KD EDUCATION ACADEMY [9582701166]

Time : 6 Hour | **STD 11 Science Physics** | **Total Marks : 370**

kd 90+ ch-13 Oscillations

*** Choose The Right Answer From The Given Options.[1 Marks Each]** **[42]**

1. The motion of satellites and planets is:
   (A) Periodic. (B) Oscillatory.
   (C) Simple harmonic. (D) Non-periodic.

2. A particle executing simple harmonic motion along y-axis has its motion described by the equation $y = A\sin(\omega t) + B$ The amplitude of the simple harmonic motion is:
   (A) A (B) B (C) A + B (D) $\sqrt{A+B}$

3. Two simple pendulums of length 5m and 10m respectively are given small linear displacement in one direction at the same time. They will be again in the phase when the pendulum of shorter length has completed oscillations:
   (A) 1 (B) 2 (C) 3 (D) 5

4. The expression for displacement of an object in SHM is $x = A\cos(\omega t)$ The potential energy at $t = \frac{T}{4}$ is
   (A) $\frac{1}{2}kA^2$ (B) $\frac{1}{8}kA^2$ (C) $\frac{1}{4}kA^2$ (D) Zero

5. The equation of motion of a particle is $x = a\cos(at)^2$. The motion is:
   (A) Periodic but not oscillatory. (B) Periodic and oscillatory.
   (C) Oscillatory but not periodic. (D) Neither periodic nor oscillatory.

6. Masses m and 3m are attached to the two ends of a spring of constant k. If the system vibrates freely, the period of oscillation will be:
   (A) $\pi\sqrt{\frac{m}{k}}$ (B) $2\pi\sqrt{\frac{3m}{2k}}$
   (C) $\pi\sqrt{\frac{3m}{k}}$ (D) $2\pi\sqrt{\frac{4m}{3k}}$

7. The displacement of a particle is represented by the equation $y = \sin^3 \omega t$. The motion is:
   (A) Non-periodic.
   (B) Periodic but not simple harmonic.
   (C) Simple harmonic with period $\frac{2\pi}{\omega}$.
   (D) Simple harmonic with period $\frac{\pi}{\omega}$.

8. Two simple harmonic motions of angular frequency 100rad/s^{-1} and 1000rad/s^{-1} have the same displacement amplitude. The ratio of their maximum acceleration is:
   (A) 1 : 10 (B) 1 : 10 (C) 1 : 10 (D) 1 : 10

9. A particle executing S.H.M. has a maximum speed of 30cm/ s and a maximum acceleration of 60cm/ s^2.The period of oscillation is:
   (A) πs. (B) $\frac{\pi}{2}$ s. (C) 2π s. (D) $\frac{\pi}{t}$ s.

10. The displacement of a particle varies with time according to the relation: $y = a\sin\omega t + b\cos\omega t$

(A) The motion is oscillatory but not S.H.M.

(B) The motion is S.H.M. with amplitude a + b.

(C) The motion is S.H.M. with amplitude $a^2 + b^2$

(D) The motion is S.H.M. with amplitude $\sqrt{a^2 + b^2}$.

11. A particle is executing simple harmonic motion with frequency f. The frequency at which its kinetic energy changes into potential energy is:

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

12. Two particles P and Q describe SHM of same amplitude a and frequency v along the same straight line. The maximum distance between two particles is $\sqrt{2}$ a. The phase difference between the particles is:

(A) Zero (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{3}$

13. In SHM:

(A) PE is stored due to elasticity of system.

(B) KE is stored due to inertia of system.

(C) Both KE and PE are stored by virtue of elasticity of system.

(D) Both (a) and (b).

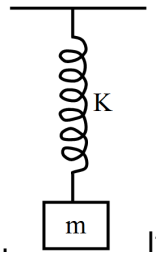
14. The periodic function $f(t) = A\sin(\omega t)$ repeats itself with periodic function of:

(A) 2π (B) 3π (C) π (D) $\frac{\pi}{2}$

15. The equation of motion of a particle is $x = a\cos(\alpha t)^2$. The motion is:

(A) Periodic but not oscillatory. (B) Periodic and oscillatory.

(C) Oscillatory but not periodic. (D) Neither periodic nor oscillatory.



16. A block is left in the equilibrium position as shown in the figure. If now it is stretched by $\frac{mg}{k}$, the net stretch of the spring is:

(A) $\frac{mg}{k}$ (B) $\frac{mg}{2k}$ (C) $\frac{2mg}{k}$ (D) $\frac{mg}{4k}$

17. The ratio of frequencies of two pendulums oscillating are 2 : 3, then their lengths are in ratio:

(A) $\sqrt{\frac{2}{3}}$ (B) $\sqrt{\frac{3}{2}}$ (C) $\frac{4}{9}$ (D) $\frac{9}{4}$

18. The displacement of a particle is represented by the equation: $y = 3\cos\left(\frac{\pi}{4} - 2\omega t\right)$ The motion of the particle is:

(A) Simple harmonic with period $2\frac{P}{w}$.

(B) Simple harmonic with period $\frac{\pi}{\omega}$.

(C) Periodic but not simple harmonic.

(D) Non-periodic.

19. For a SHM, if the maximum potential energy become double, choose the correct option.

(A) Maximum kinetic energy will become double.

(B) The total mechanical energy will become double.

(C) Both (a) and (b) 39wisd.

(D) Neither (a) nor (b).

20. The rotation of earth about its axis is:

(A) Periodic motion. (B) Simple harmonic motion.

(C) Periodic but not simple harmonic motion. (D) Non-periodic motion.

21. The displacement of a particle in SHM varies according to the relation $x = 4(\cos \pi t + \sin \pi t)$ The amplitude of the particle is:

(A) -4 (B) 4 (C) $4\sqrt{2}$ (D) 8

22. A body of mass 400g connected to a spring with spring constant $10 Nm^{-1}$, executes simple harmonic motion, time period of oscillation is

(A) $4\pi \times 10^{-1} s$

(B) $0.3\pi s$

(C) $2s$

(D) $5 \times 10^{-1} s$

23. Motion of a ball bearing inside a smooth curved bowl, when released from a point slightly above the lower point is:

(A) Simple harmonic motion. (B) Non-periodic motion.

(C) Periodic motion. (D) Periodic but not S.H.M.

24. At extreme position, velocity of the particle executing SHM that has amplitude A is:

(A) $\omega^2 A$ (B) 0 (C) ωA (D) $\frac{\omega A}{2}$

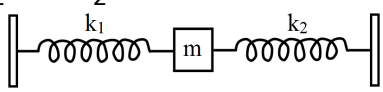
25. A particle of mass m is executing oscillation about the origin about the origin on the x-axis, its potential energy is $U = kx^3$, where k is a positive constant. If the amplitude of oscillation is a, then its time period T is:

(A) Proportional to $\frac{1}{\sqrt{a}}$ (B) Independent of a

(C) Proportional to $\sqrt{a}$

(D) Proportional to $a^{\frac{3}{2}}$

26. Two spring of force constants k_1 and k_2 are connected to a mass m as shown in figure. The frequency of oscillation of the mass is f. If both k_1 and k_2 are made four times their original values, the frequency of oscillation becomes



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

27. A particle doing simple harmonic motion, amplitude = 4cm, time period = 12sec. Ratio of time taken by it in going from its mean position to 2cm and from 2cm to extreme

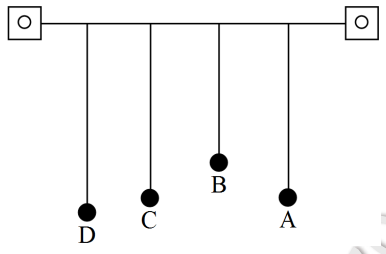
position is:

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

28. A particle executing SHM has a maximum speed of 30cm/ s angular frequency 10rad/ s. The amplitude of oscillation is:

(A) 3cm (B) 6cm (C) 1cm (D) 60cm

29. Four pendulums A, B, C and D are suspended from the same elastic support as shown in Fig A and C are of the same length, while B is smaller than A and D is larger than A. If A is given a transverse displacement,



(A) D will vibrate with maximum amplitude.

(B) C will vibrate with maximum amplitude.

(C) B will vibrate with maximum amplitude.

(D) All the four will oscillate with equal amplitude.

30. The acceleration due to gravity on the surface of the moon is 1.7ms^{-2}. The time period of a simple pendulum on the moon, if its time period on the earth is 3.5s is:

(A) 2.2s (B) 4.4s (C) 8.4s (D) 16.8s

31. The motion of a swing is:

(A) Periodic but not oscillatory. (B) Oscillatory.

(C) Linear simple harmonic. (D) Circular motion.

32. A mass of 1kg attached to the bottom of a spring has a certain frequency of vibration. The following mass has to be added to it in order to reduce the frequency by half:

(A) 1kg (B) 2kg (C) 3kg (D) 4kg

33. A mass M suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes S.H.M. of time period T. If the mass is increased by m, the time period becomes $\frac{5T}{3}$. Then the ratio of $\frac{m}{M}$ is:

(A) $\frac{3}{5}$ (B) $\frac{25}{9}$ (C) $\frac{16}{9}$ (D) $\frac{5}{3}$

34. The length of a simple pendulum is increased by 44%. What is the percentage increase in its time period?

(A) 10% (B) 20% (C) 40% (D) 44%

35. A horizontal platform with an object placed on it is executing S.H.M. in the vertical direction. The amplitude of oscillation is 3.92×10^{-3}m. At what time the object is not detached from the platform?

(A) 0.1256 sec. (B) 0.1356 sec. (C) 0.1456 sec. (D) 0.156 sec.

36. The displacement time graph of a particle executing S.H.M. is shown in Fig.Which of the following statement is/ are true?

a. The force is zero at $t = \frac{3T}{4}$.

b. The acceleration is maximum at $t = \frac{4T}{4}$.

c. The velocity is maximum at $t = \frac{T}{4}$.

d. The P.E. is equal to K.E. of oscillation at $t = \frac{T}{4}$.

37. The displacement of a particle is represented by the equation: $y = 3\cos\left(\frac{\pi}{4} - 2\omega t\right)$ The motion of the particle is:

a. Simple harmonic with period $2\frac{P}{w}$.

b. Simple harmonic with period $\frac{\pi}{\omega}$.

c. Periodic but not simple harmonic.

d. Non-periodic.

38. A wall clock uses a vertical spring-mass system to measure the time. Each time the mass reaches an extreme position, the clock advances by a second. The clock gives correct time at the equator. If the clock is taken to the poles it will:

a. Run slow.

b. Run fast.

c. Stop working.

d. Give correct time.

39. The motion of a particle is given by $x = A\sin\omega t + B\cos\omega t$. The motion of the particle is:

a. Not simple harmonic.

b. Simple harmonic with amplitude A + B.

c. Simple harmonic with amplitude $\frac{(A+B)}{2}$.

d. Simple harmonic with amplitude $\sqrt{(A^2 + B^2)}$.

40. The distance moved by a particle in simple harmonic motion in one time period is:

a. A

b. 2A

c. 4A

d. zero.

41. Two bodies A and B of equal mass are suspended from two separate massless springs of spring constant k_1 and k_2 respectively. If the bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitude of A to that of B is:

a. $\frac{k_1}{k_2}$

b. $\sqrt{\frac{k_1}{k_2}}$

c. $\frac{k_2}{k_1}$

d. $\sqrt{\frac{k_2}{k^1}}$

42. The total mechanical energy of a spring-mass system in 1 simple harmonic motion is $E = \frac{1}{2}m\omega^2 A^2$. Suppose the oscillating particle is replaced by another particle of double the mass while the amplitude A remains the same. The new mechanical energy will:

a. Become 2E

b. Become $\frac{E}{2}$

c. Become $\sqrt{2E}$

d. Remain E.

*** Fill In The Blanks** **[2]**

43. A child swinging on a swing in sitting position stands up then the time period of the swing will _____.

44. The displacement y of a particle executing periodic motion is given by $y = 4\cos^2\left(\frac{t}{2}\right)\sin(1000t)$ This expression may be considered to be a result of the superposition of _____ independent harmonics.

*** Answer The Following Questions In One Sentence.[1 Marks Each]** **[2]**

45. A platoon of soldiers marches on a road in steps according to the sound of a marching band. The band is stopped and the soldiers are ordered to break the steps while crossing a bridge. Why?

46. A small creature moves with constant speed in a vertical circle on a bright day. Does its shadow formed by the sun on a horizontal plane move in a simple harmonic motion?

*** Given Section consists of questions of 3 marks each.** **[108]**

47. Plot the corresponding reference circle for each of the following simple harmonic motions. Indicate the initial (t = 0) position of the particle, the radius of the circle, and the angular speed of the rotating particle. For simplicity, the sense of rotation may be fixed to be anticlockwise in every case: (x is in cm and t is in s). $x = 3\sin\left(2\pi t + \frac{\pi}{4}\right)$

48. A simple pendulum of length l and having a bob of mass M is suspended in a car. The car is moving on a circular track of radius R with a uniform speed v. If the pendulum makes small oscillations in a radial direction about its equilibrium position, what will be its time period?

49. A 0.2kg. of mass hangs at the end of a spring. When 0.02kg more mass is added to the end of the spring, it stretches 7cm more. If the 0.02kg mass is removed, what will be the period of vibration of the system?

50. For a particle in S.H.M., the displacement x of the particle as a function of time t is given as $x = A\sin(2\pi t)$. Here x is in cm and t is in seconds. Let the time taken by the particle to travel from x = 0 to $x = \frac{A}{2}$ be T_1 and the time taken to travel from $x = \frac{A}{2}$ to x = A be T_2. Find $\frac{T_1}{T_2}$.

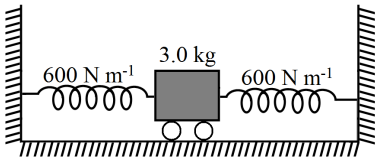
51. What is a second's pendulum? How much is its length on the surface of moon?

52. A particle of mass 0.1kg is held between two rigid supports by two springs of force constants 8N/ m and 2N/ m. If the particle is displaced along the direction of the length of the springs, calculate its frequency of vibration.

53. A spring of force constant k has a mass M suspended from it. If the spring is cut into two halves, and the same mass is attached to one of the pieces, what will be the frequencies of oscillation of the mass?

54. The displacement of a particle executing periodic motion is given by: $y = 4\cos^2\left(\frac{t}{2}\right)\sin(1000t)$. Find independent constituent simple harmonic motion.

55. A trolley of mass 3.0kg, as shown in Figure, is connected to two springs, each of spring constant 600Nm^{-1}. If the trolley is displaced from its equilibrium position by 5.0cm and released, what is (a) the period of ensuing oscillations, and (b) the maximum speed of the trolley? How much energy is dissipated as heat by the time trolley comes to rest due damping forces?



56. Displacement versus time curve for a particle executing S.H.M. is shown in Fig. Identify the points marked at which,
    i. Velocity of the oscillator is zero,
    ii. Speed of the oscillator is maximum.

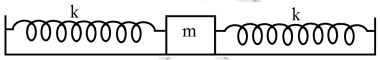
57. A cylindrical wooden block of cross-section 15.0cm? and 230 grams is floated over water with an extra weight 50 grams attached to its bottom. The cylinder floats vertically. From the state of equilibrium, it is slightly depressed and released. If the specific gravity of wood is 0.3 and g = 9.8ms^{-2}, deduce the frequency of oscillation of the block.

58. A body of mass 'm' suspended from a spring executes S.H.M. Calculate the ratio of the kinetic energy and potential energy of the body when it is at half the amplitude far from the mean position.

59. A force of 6.4N stretches a vertical spring by 0.1m. Find the mass that must be suspended from the spring so that it oscillates with the period of $\left(\frac{\pi}{4}\right)$ second.

60. The angular velocity and amplitude of a simple pendulum is ω and r respectively. At a displacement x from the mean position, if its kinetic energy is T and potential energy is V, find the ratio of T to V.

61. A body oscillates with SHM according to the equation (in SI unit) $x = 5\cos\left[2\pi t + \frac{\pi}{4}\right]$ At t = 1.5 second, calculate (i) displecement, (ii) speed.

62. Two identical springs of spring constant k each are attached to a block of mass m as shown in figure: 

Show that when the mass is displaced from its equilibrium position on either side, it executes a simple harmonic motion. Find the period of oscillations.

63. What is the ratio of maxmimum acceleration to the maximum velocity of a simple harmonic oscillator?

64.
    i. What is meant by Simple Harmonic Motion (S.H.M)?
    ii. At what points is the energy entirely kinetic and potential in S.H.M?
    iii. What is the total distance travelled by a body executing S.H.M in a time equal to its time period, if its amplitude is A?

65. Two simple harmonic motions are represented by: $x_1 = 10\sin\left(4\pi t + \frac{\pi}{4}\right)$ $x_2 = 5(\sin 4\pi t + \sqrt{3}\cos 4\pi t)$ What is the ratio of the amplitudes?

66. A cylindrical piece of cork of density of base area A and height h floats in a liquid of density ρ_l. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period. $T = 2\pi\sqrt{\frac{h\rho}{\rho_l g}}$ where ρ is the density of cork. (Ignore damping due to viscosity of the liquid).

67. A body oscillates with S.H.M. according to the equation: $x(t) = 5\cos\left(2\pi t + \frac{\pi}{4}\right)$ where x is in meters and t is in seconds. Calculate the following:
    a. Displacement at t = 0
    b. Angular frequency
    c. Magnitude of velocity (Maximum).

68. A body of mass 5kg executes S.H.M. of amplitude of 0.5m. If the force constant is 100Nm^{-1}, calculate
    i. Its time period.
    ii. Its maximum kinetic energy, maximum potential energy and total energy.

69. A harmonic oscillation is represented by $y = 0.34\cos(3000t + 0.74)$, where y and t are in m and s respectively. Deduce: (i) the amplitude, (ii) the frequency and angular frequency, (iii) the period, and (iv) the initial phase.

70. Plot the corresponding reference circle for each of the following simple harmonic motions. Indicate the initial (t = 0) position of the particle, the radius of the circle, and the angular speed of the rotating particle. For simplicity, the sense of rotation may be fixed to be anticlockwise in every case: (x is in cm and t is in s). $x = -2\sin\left(3t + \frac{\pi}{3}\right)$

71. The displacement of a particle having S.H.M. is x = 10 $\sin\left[10\pi t + \frac{\pi}{4}\right]$ m.
    i. Amplitude.
    ii. Angular frequency.
    iii. Epoch.
    iv. Time period.
    v. Frequency.
    vi. Maximum velocity.

72. Derive the expression for resultant spring constant when two springs having constants k_1 and k_2 are connected
    i. In parallel.
    ii. In series.

73. Find the displacement of a simple harmonic oscillator at which its PE is half of the maximum energy of the oscillator.

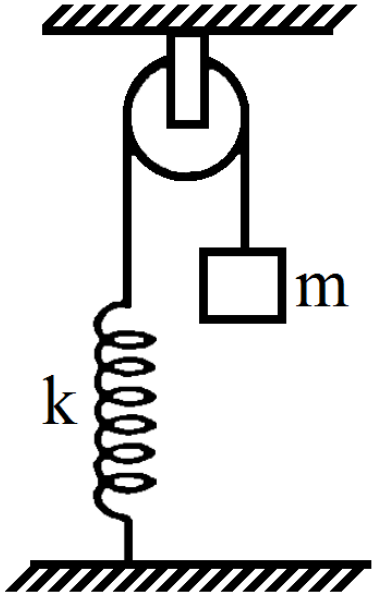
74. Displacement versus time curve for a particle executing S.H.M. is shown in Fig. Identify the points marked at which,
    i. Velocity of the oscillator is zero,
    ii. Speed of the oscillator is maximum.

75. Show that the motion of a particle represented by $y = \sin ax - \cos cot$ is simple harmonic with a period of $\frac{2\pi}{\omega}$.

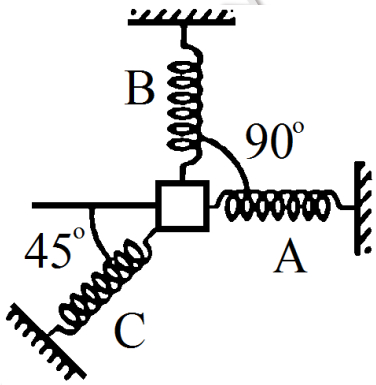
76. What is the ratio of maxmimum acceleration to the maximum velocity of a simple harmonic oscillator?

77. The pendulum of a certain clock has time period 2.04s. How fast or slow does the clock run during 24 hours?

78. The string, the spring and the pulley shown in figure are light. Find the time period of the mass m.



79. A particle of mass in is attatched to three springs A, B and C of equal force constants k as shown in figure If the particle is pushed slightly against the spring C and released, find the time period of oscillation.



80. A spring stores 5J of energy when stretched by 25cm. It is kept vertical with the lower end fixed. A block fastened to its other end is made to undergo small oscillations. If the block makes 5 oscillations each second, what is the mass of the block?

81. A block of mass 0.5kg hanging from a vertical spring executes simple harmonic motion of amplitude 0.1m and time period 0.314s. Find the maximum force exerted by. the spring on the block.

82. The maximum tension in the string of an oscillating pendulum is double of the minimum tension. Find the angular amplitude.

*** Given Section consists of questions of 5 marks each. [200]**

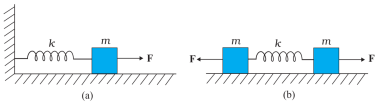
83. A block whose mass is $1kg$ is fastened to a spring. The spring has a spring constant of $50Nm^{-1}$. The block is pulled to a distance $x = 10cm$ from its equilibrium position at $x = 0$ on a frictionless surface from rest at $t = 0$. Calculate the kinetic, potential and total energies of the block when it is $5cm$ away from the mean position.

84. You are riding in an automobile of mass 3000kg. Assuming that you are examining the oscillation characteristics of its suspension system. The suspension sags 15cm when the entire automobile is placed on it. Also, the amplitude of oscillation decreases by 50% during one complete oscillation. Estimate the values of (a) the spring constant k and (b) the damping constant b for the spring and shock absorber system of one wheel, assuming that each wheel supports 750kg.

85. A body describes simple harmonic motion with an amplitude of 5cm and a period of 0.2s. Find the acceleration and velocity of the body when the displacement is (a) 5cm (b) 3cm (c) 0cm.

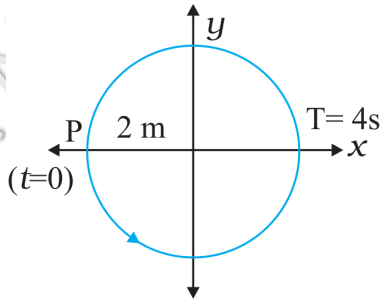
86. A circular disc of mass 10kg is suspended by a wire attached to its centre. The wire is twisted by rotating the disc and released. The period of torsional oscillations is found to be 1.5s. The radius of the disc is 15cm. Determine the torsional spring constant of the wire. (Torsional spring constant α is defined by the relation $J = -\alpha\theta$, where J is the restoring couple and θ the angle of twist).

87. Figure (a) shows a spring of force constant k clamped rigidly at one end and a mass m attached to its free end. A force F applied at the free end stretches the spring. Figure (b) shows the same spring with both ends free and attached to a mass m at either end. Each end of the spring in Fig. (b) is stretched by the same force F.



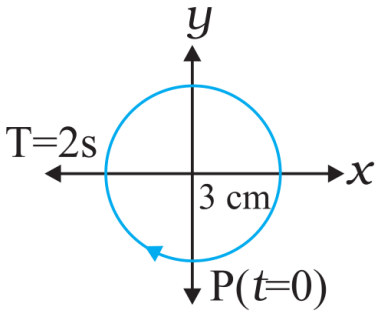
If the mass in Fig. (a) and the two masses in Fig. (b) are released, what is the period of oscillation in each case?

88. Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position, and the sense of revolution (i.e. clockwise or anti-clockwise) are indicated on each figure.



Obtain the corresponding simple harmonic motions of the x-projection of the radius vector of the revolving particle P, in each case.

89. Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position, and the sense of revolution (i.e. clockwise or anti-clockwise) are indicated on each figure.



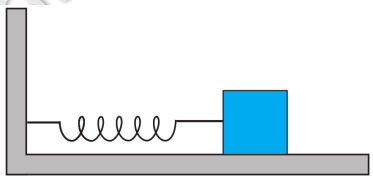
Obtain the corresponding simple harmonic motions of the x-projection of the radius vector of the revolving particle P, in each case.

90. A body of mass m is attached to one end of a massless spring which is suspended vertically from a fixed point. The mass is held in hand so that the spring is neither stretched nor compressed. Suddenly the support of the hand is removed. The lowest position attained by the mass during oscillation is 4cm below the point, where it was held in hand.
    a. What is the amplitude of oscillation?
    b. Find the frequency of oscillation?

91. A circular disc of mass 10kg is suspended by a wire attached to its centre. The wire is twisted by rotating the disc and released. The period of torsional oscillations is found to be 1.5s. The radius of the disc is 15cm. Determine the torsional spring constant of the wire. (Torsional spring constant α is defined by the relation $J = -\alpha\theta$, where J is the restoring couple and θ the angle of twist).

92. An 8kg body performs S.H.M. of amplitude 30cm. The restoring force is 60N when the displacement is 30cm. Find (a) time period (b) the acceleration, P.E. and K.E., when displacement is 12cm.

93. A spring having with a spring constant 1200N m^{-1} is mounted on a horizontal table as shown in Fig. A mass of 3kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0cm and released.



Determine (i) the frequency of oscillations, (ii) maximum acceleration of the mass, and (iii) the maximum speed of the mass.

94. An 8kg body performs S.H.M. of amplitude 30cm. The restoring force is 60N when the displacement is 30cm. Find (a) time period (b) the acceleration, P.E. and K.E., when displacement is 12cm.

95. A simple pendulum with a brass bob has a time period T. The bob is now immersed in a non-viscous liquid and oscillated. If the density of the liquid is $\frac{1}{9}$ that of brass, find the time of the same pendulum.

96. The displacement x (in cm) of an oscillating particle varies with time t (in seconds) according to the equation. $x = 2\cos(0.5\pi t + \frac{\pi}{3})$ Find
    a. Amplitude of oscillation.
    b. The time period of oscillation.
    c. The maximum velocity of the particle.
    d. The maximum acceleration of the particle.

97. A particle of mass m is executing simple harmonic oscillations of amplitude A. At $x = \frac{A}{2}$ what fraction of its energy is potential? What fraction is kinetic?

98. A body of mass 12kg is suspended by coil spring of natural length 50cm and force constant $2.0 \times 10^3 Nm^{-1}$. What is the stretched length of the spring? If the body is pulled down further strething the spring to a length of 5.9cm and then released, then what is the frequency of oscillation of the suspended mass? (Neglect the mass of the spring)

99. The displacement of two particles executing simple harmonic motion are represented by equations, $y = 4\sin(10t + \theta)$ and $y = 5\cos 10t$ What is the phase difference

between the velocities of these particles?

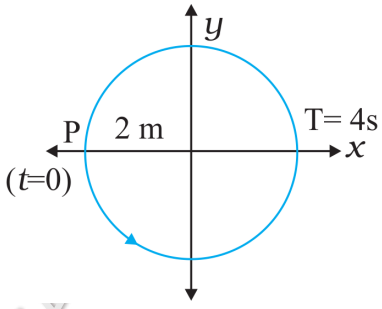
100. The number of harmonic components in the oscillations are represented by, $y = 4\cos^2$ at $\sin 4t$. What are What are their corresponding angular frequencies?

101. A particle of mass 0.8kg is executing simple harmonic motion with amplitude of 1.0 metre and periodic time $\frac{11}{7}$sec. Calculate the velocity and the kinetic energy of the particle at the moment when its displacement is 0.6 metre.

102. Given the example of the motion in the following cases:
   i. Where magnitude and direction of the acceleration of the particle changes.
   ii. Where the magnitude and direction of acceleration of body remains constant.
   iii. Where magnitude of acceleration changes but its direction remains constants.
   iv. Where the magnitude of acceleration remains constant but its direction changes.

103. What is the ratio between the distance travelled by the oscillator in one time period and amplitude?

104. Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position, and the sense of revolution (i.e. clockwise or anti-clockwise) are indicated on each figure. Obtain the corresponding simple harmonic motions of the x-projection of the radius vector of the revolving particle P, in each case.

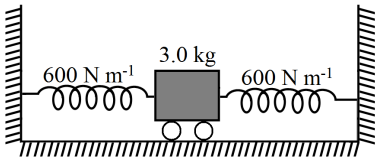


105. A simple pendulum with a brass has a time period T. The bob is now immersed in a non-viscous liquid and oscillated. If the density of the liquid is $\frac{1}{9}$ that of brass, find the time period of the same pendulum.

106. Two pendulums of lengths 100cm and 110.25cm start oscillating in phase simultaneously. After how many oscillations will they again be in phase together?

107. A block whose mass is 1kg is fastened to a spring. The spring has a spring constant of 50Nm^{-1}. The block is pulled to a distance x = 10cm from the equilibrium position at x = 0 on a frictionless surface from rest at t = 0. Calculate the kinetic, potential and total energies of the block when it is 5cm away from the mean position.

108. A trolley of mass 3.0kg, as shown in Figure, is connected to two springs, each of spring constant 600Nm^{-1}. If the trolley is displaced from its equilibrium position by 5.0cm and released, what is (a) the period of ensuing oscillations, and (b) the maximum speed of the trolley? How much energy is dissipated as heat by the time trolley comes to rest due damping forces?



109. What is the frequency of a second pendulum in an elevator moving up with an acceleration of $\frac{g}{2}$?

110. Suppose a tunnel is dug through the earth from one side to the other side along a diameter. Show that the motion of a particle dropped into the tunnel is simple harmonic motion. Find the time period. Neglect all the frictional forces and assume that the earth has a uniform density. G = 6.67 × 10^{-11}Nm^2 kg^{-2}; density of earth = 5.51 × 10^3kg m^{-3}

111. The mass 'M' attached to a spring oscillates with a period 2s. If the mass is increased by 2kg, the period increases by 1s. Find the initial mass 'M', assuming that Hooke's law is obeyed.

112. An object of mass 0.2kg executes simple harmonic oscillations along the x-axis with a frequency of $\frac{25}{\pi}$ Hertz. At the position x = 0.04m, the object has kinetic energy of 0.5J and potential energy of 0.4J. Find the amplitude of oscillations.

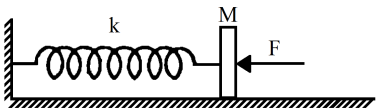
113. A spring compressed by 0.1m develops a restoring force 10N. A body of mass 4kg placed on it. Deduce
   i. The force constant of the spring.
   ii. The depression of the spring under the weight of the body(take g = 10 N/ kg).
   iii. The period of oscillation, the body is distributed and.
   iv. Frequency of oscillation.

114. A person normally weighing 50kg stands on a massless platform which oscillates up and down harmonically at a frequency of 2.0s^{-1} and an amplitude 5.0cm. A weighing machine on the platform gives the persons weight against time.
   a. Will there be any change in weight of the body, during the oscillation?
   b. If answer to part (a) is yes, what will be the maximum and minimum reading in the machine and at which position?

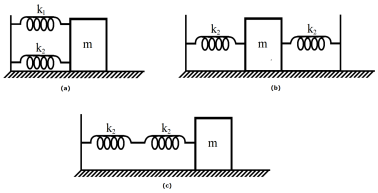
115. Find the time period of mass M when displaced from its equilibrium positon and then released for the system shown in figure.

116. In figure k = 100N/m, M = 1kg and F = 10N,
   a. Find the compression of the spring in the equilibrium position.
   b. A sharp blow by some external agent imparts a speed of 2m/s to the block towards left. Find the sum of the potential energy of the spring and the kinetic energy of the block at this instant.
   c. Find the time period of the resulting simple harmonic motion.
   d. Find the amplitude.
   e. Write the potential energy of the spring when the block is at the left extreme.
   f. Write the potential energy of the spring when the block is at the right extreme.

The answers of (b), (e) and (f) are different. Explain why this does not violate the principle of conservation of energy.



117. Find the time period of the oscillation of mass m in figure What is the equivalent spring constant of the pair of springs in each case?

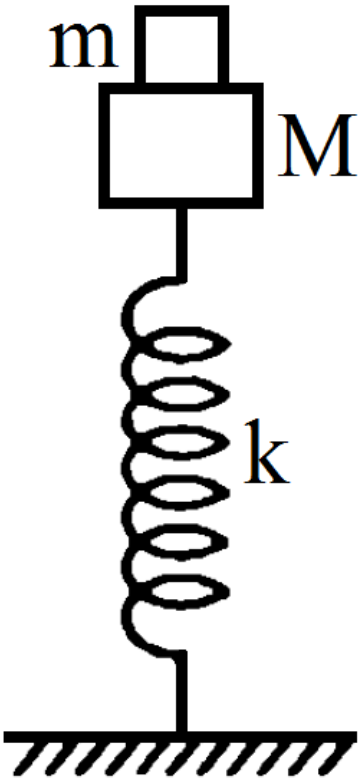


118. A small block of mass m is kept on a bigger block of mass M which is attached to a vertical spring of spring constant k as shown in the figure. The system oscillates vertically.

a. Find the resultant force on the smaller block when it is displaced through a distance x above its equilibrium position.

b. Find the normal force on the smaller block at this position. When is this force smallest in magnitude?

c. What can be the maximum amplitude with which the two blocks may oscillate together?



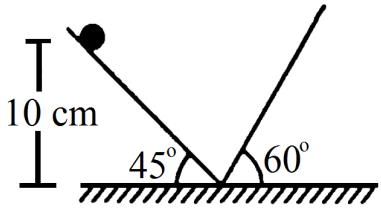
119. A particle is subjected to two simple harmonic motions given by $x_1 = 2.0\sin(100\pi t)$ and $x_2 = 2.0\sin\left(120\pi t + \frac{\pi}{3}\right)$ where x is in centimeter and t in second. Find the displacement of the particle at

a. t = 0.0125.

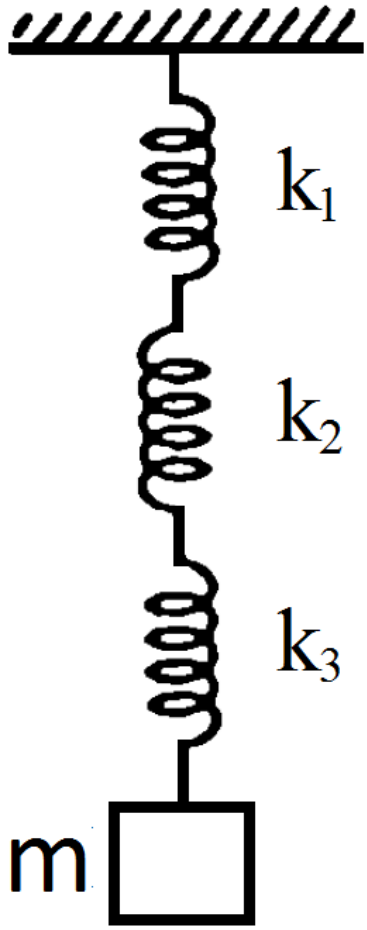
b. t = 0.025.

120. A particle having mass 10g oscillates according to the equation $x = (2.0\text{cm})\sin\left[(100\text{s}^{-1})t + \frac{\pi}{6}\right]$. Find (a) the amplitude, the time period and the spring constant (b) the position, the velocity and the acceleration at t = 0.

121. Find the time period of the motion of the particle shown in figure Neglect the small effect of the bend near the bottom.



122. Find the elastic potential energy stored in each spring shown in figure when the block is in equilibrium. Also find the time period of vertical oscillation of the block.



*** Case study based questions** **[16]**

123. The ear-ring of a lady shown in has a 3cm long light suspension wire.
   a. Find the time period of small oscillations if the lady is standing on the ground.
   b. The lady now sits in a merry-go-round moving at 4m/s in a circle of radius 2m. Find the time period of small oscillations of the ear-ring.

124. A simple pendulum fixed in a car has a time period of 4 seconds when the car is moving uniformly on a horizontal road. When the accelerator is pressed, the time period changes to 3.99 seconds. Making an approximate analysis, find the acceleration of the car.

125. A simple pendulum of length l is suspended from the ceiling of a car moving with a speed v on a circular horizontal road of radius r.

a. Find the tension in the string when it is at rest with respect to the car.

b. Find the time period of small oscillation.

126. A person goes to bed at sharp 10:00 pm every day. Is it an example of periodic motion? If yes, what is the time period? If no, why?

----- A person who never made a mistake never tried anything new. - (Albert Einstein) -----