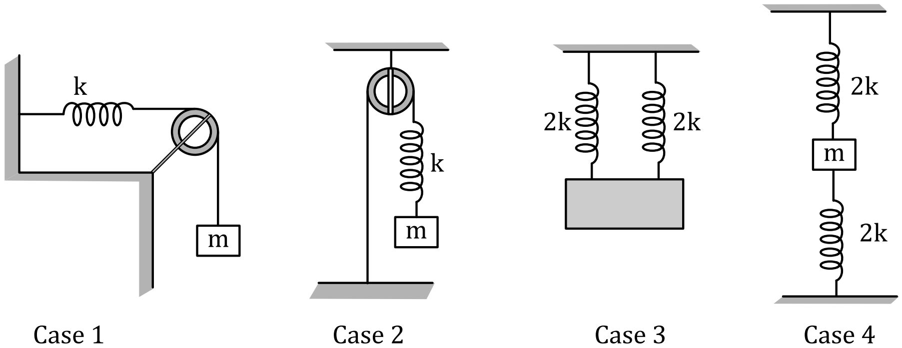
DPP 03

Q.1 A block of mass m is suspended by different springs of force constant shown in figure. Let time period of oscillation in these four positions be T_1, T_2, T_3 and T_4. Then



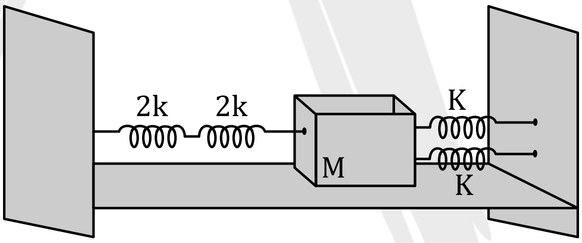
(A) $T_1 = T_2 = T_4$ (B) $T_1 = T_2$ and $T_3 = T_4$

(C) $T_1 = T_2 = T_3$ (D) $T_1 = T_3$ and $T_2 = T_4$

Q.2 Springs of constants k, 2k, 4k, 8k, ….,2048k are connected in series. A mass m is attached to one end and the system is allowed to oscillate. The time period is approximately

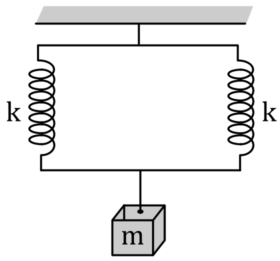
(A) $2\pi\sqrt{\frac{m}{2k}}$ (B) $2\pi\sqrt{\frac{2m}{k}}$ (C) $2\pi\sqrt{\frac{m}{4k}}$ (D) $2\pi\sqrt{\frac{4m}{k}}$

Q.3 A mass M is attached to four springs of spring constants 2K, 2K, K, K as shown in figure. The mass is capable of oscillating on a frictionless horizontal floor. If it is displaced slightly and released, the frequency of resulting S.H.M. would be



(A) $\frac{1}{2\pi}\sqrt{\frac{3K}{M}}$ (B) $\frac{1}{2\pi}\sqrt{\frac{4K}{M}}$ (C) $\frac{1}{2\pi}\sqrt{\frac{11K}{2M}}$ (D) $\frac{1}{2\pi}\sqrt{\frac{2K}{3M}}$

Q.4 The two spring mass system, shown in the figure, oscillates with a period T. If only one spring is used, the same time period will be

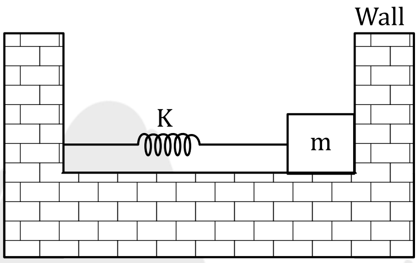


(A) $T/\sqrt{2}$ (B) $T/2$ (C) $\sqrt{2}T$ (D) $2T$

Q.5 Two simple harmonic motions $y_1 = A\sin(\omega t)$ and $y_2 = A\cos(\omega t)$ are superimposed on a particle of mass m. The total mechanical energy of the particle is

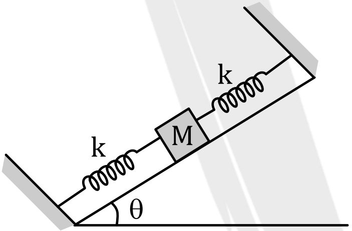
(A) $\frac{1}{2}m\omega^2A^2$ (B) $m\omega^2A^2$ (C) $\frac{1}{4}m\omega^2A^2$ (D) ZERO

Q.6 In the figure, the block of mass m, attached to the spring of stiffness k is in contact with the completely elastic wall and the compression in the spring is l. The spring is compressed further by l by displacing the block towards left and is then released. If the collision between the block and the wall is completely elastic then the time period of oscillations of the block will be



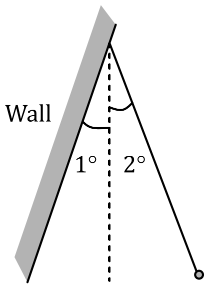
(A) $\frac{2\pi}{3}\sqrt{\frac{m}{k}}$ (B) $2\pi\sqrt{\frac{m}{k}}$ (C) $\frac{\pi}{3}\sqrt{\frac{m}{k}}$ (D) $\frac{\pi}{6}\sqrt{\frac{m}{k}}$

Q.7 On a smooth inclined plane a body of mass M is attached between two springs. The other ends of the springs are fixed to firm supports. If each spring has a force constant k, the period of oscillation of the body is (assuming the spring as massless)



(A) $2\pi\sqrt{\frac{M}{2k}}$ (B) $2\pi\sqrt{\frac{2M}{k}}$ (C) $2\pi\sqrt{\frac{M\sin\theta}{2k}}$ (D) $2\pi\sqrt{\frac{2M\sin\theta}{k}}$

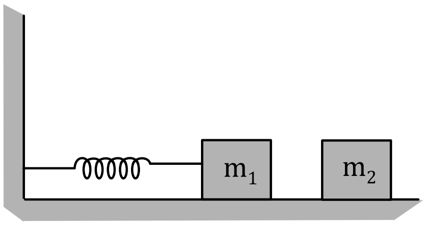
Q.8 A simple pendulum of length 1 m, hanging from an inclined wall, is made to oscillate from an angle 2° with the vertical as shown in Figure.



If collisions with the wall are elastic, time period of oscillation will be (use $g = \pi^2$)

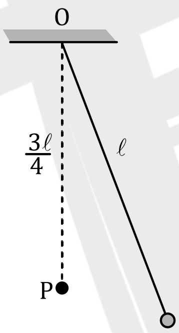
(A) $\frac{2}{3}$ s (B) $\frac{4}{3}$ s (C) 2 s (D) $\frac{1}{3}$ s

Q.9 The two blocks of mass m_1 and m_2 are kept on a smooth horizontal table as shown in figure. Block of mass m_1 but not m_2 is fastened to the spring. If now both the blocks are pushed to the left so that the spring is compressed a distance d. The amplitude of oscillation of block of mass m_1, after the system is released is



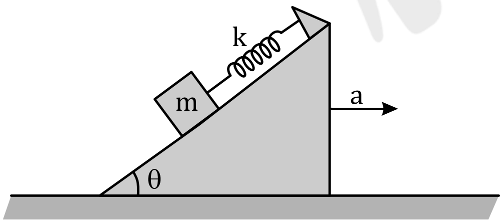
(A) $d\sqrt{\frac{m_1}{m_1+m_2}}$ (B) $d\sqrt{\frac{m_2}{m_1+m_2}}$ (C) $d\sqrt{\frac{2m_2}{m_1+m_2}}$ (D) $d\sqrt{\frac{2m_1}{m_1+m_2}}$

Q.10 A pendulum has time period T for small oscillations. An obstacle P is situated below the point of suspension O at a distance $\frac{3l}{4}$. The pendulum is released from rest. Throughout the motion the moving string makes small angle with vertical. Time after which the pendulum returns back to its initial position is



(A) T (B) $\frac{3}{4}$T (C) $\frac{4}{3}$T (D) $\frac{5}{4}$T

Q.11 A spring-block system is kept on a smooth wedge of inclination θ as shown in Figure.



The wedge is moving with constant acceleration a. Time period of small oscillation of block, assuming that at all times mass remains in contact with the wedge, is

(A) $2\pi\sqrt{\frac{m}{k\left(1+\frac{g^2}{a^2}\right)}}$ (B) $2\pi\sqrt{\frac{m\sin\theta}{k\left(1+\frac{g^2}{a^2}\right)}}$

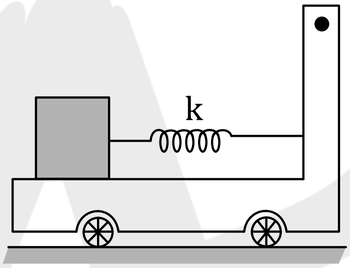
(C) $2\pi\sqrt{\frac{m\sin\theta}{k}}$ (D) $2\pi\sqrt{\frac{m}{k}}$

Q.12 A particle is vibrating in S.H.M. Its velocities are v_1 and v_2 when the displacements from the mean position are y_1 and y_2, respectively, then its time period is

(A) $2\pi\sqrt{\frac{y_1^2+y_2^2}{v_1^2+v_2^2}}$ (B) $2\pi\sqrt{\frac{v_1^2+v_2^2}{y_1^2+y_2^2}}$

(C) $2\pi\sqrt{\frac{v_2^2-v_1^2}{y_1^2-y_2^2}}$ (D) $2\pi\sqrt{\frac{y_1^2-y_2^2}{v_2^2-v_1^2}}$

Q.13 A block of mass m is attached to a massless spring of force constant k, the other end of which is fixed from the wall of a truck as shown in figure. The block is placed over a smooth surface and initially the spring is unstretched. Suddenly the truck starts moving towards right with a constant acceleration a_0. As seen from the truck



(A) the particle will execute SHM

(B) the time period of oscillations will be $2\pi\sqrt{\frac{m}{k}}$

(C) the amplitude of oscillations will be $\frac{ma_0}{k}$

(D) the energy of oscillations will be $\frac{m^2a_0^2}{k}$

Paragraph for Q.14 to Q.17

A point performs SHM along a straight line with a period T = 0.60 s and amplitude a = 10 cm. Based on the above facts, answer the following questions.

Q.14 Starting from extreme position, in what time, the point travels a distance $\frac{a}{2}$?

(A) 10 s (B) 1.0 s (C) 0.1 s (D) 0.01 s

Q.15 In PROBLEM 14, the mean velocity of the point is

(A) 0.5 ms^{-1} (B) 1 ms^{-1} (C) 1.5 ms^{-1} (D) 1.005 ms^{-1}

Q.16. Starting from the stable equilibrium position, the point travels a distance $\frac{a}{2}$ in a time of

(A) 0.01 s (B) 0.03 s (C) 0.04 s (D) 0.05 s

Q.17 In PROBLEM 16, the mean velocity of the point is

(A) 0.5 ms^{-1} (B) 1 ms^{-1} (C) 1.5 ms^{-1} (D) 1.005 ms^{-1}

Q.18 In $y = A\sin(\omega t) + A\sin\left(\omega t + \frac{2\pi}{3}\right)$ match the following table

	COLUMN-I		COLUMN-II
(A)	Motion	(p)	is periodic but not SHM
(B)	Amplitude	(q)	is SHM
(C)	Initial phase	(r)	A
(D)	Maximum velocity	(s)	$\frac{\pi}{3}$
		(t)	ωA

ANSWER KEY

1. (B)
2. (B)
3. (A)
4. (A)
5. (B)
6. (A)
7. (A)
8. (B)
9. (A)
10. (B)
11. (D)
12. (D)
13. (A,B,C)
14. (C)
15. (A)
16. (D)
17. (B)
18. A⟶(q), B⟶(r), C⟶(s), D⟶(t)