will increase

B) the time period of oscillation will decrease

C) the time period of oscillation remain unaffected

D) the mean position of S.H.M will shift to the right

6. Two simple harmonic motions are represented by the equation

$y_1 = 3\left(\sqrt{3}\cos 3\pi t + \sin 3\pi t\right)$ and $y_2 = 6\sin\left(6\pi t + \pi/6\right)$

A) The ratio A_1/A_2 of their amplitude is 1/2

B) The ratio A_1/A_2 of their amplitude is 1

C) The ratio v_1/v_2 of their maximum velocities is 1/2

D) The ratio v_1/v_2 of their maximum velocities is 2

7. For a body executing S.H.M with amplitudes A, time period T, max velocity $v_{max}$and phase constant zero, which of the following statements are correct ?

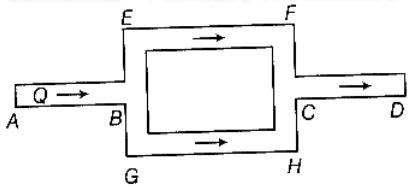
A) At $y = (A/2), v > (v_{max}/2)$

B) $v = (v_{max}/2)\ for\ y > (A/2)$

C) For $t = (T/8), y > (A/2)$

D) For $y = (A/2), t < (T/8)$

8. A liquid is flowing through horizontal pipes shown in the figure. The distances EB, BG, FC and CH are negligible. Lengths of different pipes has the following ratio $L_{AB} = L_{CD} = \frac{L_{EF}}{2} = \frac{L_{GH}}{2}$ Similarly, radii of the pipes have the ratio $R_{AB} = R_{EF} = R_{CD} = \frac{R_{GH}}{2}$. Pressure at A is $2p_0$ and pressure at D is p_0. The volume flow rate through the pipe AB is Q.



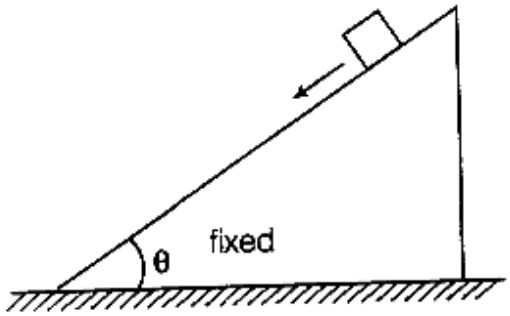
A) Volume flow rate through EF is $\frac{Q}{17}$

B) Volume flow rate through GH is $\frac{16Q}{17}$

C) Pressure at E is nearly 1.53 p_0

D) Pressure at F is nearly 1.47 p_0

9. A cubical block of side a and density ρ slides over a fixed inclined plane with constant velocity v. There is a thin film of viscous fluid of thickness t between the plane and the block. Then, the coefficient of viscosity of the thin film cannot be



A) $\frac{\rho a\ gt\sin\theta}{v}$ B) $\frac{\rho a\ gt}{v\sin\theta}$ C) $\frac{\rho a\ gt\sin\theta}{\sqrt{2}v}$ D) $\frac{\rho a\ gt}{\sqrt{2}v\sin\theta}$

10. Viscosity is exhibited by

A) solids, liquids and gases B) solids

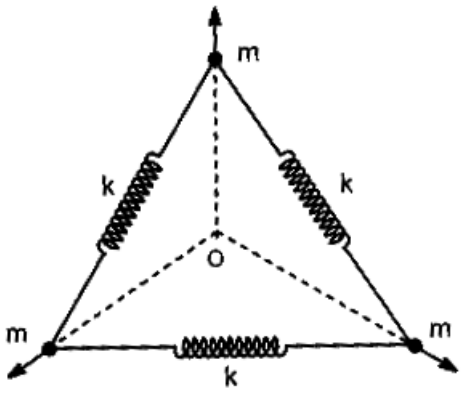
C) liquids D) gases

Section-2

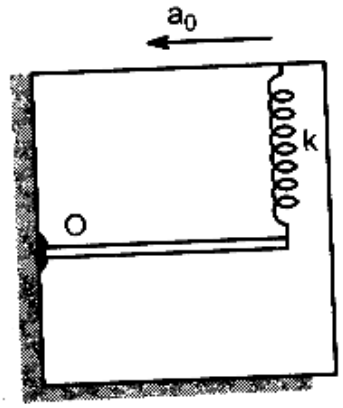
(Integer Value Correct Type)

This section contains 10 questions. The answer to each question is a **single digit integer, ranging** from 0 to 9 (both inclusive).

11. Three identical springs each of force constant k have been joined to the three identical balls (each of mass m),as shown in the figure which are at the three vertices of an equilateral triangle. In the shown arrangement, each of the spring is in its natural length. What all three balls are simultaneously given small displacements of equal magnitude along the directions as shown in the figure, the oscillation frequency for the blocks will be $\frac{1}{2\pi}\sqrt{\frac{\beta k}{3m}}$ then $\beta =$



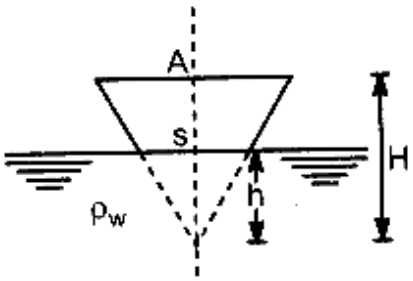
12. A rod of mass m and length l is pivoted at a point O in a car whose acceleration towards left is a_0. The rod is free to oscillate in vertical plane. In the equilibrium state the rod remains horizontal when other end is suspended by a spring of stiffness k. Find the time period of small oscillations of the rod in given by $T = \frac{2\pi}{C\sqrt{3}}$. Find the value of C. [Given value k = 20 n/m, a_0 = 10 m/s^2, m =1 kg, l = 1m.]



13. The resulting amplitude of the vibrations

$x = A\cos\omega t + \frac{A}{2}\cos\left(\omega t + \frac{\pi}{2}\right) + \frac{A}{4}\cos(\omega t + \pi) + \frac{A}{8}\cos\left(\omega t + \frac{3\pi}{2}\right)$ is $\frac{3\sqrt{\beta}}{8}A$. then $\beta =$

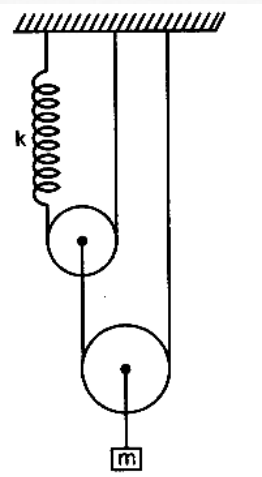
14. A cone made of a material of relative density $\left(s=\frac{27}{64}\right)$ and height 4 m floats with its apex downward in water.



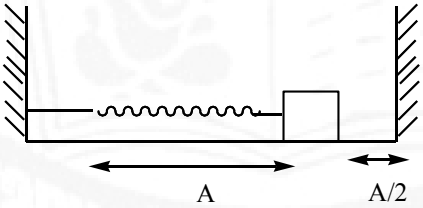
The time period of vertical oscillation if it is slightly displaced from the equilibrium position T = __seconds

15. Two particles of mass 3M/4 and M, are connected by a mass less spring of free length L and force constant k. These masses are initially at rest L apart on a horizontal frictionless table. A particle of mass M/4 moving with speed v along the line joining the two connected masses, collides with and sticks to the particle of mass 3M/4. The amplitude with which the spring between the two masses vibration is $\frac{v}{4}\sqrt{\frac{\beta M}{2K}}$ then $\beta =$

16. Find the natural frequency of oscillation of the system as shown in figure. Pulleys are mass less and frictionless. Spring and string are also mass less.($k = 10\pi^2 N/m \ \& m = 10\,kg$)



17. A block is connected to a spring such that its time period under normal condition would be T. Block is compressed by a distance A and released. An elastic wall is located in front of block at a distance of A/2. The time period of oscillation of this block $T' = \frac{\beta}{6}T$ then $\beta =$



18. Water flows through a capillary tube of radius r and length l at a rate of 40 ml per second, when connected to a pressure difference of h cm of water. Another tube of the same length but radius r/2 is connected in series with this tube and the combination is connected to the same pressure head. The rate of flow water through the combination is $\frac{120}{17\beta} cc/\sec$ then $\beta =$

19. Spherical particles of pollen are shaken up in water and allowed to settle. The depth of the water is $2\times10^{-2} m$. The diameter of the larger particles remaining in suspension one hour later is $\frac{10}{\sqrt{\beta}}\mu m$. Assuming the particles take negligible time to attain terminal velocity. Then $\beta =$

    Density of pollen $=1.8\times10^{3} kg\,m^{-3}$, Viscosity of water $=1\times10^{-2}$ poise and Density of water $=1\times10^{3}$ kg m^{-3}

20. A plate of area 2m^2 is made to move horizontally with a speed of 2 ms^{-1} by applying a horizontal tangential force over the free surface of a liquid. The depth of the liquid is 1 mm and the liquid in contact with the bed is stationary. Coefficient of viscosity of liquid = 0.01 Poise. The tangential force needed to move the plate is αN. Find the value of α