CLASS TEST

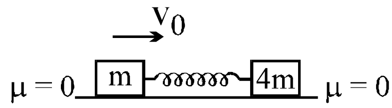
SECTION-I

Single Correct Answer Type **6 Q. [3 M (–1)]**

1. Two particles P and Q describe simple harmonic motions of same period, same amplitude, along the same line about the same equilibrium position O. When P and Q are on opposite sides of O at the same distance from O they have the same speed of 1.2 m/s in the same direction, when their displacements are the same they have the same speed of 1.6 m/s in opposite directions. The maximum velocity in m/s of either particle is :

(A) 2.8 (B) 2.5 (C) 2.4 (D) 2

2. Two blocks of masses m and 4m lies on a smooth horizontal surface connected with a spring in its natural length. Mass m is given velocity v_0 through an impulse as shown in the diagram. Which of the following is **not true** about subsequent motion



(A) Kinetic energy is maximum in ground frame and centre of mass (COM) frame simultaneously

(B) Value of maximum kinetic energy & minimum kinetic energy is same in COM frame & ground frame

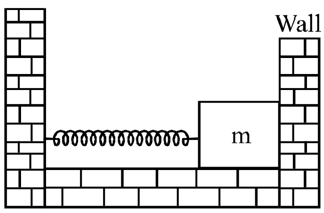
(C) Minimum kinetic energy is zero in COM frame but non zero in ground frame

(D) Maximum and minimum kinetic energies of m in ground frame is respectively $\frac{1}{2}mv_0^2$ and zero

3. A particle is performing simple harmonic motion with time period T. At an instant its speed is 60% of its maximum value and is increasing. After an interval Δt its speed becomes 80% of its maximum value and is decreasing. The smallest value of Δt in terms of T will be :-

(A) $\frac{T}{4}$ (B) $\frac{T}{2}$ (C) $\frac{3T}{8}$ (D) $\frac{3T}{4}$

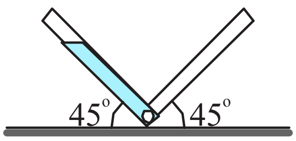
4. In the figure, the block of mass m, attached to the spring of stiffness k is in contact with the completely elastic wall, and the compression in the spring is 'e'. The spring is compressed further by 'e' by displacing the blocktowards left and is then released. If the collision between the block and 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) $2\pi\sqrt{\frac{m}{k}}$

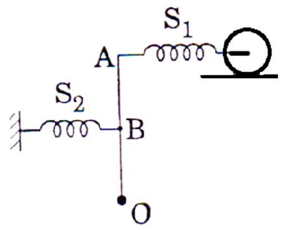
(C) $\frac{\pi}{3}\sqrt{\frac{m}{k}}$ (D) $\frac{\pi}{6}\sqrt{\frac{m}{k}}$

5. A thin L-shaped glass tube is fixed in the vertical plane as shown. Initially, the left part of the tube contains a column of water of length d. A valve at the bottom of the tube prevents the water from moving. Suddenly, the valve is opened. Find the time water takes to move completely into the right part of the tube. Neglect viscous forces.



(A) $t = 2\pi\sqrt{\frac{d}{\sqrt{2}g}}$ (B) $t = 2\pi\sqrt{\frac{d}{2g}}$ (C) $t = \pi\sqrt{\frac{d}{2g}}$ (D) $t = \pi\sqrt{\frac{d}{\sqrt{2}g}}$

6. A solid sphere (m kg, R meter) placed on a horizontal rough plane, is attached to a spring S_1, fixed to a light rod OA of length L meter ,as shown in the **figure**. The other end O of the rod is hinged to rotate in the plane about vertical axis passing through it. A spring S_2 is fixed to the midpoint B of the rod. If the spring constants of both springs are $k\ Nm^{-1}$ each, then the angular frequency of oscillations of the mass would be (in $rad\ s^{-1}$)



(A) $\omega = \sqrt{\frac{k}{7m}}$ (B) $\omega = \sqrt{\frac{11k}{28m}}$

(C) $\omega = \sqrt{\frac{2k}{7m}}$ (D) $\omega = \sqrt{\frac{2k}{5m}}$

Multiple Correct Answer Type 4 Q. [4 M (–1)]

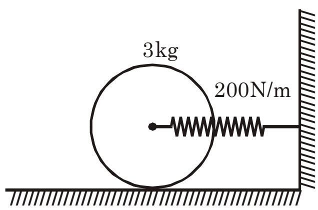
7. Two particles of mass $\frac{3M}{4}$ and M, are connected by a massless spring of free length L and force constant k. These masses are initially at rest L apart on a horizontal frictionless table. A particle of mass $\frac{M}{4}$ moving with speed v along the line joining the two connected masses, collides with and sticks to the particle of mass $\frac{3M}{4}$. Find the amplitude A and period T with which each of the masses vibrate

(A) $A = \frac{v}{8}\sqrt{\frac{M}{2k}}$ (B) $A = \frac{v}{4}\sqrt{\frac{M}{2k}}$ (C) $T = 2\pi\sqrt{\frac{M}{2k}}$ (D) $T = \pi\sqrt{\frac{M}{2k}}$

8. The potential energy U of a particle is given by $U = \{20 + (x-4)^2\}$J. Total mechanical energy of the particle is 36 J. Select the correct alternative(s)
(A) the particle oscillates about point x=4 m
(B) the amplitude of the particle is 4m
(C) the kinetic energy of the particle at x=2 m is 12 J
(D) the motion of the particle is periodic but not simple harmonic

9. A 20 gm particle is subjected to two simple harmonic motions $x_1 = 2 \sin 10t$, $x_2 = 4 \sin\left(10t + \frac{\pi}{3}\right)$ along same straight line. Where x_1 and x_2 are in metre and t is in sec.
(A) the displacement of the particle at t = 0 will be $2\sqrt{3}$ m
(B) maximum speed of the particle will be $20\sqrt{7}$ m/s
(C) magnitude of maximum acceleration of the particle will be $200\sqrt{7}$ m/s^2.
(D) Energy of the resultant motion will be 28 J.

10. The uniform solid cylinder rolls without slipping on the surface as shown. If the maximum compression in spring is 15cm, the possible values of friction force acting on the cylinder during its motion is :

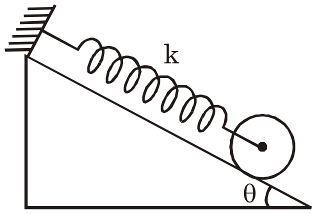


(A) 4N (B) 10N (C) 12N (D) 15N

Linked Comprehension Type **(1 Para × 2Q.) [3 M (-1)]**
(Single Correct Answer Type)

Paragraph for Questions No. 11 and 12

A disc of mass M is connected with ideal spring of force constant k is released from unstreched position of the spring, then the disc roll down the inclined plane. Friction is sufficient to prevent slipping.



11. What is the amplitude of and time period of oscillation respectively.

(A) $\frac{mg\sin\theta}{k}, 2\pi\sqrt{\frac{m}{k}}$ (B) $\frac{mg\sin\theta}{k}, 2\pi\sqrt{\frac{3m}{2k}}$

(C) $\frac{2mg\sin\theta}{k}, 2\pi\sqrt{\frac{3m}{2k}}$ (D) $\frac{mg\sin\theta}{2k}, 2\pi\sqrt{\frac{m}{k}}$

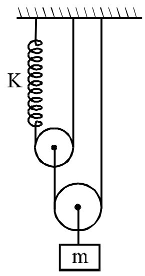
12. Friction force at the mean position is

(A) $\frac{1}{3}mg\cos\theta$ (B) $\frac{2}{3}mg\cos\theta$ (C) Zero (D) mg $\sin\theta$

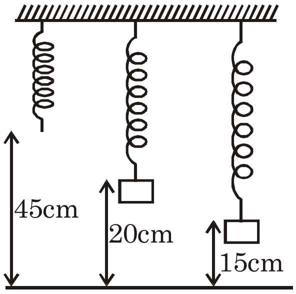
SECTION-II

Numerical Answer Type Question **2Q.[3(0)]**
(upto second decimal place)

1. Find the natural angular frequency (in rad/s) of oscillation of the system as shown in figure. Pulleys are massless and frictionless. Spring and string are also massless. Take spring constant as 100 N/m and mass m = 1 kg



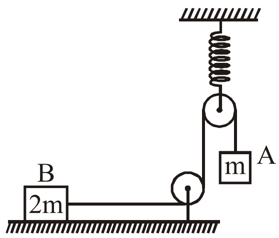
2. A massless spring is suspended from a hook at the top. A small mass of 180 gm is suspended from the bottom of the hook. At the equilibrium it is at 20 cm from ground. It is pulled down to distance 15 cm from ground and released. Find the time (in sec) at which it is first at 25 cm from the ground. Take $\pi^2 = 10$.



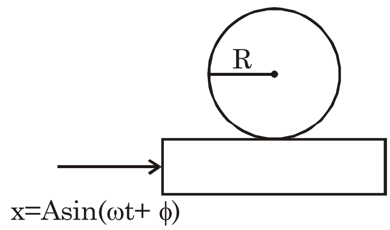
SECTION-III

Numerical Grid Type (Ranging from 0 to 9) **5 Q. [4 M (0)]**

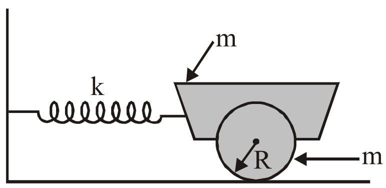
1. In the given figure, spring and pulleys are massless. Block A is performing SHM of amplitude 1m and time period π sec. If block B remains at rest, then minimum value of coefficient of friction between block B and surface will be μ. Fill 10μ in OMR sheet. ($g = 10\ m/s^2$)



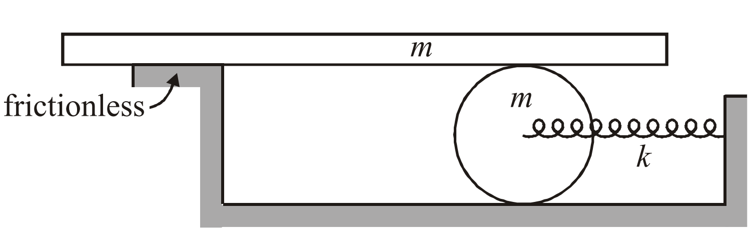
2. A solid sphere of mass m and radius R is resting on platform and sphere is free to rotate about it's axis. Plate is given a displacement $x = A\sin(\omega t + \phi)$ along it's length as shown in figure. There is no slipping between sphere and platform. If maximum torque acting on sphere is $\frac{2m\omega^2 AR}{\beta}$. Find β.



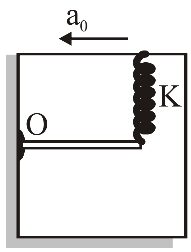
3. A cart consists of a body of mass m and two wheels, each of mass m and radius R. The cart is attached to a spring of constant k. The other end of the spring is fixed to a wall as shown in figure. If time period of oscillation is $\beta \times 2\pi\sqrt{\frac{m}{k}}$ then find the value of β



4. The axle of a uniform cylinder with mass m and radius R is connected to a spring with spring constant k, as shown in the Fig. A horizontal board with mass m rests on top of the cylinder, and the board also rests on top of a frictionless support near its left end.The system is slightly displaced from equilibrium. There is no slipping between the cylinder and the board, or between the cylinder and the ground. The angular frequency of the oscillatory motion is p. The value of $\frac{11p^2 m}{k}$ is .



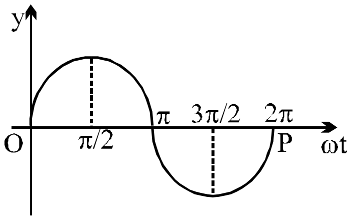
5. A rod of mass m and length l is pivoted at a point O in a car whose acceleration towards left is a_0. The rod is free to oscillate in vertical plane. In the equilibrium state the rod remains horizontal when other end is suspended by a spring of stiffness K. The time period of small oscillations of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



SECTION-IV

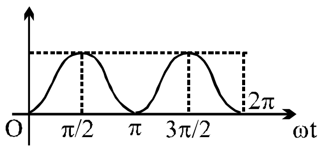
Matrix Match Type (4 × 5) **1 Q. [8 M (for each entry +2(0)]**

1. The graph plotted between phase angle (ϕ) and displacement of a particle from equilibrium position (y) is a sinusoidal curve as shown below. Then the best matching is

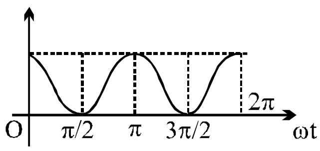


Column A | **Column B**

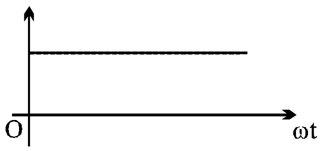
(A) K.E. versus phase angle curve

(P)


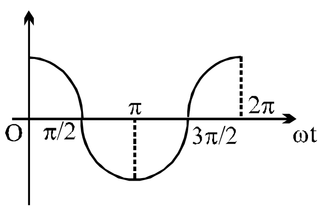
(B) P.E. versus phase angle curve

(Q)


(C) T.E. versus phase angle curve

(R)


(D) Velocity versus phase angle curve

(S)


CLASS TEST # 02 (TNAS)	ANSWER KEY

SECTION-I

Single Correct Answer Type — **6 Q. [3 M (–1)]**

1. Ans. (D)	**2. Ans. (B)**	**3. Ans. (A)**	**4. Ans. (A)**
5. Ans. (D)	**6. Ans. (A)**		

Multiple Correct Answer Type — **4 Q. [4 M (–1)]**

7. Ans. (A,C)	**8. Ans. (A,B,C)**	**9. Ans. (A,B,C,D)**	**10. Ans. (A,B)**

Linked Comprehension Type — **(1 Para × 2Q.) [3 M (-1)]**

(Single Correct Answer Type)

11. Ans. (B)	**12. Ans. (C)**

SECTION-II

Numerical Answer Type Question — **2Q.[3(0)]**

(upto second decimal place)

1. Ans. 40.00	**2. Ans. 0.50**

SECTION-III

Numerical Grid Type (Ranging from 0 to 9) — **5 Q. [4 M (0)]**

1. Ans. 7	**2. Ans. 7**	**3. Ans. 2**	**4. Ans. 2**
5. Ans. 5			

SECTION-IV

Matrix Match Type (4 × 5) — **1 Q. [8 M (for each entry +2(0)]**

1. Ans. (A) Q; (B) P; (C) R; (D) S