PHYSICS

BOOKS - KUMAR PRAKASHAN KENDRA

PHYSICS (GUJRATI ENGLISH)

OSCILLATIONS

Section A Questions Answers

1. What is motion? Mention different types of motions.

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2. Study of which motion is required to understand many physical phenomena?

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3. Which concepts are needed for description of a periodic motion?

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4. What is periodic motion? Give its examples.

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5. What is oscillatory motion? Give its examples.

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6. Define simple harmonic motion and write its important characteristics.

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7. Difference between periodic motion and simple harmonic motion.

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8. Write the difference between oscillations and vibration.

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9. Write the defination, unit, dimensional formula and relation between periodic time and frequency.

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10. What is displacement? Explain its general meaning by giving examples.

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11. Explain periodic function.

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12. Give the importance of periodic sine and cosine functions.

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13. Define simple harmonic motion and explain it.

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14. Explain by plats the position of particle executing simple harmonic motion at different time.

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15. Draw a graph of displacement varsus time as a function of time in simple harmonic motion.

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16. Define amplitude of SHM and draw two different SHM in one figure having for two different amplitudes.

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17. Explain what is phase and draw in a single graph of different phases of simple harmonic motions.

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18. Define periodic time and angular frequency and obtain the relation between them.

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19. Draw plots for initial phase $\phi = 0$ for different periods.

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20. Show that simple harmonic motion may be regarded as the projection of uniform circular motion along a diameter of the circle.

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21. Explain that simple harmonic motion is the projection of uniform circular motion on a diameter of the reference circle and obtain the velocity and acceleration.

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22. Show that simple harmonic motion may be regarded as the projection of uniform circular motion along a

diameter of the circle.

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23. Explain geometrical repersentation of simple harmonic motion.

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24. Show that simple harmonic motion may be regarded as the projection of uniform circular motion along a diameter of the circle.

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25. Obtain the velocity of projected particle executing uniform circular motion.

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26. Obtain instantaneous velocity of a particle executing SHM.

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27. Obtain instantaneous acceleration of a SHM particle with the help of reference circle.

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28. Obtain the formula of acceleration of a particle from the formula of displacement of SHM.

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29. Explain by drawing graphs of displacement $x(t) \to t$, velocity $v(t) \to t$ and acceleration $a(t) \to t$ of SHM for initial phase zero.

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30. Write the force law for SHM and obtain formula of period of SHM particle.

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31. Obtain the force law for SHM from the displacement of SHM particle.

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32. Obtain the expression of displacement from force law for simple harmonic motion.

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33. What is linear harmonic oscillator ? And what is non-linear oscillator?

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34. Obtain the expressions of kinetic energy potential energy and total energy in simple harmonic motion.

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35. Explain and draw the graphs of kinetic energy, potential energy and mechanical energy versus displacement for SHM.

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36. Explain and draw the graphs of kinetic energy, potential energy and total energy as a function of time.

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37. Why absolutely pure simple harmonic motion is not possible?

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38. Show that the oscillations due to a spring are simple harmonic oscillations and obtain the expression of periodic time.

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39. What is simple pendulum? Deduce an expression for the time period of simple pendulum.

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40. What is pure simple harmonic oscillation? Why they are not 100% possible in practice?

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41. What are damed oscillations? Discuss it by illustration of spring.

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42. Derive differenital equation for damping oscillations and writes its solution.

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43. Write the expression of mechanical energy of damped oscillator.

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44. Define : Natural oscillations, free oscillation and forced oscillation.

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45. Obtain the differential equation of forced oscillation.

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46. Explain the behaviour of the oscillator when the driving frequency is far from natural frequency in small damped oscillations.

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47. Explain the behaviour of the oscillator when the driving frequency is close to natural frequency in small damped oscillation and define the resonance.

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48. To understand resonance describe the experiment of oscillations of five pendulums.

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49. Write the practical examples of resonance.

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Section A Try Yourself

1. What is motion ?

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2. Generation and propagation of sound and electromagnetic waves can be understood by which motion?

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3. Define periodic motion.

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4. Define oscillatory motion.

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5. Write the differences between periodic and simple harmonic motion.

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6. Define simple harmonic motion and explain it.

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7. Write important characteristics of simple harmonic motion.

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8. Write the difference between oscillations and vibration.

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9. Write the defination, unit, dimensional formula and relation between periodic time and frequency.

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10. Define and explain displacement

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11. Explain periodic function.

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12. Which physical quantity is there in A.C. circuit as displacement variable?

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13. Write the displacement variable in propagation of sound in air.

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14. Write the displacement variable in simple pendulum.

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15. Write the displacement variable in the propagation of light.

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16. Why periodic time $T = \frac{2\pi}{\omega}$ of function $f(t) = A\cos\omega t$ should be taken?

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17. Define simple harmonic motion and explain it.

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18. Draw a graph of displacement varsus time as a function of time in simple harmonic motion.

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19. Who decides the characteristics of SHM?

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20. Define amplitude of SHM and draw two different SHM in one figure having for two different amplitudes.

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21. Define phase at time t and initial phase.

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22. Define periodic motion.

Watch Video Solution

23. Define periodic time and angular frequency and obtain the relation between them.

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24. What is the projection of uniform circular motion?

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25. What is reference particle and reference circle?

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26. What is the amplitude of particle executing uniform circular motion?

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27. What is the angular frequency of reference particle executing SHM?

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28. SHM is associated with what kind of motion?

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29. What is the linear velocity of a particle of a uniform circular motionk of radius A and angular velocity ω?

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30. Give the direction of velocity at a point on the circle in uniform circular motion.

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31. Write the formula of instantaneous velocity of SHM particle along X-axis.

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32. Where is maximum acceleration and zero velocity of a particle axecuting SHM?

Watch Video Solution

33. Write the formula of instantaneous of SHM particle along X-axis.

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34. Where is maximum acceleration and zero acceleration of a particle executing SHM?

Watch Video Solution

35. Give the direction of velocity of SHM particle.

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36. Give the direction of acceleration of SHM particle.

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37. Obtain the ratio of maximum acceleration and maximum velocity of a SHM particle.

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38. Write the phase difference between displacement and velocity, displacement and accelerationl and velocity and acceleration.

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39. Write force law for SHM.

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40. Write the periodic time for SHM particle.

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41. What is linear harmonic oscillator?

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42. What is non-linear harmonic oscillator?

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43. What is forced constant of SHM particle?

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44. Write the expression of kinetic of SHM particle (i) As a function of displacement (ii) as a function of time.

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45. Write the expression of potential energy of SHM particle (i) as a function of displacement (ii) as a function of time.

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46. On which the mechanical energy depends? And does not depend?

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47. Write the conditionsl of points of intersections of graph of kinetic energy and potential energy.

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48. If T is the period of SHM, then write the period of kinetic and potential energy.

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49. Write Hooke's law.

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50. What is restoring force?

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51. Write the expression of restoring force produced in the spring when the body attached at the end of the spring pull down through small displacement.

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52. What is spring constant of spring? Write its unit and dimensional formula.

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53. Which type of springs have fast oscillation? Stiff or soft.

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54. How the period of oscillation depend on the mass of block attached to the end of spring?

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55. Define simple pendulum.

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56. Define the length of pendulum.

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57. 'Motion of simple pendulum from mean positionl for small displacement is a simple harmonic motion" - Explain this statement.

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58. Write the laws of simple pendulum.

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59. What are damed oscillations? Discuss it by illustration of spring.

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60. If velocity is not large then on which, the force on oscillator in medium depends?

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61. Write the equation of angular frequency for damped oscillation.

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62. Write the equation of amplitude for damped oscillations.

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63. If damped oscillator is very heavy then what is its frequency?

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64. What is the amplitude of damped oscillator if time becomes $t = 2m$?

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Section B Numerical From Textual Illustrations

1. On an average, a human heart is found to beat 75 times in a minute. Calculate its frequency and period.

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2. On an average a human heart is found to beat 81 times in a minute. Calculate its frequency and period.

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3. On an average a human heart is found to beat 300 times in a minute. Calculate its frequency and period.

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4. Which of the following functions of time represent (a) periodic and (b) non-periodic motion? Give the period for each case of periodic motion [ω is any positive constant].

(i) $\sin \omega t + \cos \omega t$

(ii) $\sin \omega t + \cos 2\omega t + \sin 4\omega t$

(iii) $e^{-\omega t}$

(iv) $\log(\omega t)$

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5. Which of the following functions of time represent (a) periodic and (b) non-periodic motion? Give the period for each case of periodic motion [ω is any positive constant].

(i) $\sin \omega t + \cos \omega t$

(ii) $\sin \omega t + \cos 2\omega t + \sin 4\omega t$

(iii) $e^{-\omega t}$

(iv) $\log(\omega t)$

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6. Which of the following functions of time represent (a) periodic and (b) non-periodic motion? Give the period for each case of periodic motion [ω is any positive constant].

(i) $\sin \omega t + \cos \omega t$

(ii) $\sin \omega t + \cos 2\omega t + \sin 4\omega t$

(iii) $e^{-\omega t}$

(iv) $\log(\omega t)$

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7. Which of the following functions of time represent (a) periodic and (b) non-periodic motion? Give the period for each case of periodic motion [ω is any positive constant].

(i) $\sin \omega t + \cos \omega t$

(ii) $\sin \omega t + \cos 2\omega t + \sin 4\omega t$

(iii) $e^{-\omega t}$

(iv) $\log(\omega t)$

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8. Which of the following functions does not indicates simple harmonic motion?

A. $y = a \sin \omega t$

B. $y = a \cos \omega t$

C. $y = a \sin \omega t + b \cos \omega t$

D. $y = a \tan \omega t$

Answer: D

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9. Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (ω is any positive constant):

(a) $\sin \omega t - \cos \omega t$

(b) $\sin^3 \omega t$

(c) $3 \cos(\pi / 4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp\left(- \omega^2 t^2 \right)$

(f) $1 + \omega t + \omega^2 t^2$

A. $y = \sin \omega t - \cos \omega t$

B. $y = \sin^3 \omega t$

C. $y = 5\cos\left(\frac{3\pi}{4} - 3\omega t\right)$

D. $y = 1 + \omega t + \omega^2 t^2$

Answer: B::D

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10. Which of the following functions of time represent (a) simple harmonic motion and (b) periodic but not simple harmonic? Give the period for each case.

(1) $\sin \omega t - \cos \omega t$

(2) $\sin^2 \omega t$

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11. Which of the following functions of time represent (a) simple harmonic motion and (b) periodic but not simple harmonic? Give the period for each case.

(1) $\sin \omega t - \cos \omega t$

(2) $\sin^2 \omega t$

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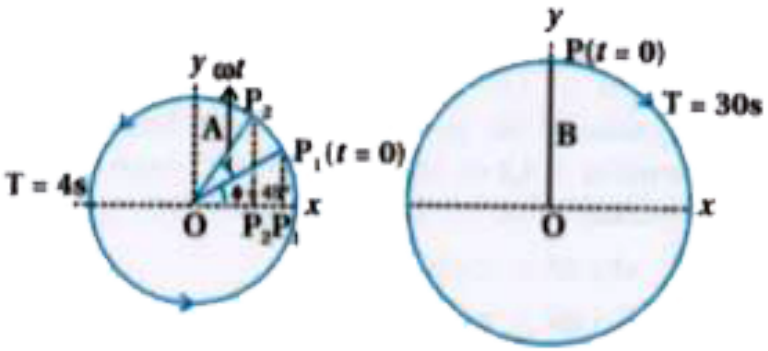
12. Figures depicts two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution are indicated on the figures. Obtain the simple harmonic motions of the x-projection of the radius vector of the rotating particle P in each

case.



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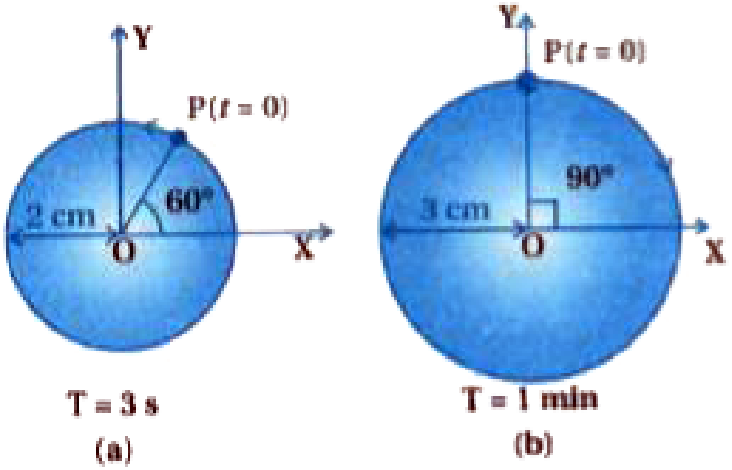
13. Obtain the equation for SHM of the Y-projection of the radius vector of the revolving particle P in case (a)

and (b) of figure.



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14. A body oscillates with SHM according to the equation (in SI units),

$x = 5\cos[2\pi t + \pi/4]$.

At t = 1.5 s, calculate the (a) displacement, (b) speed and (c) acceleration of the body.

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15. A body oscillates with SHM according to the equation (in SI units),

$x = 5\cos[2\pi t + \pi/4]$.

At t = 1.5 s, calculate the (a) displacement, (b) speed and (c) acceleration of the body.

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16. A body oscillates with SHM according to the equation (in SI units),

$x = 5\cos[2\pi t + \pi/4]$.

At t = 1.5 s, calculate the (a) displacement, (b) speed and (c) acceleration of the body.

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17. A body oscillator with SHM according to the equation (in SI units)

$$x = 10\cos\left[2\pi t + \frac{\pi}{4}\right]$$

At $t = 1.5s$ calculate the displacement.

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18. A body oscillator with SHM according to the equation (in SI units)

$x = 10\cos\left[2\pi t + \frac{\pi}{4}\right]$

At $t = 1.5s$ calculate the speed.

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19. A body oscillator with SHM according to the equation (in SI units)

$x = 10\cos\left[2\pi t + \frac{\pi}{4}\right]$

At $t = 1.5s$ calculate the acceleration of the body.

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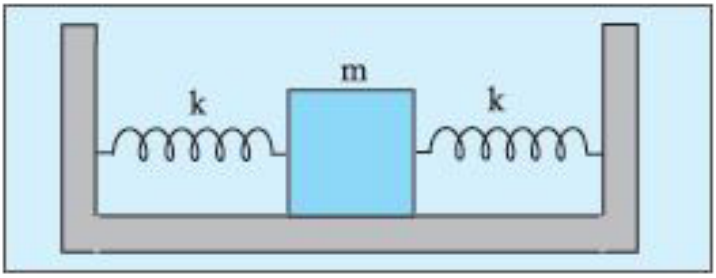
20. Two identical springs of spring constant k are attached to a block of mass m and to fixed supports as

shown in Fig. 14.14. 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.



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21. 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=10 cm 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 5 cm away from the mean position.

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22. A block whose mass is 2kg is fastened to a spring. The spring has a spring constant of $100Nm^{-1}$. The block is pulled to a distance x=10 cm 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 5 cm away from the mean position.

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23. 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=10 cm 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 $7.07cm$ away from the mean position.

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24. A 5kg collar is attached to a spring of spring constant $500Nm^{-1}$. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by $10.0cm$ and released. Calculate the period of oscillation.

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25. A 5 kg collar is attached to a spring of spring constant 500 N m^{-1}. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by 10.0 cm and released. Calculate

(a) the period of oscillation,

(b) the maximum speed and

(c) maximum acceleration of the collar.

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26. A 5 kg collar is attached to a spring of spring constant 500 N m^{-1}. It slides without friction over a

horizontal rod. The collar is displaced from its equilibrium position by 10.0 cm and released. Calculate

(a) the period of oscillation,

(b) the maximum speed and

(c) maximum acceleration of the collar.

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27. A 2kg collar is attached to a spring of spring constant $800Nm^{-1}$. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by $10.0cm$ and released. Calculate the period of the oscillation.

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28. A 2kg collar is attached to a spring of spring constant $800Nm^{-1}$. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by $10.0cm$ and released. Calculate the maximum speed.

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29. A 2kg collar is attached to a spring of spring constant $800Nm^{-1}$. It slides without friction over a horizontal rod. The collar is displaced from its equilibrium position by $10.0cm$ and released. Calculate maximum acceleration of the collar.

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30. What is the length of a simple pendulum, which ticks seconds ?

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31. How much will the length of a simple pendulum be if its time period is 3s?

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32. What would be the length of a simple pendulum on Moon if we get its period of 2s?

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33. What will be the time period of seconds pendulum if its length is doubled?

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34. For the damped oscillator, the mass m of the block is $200g$, $k = 90Nm^{-1}$ and the damping constant b is $40gs^{-1}$. Calculate the period of oscillation.

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35. For the damped oscillator, the mass m of the block is $200g$, $k = 90Nm^{-1}$ and the damping constant b is

$40gs^{-1}$. Calculate time taken for its amplitude of vibrations to drop to half of its initial value.

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36. For the damped oscillator, the mass m of the block is $200g$, $k = 90Nm^{-1}$ and the damping constant b is $40gs^{-1}$. Calculate the time taken for its mechanical energy to drop to half its initial value.

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37. For the damped oscillator, the mass m of the block is $400g$, $k = 120Nm^{-1}$ and the damping constant b is

$50gs^{-1}$. Calculate the period of oscillation.

Watch Video Solution

38. For the damped oscillator, the mass m of the block is $400g$, $k = 120Nm^{-1}$ and the damping constant b is $50gs^{-1}$. Calculate time taken for its amplitude of vibration to drop to half of the initial value.

Watch Video Solution

39. For the damped oscillator, the mass m of the block is $400g$, $k = 120Nm^{-1}$ and the damping constant b is

$50gs^{-1}$. Calculate time taken for its amplitude of vibration to drop to half of the initial value.

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40. A oscillator of mass 100g executes damped oscillation. When it complete 100 oscillations its amplitude of oscillation becomes half to its original amplitude. If time period is 2s, then find the value of damping coefficient.

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Section B Numerical From Textual Exercise

1. Which of the following examples represent periodic motion?

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2. Which of the following examples represent periodic motion?

A freely suspended bar magnet displaced from its N-S direction and released.

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3. Which of the following examples represent periodic motion?

A hydrogen molecule rotating about its center of mass.

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4. Which of the following examples represent periodic motion?

An arrow released from a bow.

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5. Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion?

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6. Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion?

Watch Video Solution

7. Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion?

Watch Video Solution

8. Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion?

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9. Fig. 14.23 depicts four x-t plots for linear motion of a particle. Which of the plots represent periodic motion? What is the period of motion (in case of periodic motion) ?

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10. Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (ω is any positive constant):

(a) $\sin \omega t - \cos \omega t$

(b) $\sin^3 \omega t$

(c) $3 \cos(\pi / 4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp\left(- \omega^2 t^2 \right)$

(f) $1 + \omega t + \omega^2 t^2$

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11. Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (ω is any positive constant):

(a) $\sin \omega t - \cos \omega t$

(b) $\sin^3 \omega t$

(c) $3 \cos(\pi/4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp(-\omega^2 t^2)$

(f) $1 + \omega t + \omega^2 t^2$

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(b) $\sin^3 \omega t$

(c) $3 \cos(\pi / 4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp\left(- \omega^2 t^2 \right)$

(f) $1 + \omega t + \omega^2 t^2$

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(b) $\sin^3 \omega t$

(c) $3 \cos(\pi/4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp(-\omega^2 t^2)$

(f) $1 + \omega t + \omega^2 t^2$

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(c) $3 \cos(\pi / 4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp\left(- \omega^2 t^2 \right)$

(f) $1 + \omega t + \omega^2 t^2$

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15. Which of the following functions of time represent (a) simple harmonic, (b) periodic but not simple harmonic, and (c) non-periodic motion? Give period for each case of periodic motion (ω is any positive constant):

(a) $\sin \omega t - \cos \omega t$

(b) $\sin^3 \omega t$

(c) $3 \cos(\pi / 4 - 2\omega t)$

(d) $\cos \omega t + \cos 3\omega t + \cos 5\omega t$

(e) $\exp\left(- \omega^2 t^2 \right)$

(f) $1 + \omega t + \omega^2 t^2$

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16. A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is

at the end A.

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17. A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is

at the end B.

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18. A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is

at the mid-point of AB going towards A.

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19. A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give

the signs of velocity, acceleration and force on the particle when it is

at 2 cm away from B going towards A.

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20. A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is

at 3 cm away from A going towards B.

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21. A particle is in linear simple harmonic motion between two points, A and B, 10 cm apart. Take the direction from A to B as the positive direction and give the signs of velocity, acceleration and force on the particle when it is

at 4 cm away from B going towards A.

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22. Which of the followng relationships between the acceleration a and the displacement x of a particle involve simple harmonic motion?

$a = 0.7x.$

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23. Which of the following relationships between the acceleration a and the displacement x of a particle involve simple harmonic motion?

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24. Which of the followng relationships between the acceleration a and the displacement x of a particle involve simple harmonic motion?

$a = -10x$

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25. Which of the following relationships between the acceleration a and the displacement x of a particle involve simple harmonic motion?

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26. The motion of a particle executing simple harmonic motion is described by the displacement function,

$x(t) = A\cos(\omega t + \phi)$.

If the initial (t = 0) position of the particle is 1 cm and its initial velocity is ω cm/s, what are its amplitude and initial phase angle ? The angular frequency of the particle is πs^{-1}. If instead of the cosine function, we choose the sine function to describe the SHM :

$x = B\sin(\omega t + \alpha)$, what are the amplitude and initial phase of the particle with the above initial conditions.

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27. A spring balance has a scale that reads from 0 to 50 kg. The length of the scale is 20 cm. A body suspended from this balance, when displaced and released, oscillates with a period of 0.6 s. What is the weight of the body ?

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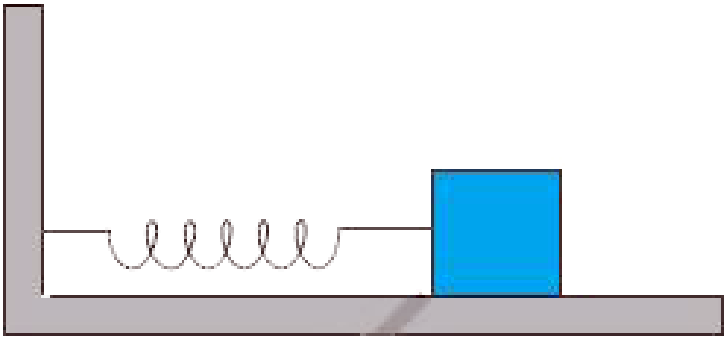
28. A spring having with a spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in Fig. 14.24. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.



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

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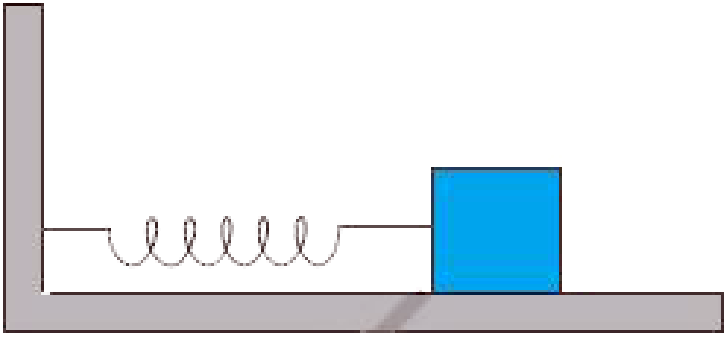
29. A spring having with a spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in Fig. 14.24. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.



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

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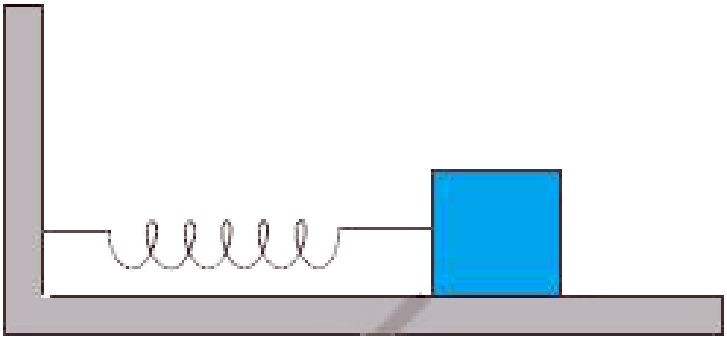
30. A spring having with a spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in Fig. 14.24. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 2.0 cm and released.



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

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31. In Exercise 9, let us take the position of mass when the spring is unstretched as x=0, and the direction from left to right as the positive direction of x-axis. Give x as a function of time t for the oscillating mass if at the moment we start the stopwatch (t=0), the mass is at the mean position.

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32. In Exercise 9, let us take the position of mass when the spring is unstretched as x=0, and the direction from left to right as the positive direction of x-axis. Give x as a function of time t for the oscillating mass if at the moment we start the stopwatch (t=0), the mass is at the maximum streatched position.

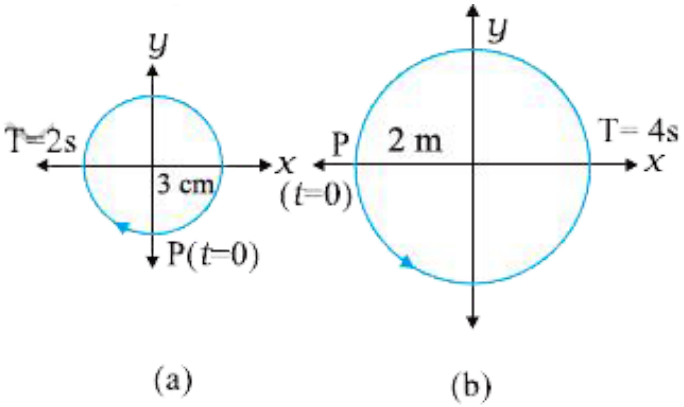
Watch Video Solution

33. In Exercise 9, let us take the position of mass when the spring is unstretched as x=0, and the direction from left to right as the positive direction of x-axis. Give x as a function of time t for the oscillating mass if at the moment we start the stopwatch (t=0), the mass is at the maximum compressed position.

In what way to these functions for SHM differ from each other, in frequency, in amplitude or the initial phase?

Watch Video Solution

34. Figures 14.25 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.

Watch Video Solution

35. 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).

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36. 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).

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37. 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).

Watch Video Solution

38. 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).

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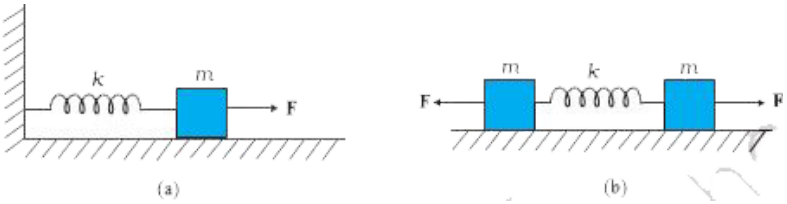
39. Figure 14.26 (a) shows a spring of force constant k clamped rigidly at one end and a mass m attached to its free end. A force F applied at the free end stretches the spring. Figure 14.26 (b) shows the same spring with both ends free and attached to a mass m at either end. Each

end of the spring in Fig. 14.26(b) is stretched by the same force F.



What is the maximum extension of the spring in the two cases ?

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40. The piston in the cylinder head of a locomotive has a stroke (twice the amplitude) of 1.0 m. If the piston moves with simple harmonic motion with an angular frequency of 200 rad/min, what is its maximum speed ?

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41. The acceleration due to gravity on the surface of moon is $1.7ms^{-2}$. What is the time period of a simple pendulum on the surface of moon if its time period on the surface of earth is 3.5 s ? (g on the surface of earth is 9.8 m s^{-2})

Watch Video Solution

42. Answer the following question :

Time period of a particle in SHM depends on the force constant k and mass m of the particle:

$T = 2\pi\sqrt{\frac{m}{k}}$. A simple pendulum executes SHM

approximately. Why then is the time period of a pendulum independent of the mass of the pendulum?

Watch Video Solution

43. Answer the following question :

The motion of a simple pendulum is approximately simple harmonic for small angle oscillations. For larger angles of oscillation, a more involved analysis shows that T is greater than $2\pi\sqrt{\frac{l}{g}}$, Think of a qualitative argument to appreciate this result.

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44. Answer the following question :

A man with a wristwatch on his hand falls from the top of a tower. Does the watch give correct time during the free fall ?

Watch Video Solution

45. Answer the following question :

What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity ?

Watch Video Solution

46. 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 ?

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47. A cylindrical piece of cork of density of base area A and height h floats in a liquid of density p_l. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period $T = 2\pi\sqrt{\frac{hp}{p_1 g}}$

where p is the density of cork. (Ignore damping due to viscosity of the liquid).

Watch Video Solution

48. One end of a U-tube containing mercury is connected to a suction pump and the other end to atmosphere. A small pressure difference is maintained between the two columns. Show that, when the suction pump is removed, the column of mercury in the U-tube executes simple harmonic motion.

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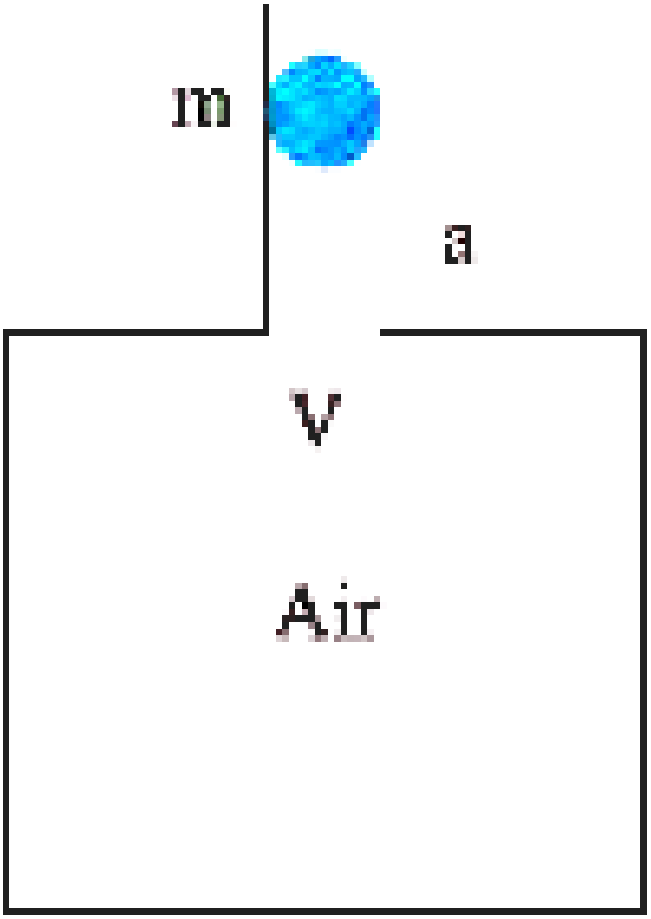
Section B Additional Exercise

1. An air chamber of volume V has a neck area of cross section a into which a ball of mass m just fits and can move up and down without any friction (Fig.14.27). Show that when the ball is pressed down a little and released , it executes SHM. Obtain an expression for the time period of oscillations assuming pressure-volume

variations of air to be isothermal [see Fig. 14.27].



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2. You are riding in an automobile of mass 3000 kg. Assuming that you are examining the oscillation characteristics of its suspension system. The suspension sags 15 cm when the entire automobile is placed on it. Also, the amplitude of oscillation decreases by 50% during one complete oscillation. Estimate the values of the spring constant k.

Watch Video Solution

3. You are riding in an automobile of mass 3000 kg. Assuming that you are examining the oscillation characteristics of its suspension system. The suspension sags 15 cm when the entire automobile is placed on it.

Also, the amplitude of oscillation decreases by 50% during one complete oscillation. Estimate the values of the damping constant b for the spring and shock absorbar system of one wheel, assuming that each wheel supports 750 kg.

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4. Show that for a particle in linear SHM the average kinetic energy over a period of oscillation equals the average potential energy over the same period.

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5. A circular disc of mass 10 kg 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 15 cm. 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).

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6. A body describes simple harmonic motion with an amplitude of 5 cm and a period of $0.2s$. Find the

acceleration and velocity of the body when the displacement is 5 cm.

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7. A body describes simple harmonic motion with an amplitude of 5 cm and a period of $0.2s$. Find the acceleration and velocity of the body when the displacement is 3 cm.

Watch Video Solution

8. A body describes simple harmonic motion with an amplitude of 5 cm and a period of $0.2s$. Find the

acceleration and velocity of the body when the displacement is 0 cm.

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9. 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. Determine the amplitude of the resulting oscillaters ω, x_0 and v_0. [Hint : Start with the equation $x = a\cos(\omega t + \theta)$ and note that the initial velocity is negative.]

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Section B Numerical From Darpan Based On Textbook

1. The displacement of a simple harmonic oscillator is given by $y = 0.40 \sin(440t + 0.61)$. For this, what are the value of amplitude.

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2. The displacement of a simple harmonic oscillator is given by $y = 0.40 \sin(440t + 0.61)$. For this, what are the value of angular frequency.

Watch Video Solution

3. The displacement of a simple harmonic oscillator is given by $y = 0.40\sin(440t + 0.61)$. For this, what are the value of time period.

Watch Video Solution

4. The displacement of a simple harmonic oscillator is given by $y = 0.40\sin(440t + 0.61)$. For this, what are the value of initial phase?

Watch Video Solution

5. The SHM is represented by $y = 3\sin 314t + 4\cos 314t$ y in cm and t in second. Find the amplitude of SHO.

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6. A particle executes SHM on a straight line path. The amplitude of oscillation is 2 cm. When the displacement of the particle from the mean position is 1 cm, the magnitude of its acceleration is equal to that of its velocity. Find the time period, maximum velocity and maximum acceleration of SHM.

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7. A rectangular pipe having cross-sectional area A is closed at one end and at its other end a block having same cross-section is placed so that the system is

airtight. In the equilibrium position of the block, the pressure and volume of air enclosed in the pipe and P and V respectively. Prove that the block performs SHM when it is given a small displacement 'x' inward and released. Also find the period of this SHM. Assume the walls to be frictionless and compression of air to be isothermal.

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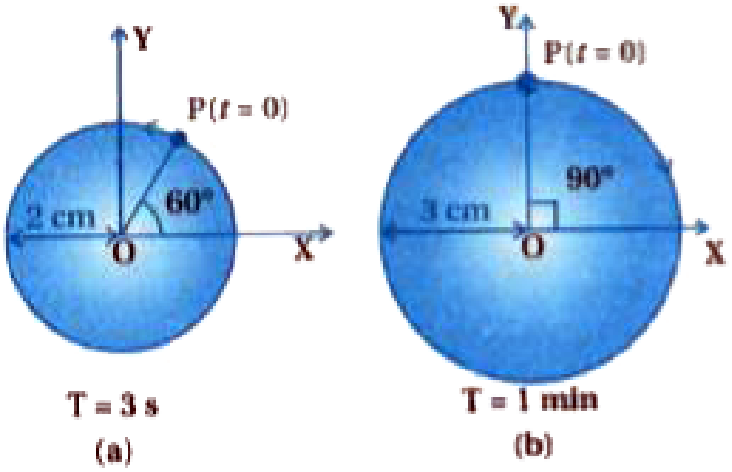
8. A body weighing 10kg has a velocity of $6ms^{-1}$, after one second of starting from the mean position. If the time period of SHO is 6s, find the kinetic energy, potential energy and total mechanical energy of SHO.

Watch Video Solution

9. Obtain the equation for SHM of the Y-projection of the radius vector of the revolving particle P in case (a) and (b) of figure.



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10. Three springs are connected to a mass $m = 80g$ as shown in figure. What is the effective spring constant and periodic time, if $k = 2Nm^{-1}$?

Watch Video Solution

11. A oscillator of mass 100g executes damped oscillation. When it complete 100 oscillations its amplitude of oscillation becomes half to its original amplitude. If time period is 2s, then find the value of damping coefficient.

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12. Amplitude of an SHO is A. When it is at a distance y from the mean position of the path of its oscillation, the SHO receives blow in the direction of its motion, which doubles its velocity instantaneously. Find the new amplitude of its oscillations.

Watch Video Solution

13. A simple pendulum has a length L and a bob of mass m. The bob is oscillating with amplitude A. Show that the maximum tension (T) in the string is (for small angular displacement).

$$T_{\max} = mg\left[1 + \left(\frac{A}{L}\right)^2\right].$$

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14. Two simple harmonic motions are represented by $y_1 = 10 \sin \frac{\pi}{4}(12t + 1)$ and $y_2 = 5\left(\sin 3\pi t + \sqrt{3} \cos 3\pi t\right)$. Find out the ratio of their amplitudes. What are the time period of two motions.

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15. For a linear SHM, when the distance of the oscillator from the equilibrium position has values y_1 and y_2 the velocities are v_1 and v_2. Show that the time period of oscillation is $T = 2\pi \left[\frac{y_2^2 - y_1^2}{v_1^2 - v_2^2}\right]^{\frac{1}{2}}$.

Watch Video Solution

Section C Objective Questions

1. What is the phase difference between the velocity and displacement of a paticle executing SHM?

Watch Video Solution

2. What is the phase difference the velocity and acceleration of a particle executing SHM?

Watch Video Solution

3. What is the phase difference between the displacement and acceleration of a particle executing SHM?

Watch Video Solution

4. The total energy at amplitude of 4 cm of a particle executes a SHM is 20 J. What will be its total energy at distance x = 2 cm?

Watch Video Solution

5. At which point (place) particle executes SHM have maximum kinetic energy and maximum potential energy?

Watch Video Solution

6. Amplitude of SHM particle is 4 cm. At what distance from mean positon will the potential energy and kinetic energy be equal?

Watch Video Solution

7. Write the maximum velocity of a SHM oscillatior in terms of mechanical energy E and mass of oscillator m.

Watch Video Solution

8. What is the displacement of a body in SHM when the potential energy becomes three times than kinetic energy?

Watch Video Solution

9. A body of mass m is executing SHM with amplitude a. When its displacement x=1 unit, the force is b then what will be its maximum kinetic energy?

Watch Video Solution

10. The maximum restoring force of a body executing SHM is α and total energy is β obtain it's the amplitude

in terms of β and α.

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11. The initial phase of body executing SHM is $\frac{\pi}{4}$, then what will be its phase at the end of 10 oscillations?

Watch Video Solution

12. Maximum velocity and maximum acceleration of a particle executing SHM are β and α respectively, what will its frquency?

Watch Video Solution

13. The spring mass system oscillating horizontally. What will be the effect on the time period if the spring is made to oscillate vertically?

Watch Video Solution

14. Is the oscillation of a simple pendulum at the centre of the earth be possible?

Watch Video Solution

15. What is condition for a body suspended at the end of a spring having simple harmonic oscillation?

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16. If two persons sitting on a swing instead of one, why the periodic time does not changed?

Watch Video Solution

17. If the mass of a bob of a pendulum increased by 9 times, the period of pendulum will?

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18. If the amplitude of body executes SHM becomes doubled, what will be its energy?

Watch Video Solution

Watch Video Solution

19. In a SHM at which point velocity and acceleration is zero?

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20. A artificial satellite circulating about the earth. Is its circular motion a simple harmonic motion?

Watch Video Solution

21. With what the natural frequency of oscillation of a body be dedermined

Watch Video Solution

22. What provides the restoring force in the following cases ?

Compressed spring becomes force for oscillation.

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23. What provides the restoring force in the following cases ?

Displacement of water in U-tube.

Watch Video Solution

24. What provides the restoring force in the following cases ?

Displacement of pendulum bob from mean position.

Watch Video Solution

25. Sometimes when the speed of vehicle increased, its body start to bounce why?

Watch Video Solution

26. If a vertical mass spring system is taken to the moon, will its time period after?

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Watch Video Solution

27. The frequency of oscillation of a mass m suspended by a spring is 'v'. If mass is cut to one fourth then what will be the frequency of oscillation?

Watch Video Solution

28. If a tunnel is dig along the diameter of earth and a body is dropped freely in it. The motion of this body is....., if there is no frictional force of medium acting on it. (Fill in the blank).

Watch Video Solution

29. When a body executes a simple harmonic motion and makes $\frac{1}{2\pi}$ oscillations, then its phase increases to..... rad. (Fill in the blank).

Watch Video Solution

30. At every second, phase of body executes simple harmonic motion increases to..... (Fill in the blank).

Watch Video Solution

31. Ratio of force constants of two springs is 1 : 2 and the ratio of mechanical energy of them is 2 : 9, ratio of

amplitudes of two bodies suspended at the end of spring is.....

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32. How many amplitudes of SHO covers the distance in the half period?

Watch Video Solution

33. A force of 20 dyne applied to the end of spring increase its length of 1mm, then force constant will be what ?

Watch Video Solution

34. Force constant of spring is $0.5Nm^{-1}$. The force necessary to increase the length of 10 cm of spring will be..... (Fill in the blank).

Watch Video Solution

35. If the length of second pendulum becomes $\frac{1}{3}$ what will be its periodic time?

Watch Video Solution

36. A person moves in sea water by terminal velocity with electronic digital watch, then what is the effect in

measurement of time of water proof watch?

Watch Video Solution

37. When pendulum clock is running fast, what should be done for adjust the true time?

Watch Video Solution

38. A particle executes two types of SHM. $x_1 = A_1 \sin \omega t$ and $x_2 = A_2 \sin\left[\omega t + \frac{\pi}{3}\right]$, then find the displacement at time t=0.

Watch Video Solution

39. A particle executes two types of SHM. $x_1 = A_1 \sin \omega t$ and $x_2 = A_2 \sin\left[\omega t + \frac{\pi}{3}\right]$, then find the maximum speed of the particle.

Watch Video Solution

40. A particle executes two types of SHM. $x_1 = A_1 \sin \omega t$ and $x_2 = A_2 \sin\left[\omega t + \frac{\pi}{3}\right]$, then find the maximum acceleration of the particle.

Watch Video Solution

41. Displacement of SHM particle is $x = 5 \sin \pi t$ where x is in cm. Then how much time taken by the particle from

the mean position to at maximum displacement.

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42. A girl is swinging a swing in the sitting position. What will be the effect on the time period of the swing if she stand up?

Watch Video Solution

43. The periodic time of SHM also measured by $t = 2\pi\sqrt{\frac{\text{displacement}}{\text{acceleration}}}$ can we say that the time period depend on the displacement?

Watch Video Solution

44. Two simple pendulums of equal length cross each other at mean position. What is their phase difference?

Watch Video Solution

45. The amlitude of a particle executes SHM is 2 cm and the force acting at extreme position on particle is 4N, then what is force at midway between mean position and extreme point?

Watch Video Solution

46. Can simple pendulum clock be used in an artificial satellite? Why ?

Watch Video Solution

47. When body of mass m is suspended from a spiral spring and spring gets stretched through a distance 20 cm if it is stretched below 20 cm and leave then what is period of oscillation?

Watch Video Solution

48. The particle executes simple harmonic motion have periodic time $0.05s$ and amplitude 4 cm, then what its

maximum velocity?

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49. At which position in the string of simple pendulum has maximum tension?

Watch Video Solution

50. Which basic properties are needed for the system being oscillate?

Watch Video Solution

51. Can an oscillatory motion be non-periodic?

Watch Video Solution

52. Give the formula of force acting on a particle executes simple harmonic motion.

Watch Video Solution

53. What happens to the time period of a simple pendulum when it is taken to moon's surface from earth's surface?

Watch Video Solution

54. What is the values of frequency in the differential equation of SHM $\frac{d^2x}{dt^2} + 100x = 0$?

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55. Amplitude of a SHO is $\sqrt{5}cm$. At what displacement from the mean position the ratio of kinetic energy to potential energy is 4?

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56. A particle is performing SHM. Its path length is 8 cm, amplitude is 4/1 th the path length and time period 0.2s.

If the particle is initially in the mean position, the time at which it will be at 1 cm will be

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57. A spring is stretched by 3 cm, its potential energy is U_1. If the spring is stretched by 6 cm, its potential energy be that is stored in it is $U_2 = \ldots\ldots U_1$. (Fill in the blank).

Watch Video Solution

58. Difference between periodic motion and simple harmonic motion.

Watch Video Solution

59. A spring has spring constant k and l. If it cut into piece spring in the proportional to $\alpha:\beta:\gamma$ then obtain the spring constant of every piece in term of spring constant of original spring (Here, α, β and γ are integers).

Watch Video Solution

60. Two springs having spring constant k_1 and k_2 is connected in series, its resultant spring constant will be 2 unit. Now if they connected in parallel its resultants spring constant will be 9 unit, then find the value of k_1 and k_2.

Watch Video Solution

Section C Objective Questions True Or False

1. The acceleration of SHO at mean position is maximum.

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2. The mechanical energy of SHO depend on the maximum displacement.

Watch Video Solution

3. Periodic time for second pendulum is 1 second.

Watch Video Solution

4. If the frequency of SHM is v then frequency of kinetic energy is also v.

Watch Video Solution

5. If the spring is cut in two equal piece the spring constant of every piece decreases.

Watch Video Solution

6. Displacement of SHO increases, its acceleration decrease.

Watch Video Solution

7. A system can happen to oscillate, have more than one natural frequency.

Watch Video Solution

8. The periodic time of SHM on amplitude or energy or phase constant.

Watch Video Solution

Section C Objective Questions Fill In The Blank

1. The ratio of displacement at any position and.....remains constant for a particle executed SHM.

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2. The radius of reference circle is equal to the.....of the oscillator.

Watch Video Solution

3. Increase in phase per second of SHO=.....

Watch Video Solution

4. SHO covers.....distance in the periodic time.

Watch Video Solution

5. In SHM.....quantities are always positive.

Watch Video Solution

6. A periodic motion obey law.....is only a simple harmonic motion.

Watch Video Solution

7. SHO of periodic time 2 second starts its oscillation from the lower end of its path of motion, its phase will be.....at time 2 second.

Watch Video Solution

Section C Objective Questions Matching

1. In the following table time in column-I and phase of oscillatior starts from mean position at a time is in

column-II. Match them appropriately.

Column-I		Column-II	
(a)	$t = \frac{T}{8}$	(i)	$\theta = \frac{5\pi}{4}$
(b)	$t = \frac{5T}{8}$	(ii)	$\theta = \frac{3\pi}{2}$
		(iii)	$\theta = \frac{\pi}{4}$

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2. In the following table relation of graph in column-I and shape of graph in column-II is shown match them

appropriately.

Column-I		Column-II	
(a)	$T^2 \to l$	(i)	Linear
(b)	$T^2 \to g$	(ii)	Parabolic
(c)	$T \to l$	(iii)	Hyperbolic

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3. In the following table displacement of SHO is in column-I and kinetic energy in column-II is shown. Match

them appropriately.

Column-I		Column-II	
(a)	$y = \frac{A}{\sqrt{2}}$	(i)	$K = \frac{3E}{4}$
(b)	$y = \frac{\sqrt{3}A}{2}$	(ii)	$K = \frac{E}{4}$
		(iii)	$K = \frac{E}{2}$

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4. A body performing SHO with total energy of 100 J. In below column-I kinetic energy at difinite time and in column-II potential energy at that time is shown. Match

them appropriately.

Column-I		Column-II	
(a)	K = 10 J	(i)	U = 40 J
(b)	K = 60 J	(ii)	U = 90 J
		(iii)	U = 50 J

.

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Section C Objective Questions Assertion Or Reasion

1. Assertion : All oscillatory motions are necessarily periodic motion but all periodic motion are not oscillatory.

Reason : Simple pendulum is an example of oscillatory motion.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: B

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2. Assertion : IN extreme position of particle executing SHM, kinetic energy and mechanical energy are same.

Reason : At extreme position velocity of a particle executing SHM is zero.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: D

Watch Video Solution

3. Assertion : Oscillations of hard spring are slow than soft spring.

Reason : For hard spring constant is larger than soft spring constant.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: D

Watch Video Solution

4. Assertion : The amplitude of forced oscillation are constant.

Reason : No external force acts on forced oscillator.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: C

Watch Video Solution

5. Assertion : As the mass of simple pendulum increases, its periodic time increases.

Reason : Periodic time of simple pendulum is $T = 2\pi\sqrt{\frac{l}{g}}$.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: D

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6. Assertion : Damped oscillation indicates loss of energy. Reason : The energy loss in damped oscillation my be due to friction, air resistance.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: B

Watch Video Solution

7. Assertion : The amplitude of an oscillating pendulum decreases gradually with time.

Reason : The frequency of the pendulum decreases with time.

A. Both are ture and the reason is the correct explanation of the assertion.

B. Both are ture and the reason is not correct explanation of the assertion.

C. Assertion is true, but the reason is false.

D. Both assertion and reason are false.

Answer: C

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Section D Ncert Exemplar Solution Mcqs

1. The displacement of a particle 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 $\frac{2\pi}{\omega}$

B. simple harmonic with period $\frac{\pi}{\omega}$

C. periodic but not simple harmonic

D. non-periodic

Answer: B

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2. 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 $\frac{\pi}{\omega}$

Answer: B

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3. The relation between acceleration and displacement of four particle are given below, which one of the particle is exempting simple harmonic motion?

A. $a_x = +2x$

B. $a_x = +2x^2$

C. $a_x = -2x^2$

D. $a_x = -2x$

Answer: D

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4. Motion of an oscillating liquid column in a U-tube is.....

A. periodic but not simple harmonic

B. non-periodic

C. simple harmonic and time period is independent of the density of the liquid

D. simple harmonic and time period is directly proportional to the density of the liquid

Answer: C

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5. A particle is acted simultaneouosly be mutually perpendicular simple harmonic motion $x = a\cos\omega t$ and $y = a\sin\omega t$. The trajectory of motion of the particle will be.....

A. an ellipse

B. a parabola

C. a circle

D. a straight line

Answer: C

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6. 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 SHM

B. the motion is SHM with amplitude $a + b$

C. the motion is SHM with amplitude $\left(a^2 + b^2\right)$

D. the motion is SHM with amplitude $\sqrt{\left(a^2\right) + \left(b^2\right)}$

Answer: D

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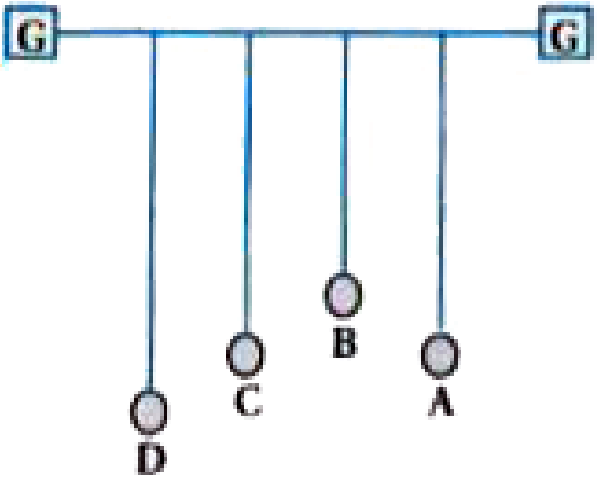
7. Four pendulums A, B, C and D are suspended from the same elastic support as shown in figure. A and C are of

the same length, while B is smaller than A and D is larger them A. If A is given a transverse displacement,



A. D will vibrate with maximum amplitude

B. C will vibrate with maximum amlitude

C. B vibrate with maximum amplitude

D. All the four will oscillate with equal amplitude

Answer: C

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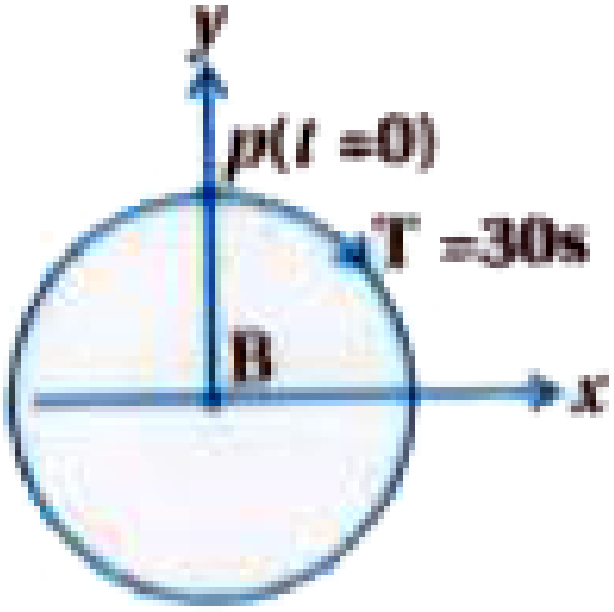
8. Figure shows the circular motion of a particle. The radius of the circle, the period, sense of revolution and the initial position are indicated on the figure. The simple harmonic motion of the x-projection of the radius vector of the rotating particle P is.....



A. $x(t) = B\sin\left(\frac{2\pi t}{30}\right)$

B. $x(t) = B\cos\left(\frac{\pi t}{15}\right)$

C. $x(t) = B\sin\left(\frac{\pi t}{15} + \frac{\pi}{2}\right)$

D. $x(t) = B\cos\left(\frac{\pi t}{15} + \frac{\pi}{2}\right)$

Answer: A

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9. 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

Answer: C

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10. A particle executing SHM 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. $2\pi s$

D. $\frac{\pi}{t} s$

Answer: A

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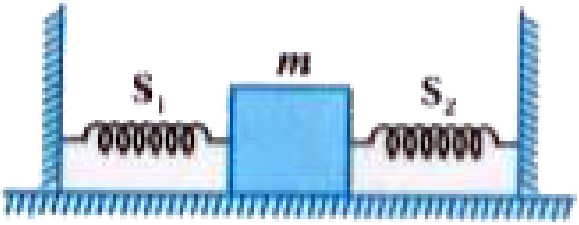
Section D Ncert Exemplar Solution Mcqs More Than One Options

1. When a mass m is connected individually to two springs S_1 and S_2 the oscillation frequencies are v_1 and v_2. If the same mass is attached to the two springs as shown in figure, the oscillation frequency

would be



A. $v_1 + v_2$

B. $\sqrt{v_1^2 + v_2^2}$

C. $\left(\frac{1}{v_1} + \frac{1}{v_2}\right)^{-1}$

D. $\sqrt{v_1^2 - v_2^2}$

Answer: B

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2. 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

Answer: A::C

Watch Video Solution

3. 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 SHM

Answer: A::C

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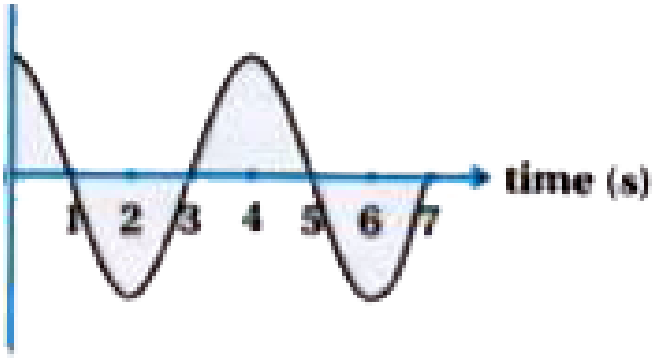
4. Displacement versus time curve for a particle executing SHM is shown in figure. Choose the correct

statements.



A. Phase of the oscillator is same at $t = 0s$ and $t = 2s$.

B. Phase of the oscillator is same at $t = 2s$ and $t = 6s$.

C. Phase of the oscillator is same at $t = 1s$ and $t = 7s$.

D. Phase of the oscillator is same at $t = 1s$ and $t = 5s$.

Answer: B::D

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5. Which of the following statements is/are true for a simple harmonic oscillator?

A. Force acting is directly proportional to displacement from the mean position and opposite to it

B. Motion is periodic

C. Acceleration of the oscillator is constant

D. The velocity is periodic

Answer: A::B::D

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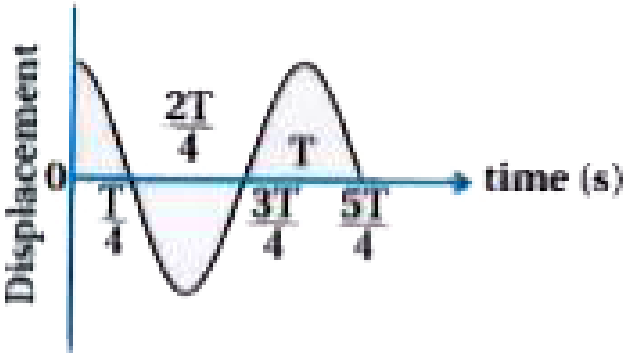
6. The displacement time graph of a particle executing SHM is shown in figure. Which of the following statement is/are true?



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 PE is equal to KE of oscillation $t = \frac{T}{2}$.

Answer: A::B::C

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7. A body is performing SHM, then its

A. Average total energy per cycle is equal to its maximum kinetic energy.

B. average kinetic energy per cycle is equal to half of its maximum kinetic energy.

C. mean velocity over a complete cycle is equal to $\frac{2}{\pi}$ times of its maximum velocity

D. root mean square velocity is $\frac{1}{\sqrt{2}}$ times of its maximum velocity.

Answer: A::B::D

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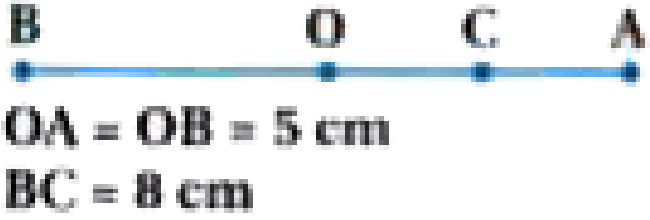
8. A particle is in linear simple harmonic motion between two points. A and B, 10 cm apart (figure) take the direction from A to B as the positive direction and

choose the correct statements.



A. The sign of velocity, acceleration and force on the particle when it is 3cm away from a going towards B are positive.

B. The sign of velocity of the particle at C going towards B is negative.

C. The sign of velocity, acceleration and force on the particle when it is 4cm away from B going towards A are negative.

D. The sign of acceleration and force on the particle when it is at points B is negative.

Answer: A::C::D

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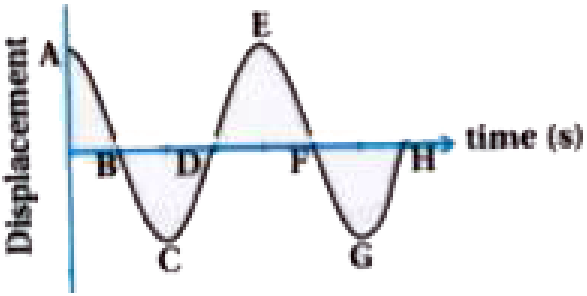
Section D Ncert Exemplar Solution Very Short Answer Questions

1. Displacement versus time curve for a particle executing SHM is shown in figure. Idendify the points marked at which (i) velocity of the oscillator is zero, (ii) speed of the

oscillator is maximum.



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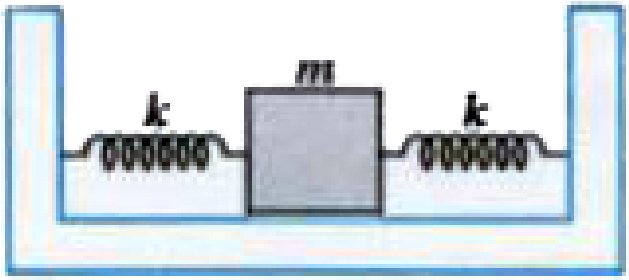
2. Two identical springs of spring constant k are attached to a block of mass m and to fixed supports as shown in figure. When the mass is displaced from equilibrium position by a distance x towards right, find the restoring

force.



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3. What are the two basic characteristics of a simple harmonic motion?

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4. When will the motion of a simple pendulum be simple harmonic?

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5. Obtain the ratio of maximum acceleration and maximum velocity of a SHM particle.

Watch Video Solution

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

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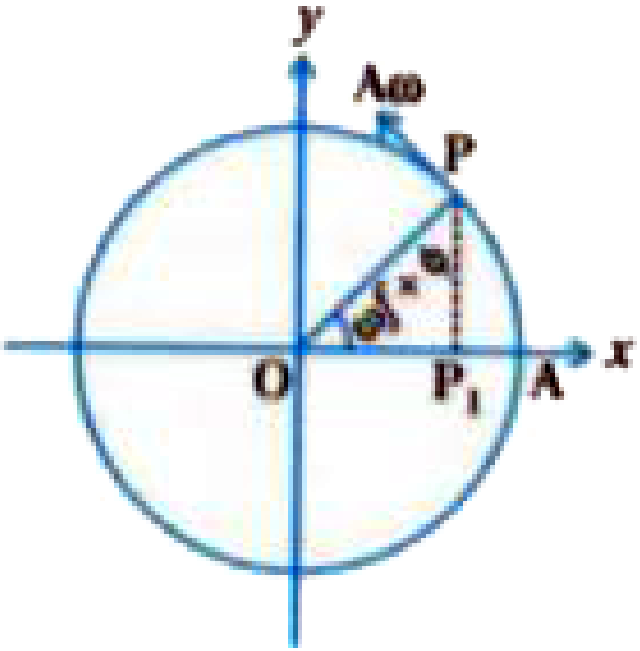
7. In the figure, what will be the sign of the velocity of the point P_1, which is the projection of the velocity of the reference particle P. P is moving in a circle of radius R in anti-clockwise direction.



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8. Show that for a particle executing SHM, velocity and displacement have a phase difference of $\frac{\pi}{2}$.

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9. Draw a graph to show the variation of PE, KE and total energy of a simple harmonic oscillator with displacement.

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10. The length of a second's pendulum on the surface of earth is 1m. What will be the length of a second's pendulum on the moon?

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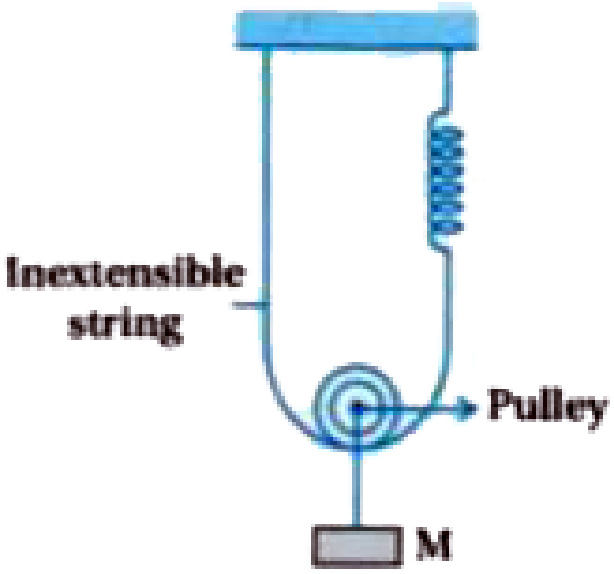
Section D Ncert Exemplar Solution Short Answer Questions

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



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

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

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4. A body of mass m is situated in a potential field $U(x) = U_0(1 - \cos \alpha x)$ when U_0 and α are constants. Find the time period of small oscillations.

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5. A mass 2kg is attached to the spring of spring constant $50Nm^{-1}$. The block is pulled to a distance of 5 cm from its equilibrium position at x= 0 on a horizontal frictionless surface from rest at t=0. Write the expression for its displacement at anytime t.

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6. Consider a pair of identical pendulums, which oscillate with equal amplitude independently such that when one pendulum is at its extreme position making an angle of 2° to the right with the vertical, the other pendulum makes an angle of 1° to the left of the vertical. What is the phase difference between the pendulums?

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Section D Ncert Exemplar Solution Long Answer Questions

1. 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.

Will there be any change in weight of the body, during the oscillation?

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2. 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.

If answer of part (1) is yes, what will be the maximum and minimum reading in the machine and at which position?

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3. 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 neighter stretched nor comprssed. Suddenly the support of the hand is removed. The lawest position attained by the mass during oscillation is 4 cm below the point, where it was held in hand.

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4. 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 neighter

stretched nor comprssed. Suddenly the support of the hand is removed. The lawest position attained by the mass during oscillation is 4 cm below the point, where it was held in hand.

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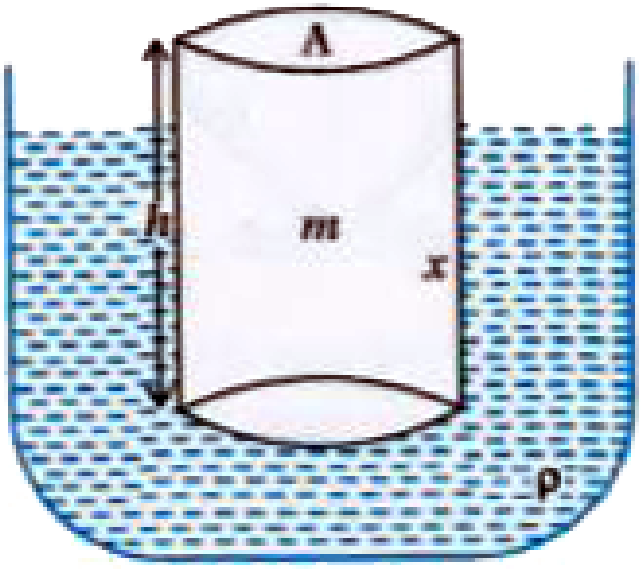
5. A cylindrical log of wood of height h and area of cross-section A floats in water. It is pressed and then released. Show that the log would execute SHM with a time period.

$$T = 2\pi\sqrt{\frac{m}{Apg}}$$

where, m is mass of the body and p is density of the

liquid.



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6. One end of V-tube containing mercury is connected to a suction pump and the other end to atmosphere. The two arms of the tube are inclined to horizontal at an angle of 45° each. A small pressure difference is created between two columns when the suction pump is

removed. Will the column of mercury in V-tube execute simple harmonic motion? Neglect capillary and viscous forces. Find the time period of oscillation.

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7. A tunnel is dug through the centre of the earth. Show that a body of mass m when dropped from rest from one end of the tunnel will execute simple harmonic motion.

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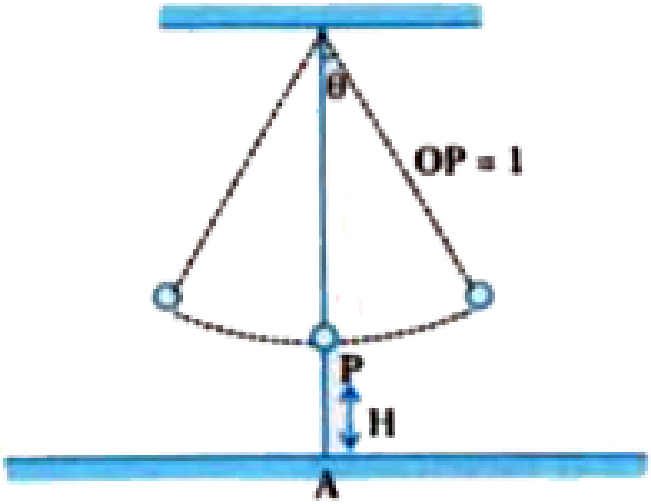
8. A simple pendulum of time period 1s and length l is hung from a fixed support at 0. Such that the bob is at a

distance H vertically above A on the ground (figure) the amplitude is θ_0 the string snaps at $\theta = \frac{\theta_0}{2}$. Find the time taken by the bob to hit the ground. Also find distance from A where bob hits the ground. Assume θ_0 to be small, so that $\sin\theta_0 \approx \theta_0$ and $\cos\theta_0 \approx 1$.



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Section E Mcqs Asked In Gujarat Board And Competitive Exams

1. A particle executes SHM along X-axis. The force acting on it is given by.....

A. $-Akx$

B. $A\cos(kx)$

C. $A\exp(-kx)$

D. Akx

Answer: A

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2. The angular velocity and the amplitude of a simple pendulum is ω and A respectively. At a displacement x

from the mean position if its kinetic energy is k and potential energy U, then the ratio of K and U is.....

A. $\frac{x^2\omega^2}{(A^2 - x^2\omega^2)}$

B. $\frac{x^2}{(A^2 - x^2)}$

C. $\frac{A^2 - x^2\omega^2}{x^2\omega^2}$

D. $\frac{A^2 - x^2}{x^2}$

Answer: D

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3. If a simple harmonic oscillator has got a displacement of $0.02m$ and acceleration eaual to $2.0m/s^2$ at any time, the angular frequency of the oscillator is equal to.....

A. $10 rad/s$

B. $0.1 rad/s$

C. $100 rad/s$

D. $1 rad/s$

Answer: A

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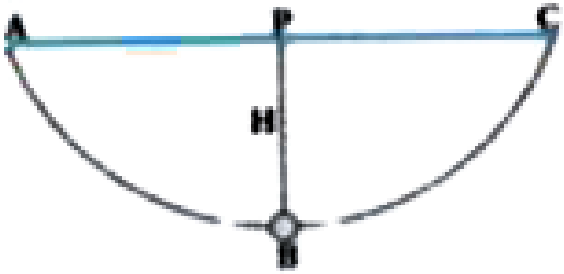
4. A simple pendulum with a bob of mass m oscillates from A to C and back to such that PB is H. If the acceleration due to gravity is g, then the velocity of the

bob as it passes through B is.....



A. mgH

B. $\sqrt{2gH}$

C. $2gH$

D. zero

Answer: B

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5. Which of the following is not an example of resonance?

A. Tunning fork

B. Forced oscillations

C. Free oscillation

D. Damped oscillations

Answer: B

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6. Time period of a simple pendulum is 2s. If its length is increased by 4 times, then its period becomes.....

A. $16s$

B. $12s$

C. $8s$

D. $4s$

Answer: D

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7. A particle performs a SHM with amplitude of $0.01m$ and the frequency of its oscillation is 60 Hz. Find the maximum acceleration of a particle.

A. $144\pi^2 m/\sec^2$

B. $144m/\sec^2$

C. $\frac{144}{\pi^2}m/\sec^2$

D. $288\pi^2 m/\sec^2$

Answer: A

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8. The equation of simple harmonic is as following $y(t) = 10\sin(20t + 45^\circ)$. Find the amplitude of SHM.

A. $a = 30$

B. $a = 20$

C. $a = 10$

D. $a = 5$

Answer: C

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9. A hollow sphere filled with water and one small hole at bottom is hung by a long thread and made to oscillates. The effect on the period of oscillation as water slowly flows out of the hole at bottom.....

A. decreases continuously

B. increases continuoulsy

C. first decrease and then becomes equal to its original value

D. first increases and then becomes equal to its original value

Answer: D

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10. Displacement between maximum potential energy position and maximum kinetic energy position for a particle executing simple harmonic motion is.....

A. $-A$

B. $+A$

C. $\pm A$

D. $\pm \frac{A}{4}$

Answer: C

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11. The circular motion of a particle with constant speed is.....

A. periodic but not simple harmonic

B. simple harmonic but not periodic

C. periodic and simple harmonic

D. none of these

Answer: B

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12. The potential energy of a long spring when stretched by 2cm is U. If the spring is stretched by 8 cm the potential energy stored in it is.....

A. $8U$

B. $16U$

C. $\frac{U}{4}$

D. $4U$

Answer: B

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13. What is the phase difference the velocity and acceleration of a particle executing SHM?

A. π

B. 0.707π

C. zero

D. 0.5π

Answer: D

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14. The particle executing simple harmonic motion has a kinetic energy $K_0 \cos^2 \omega t$. The maximum value of potential energy and the total energy are respectively.....and.....

A. $\frac{K_0}{2}$ and K_0

B. (K_0) and $2K_0$

C. (K_0) and K_0

D. 0 and $2K_0$

Answer: C

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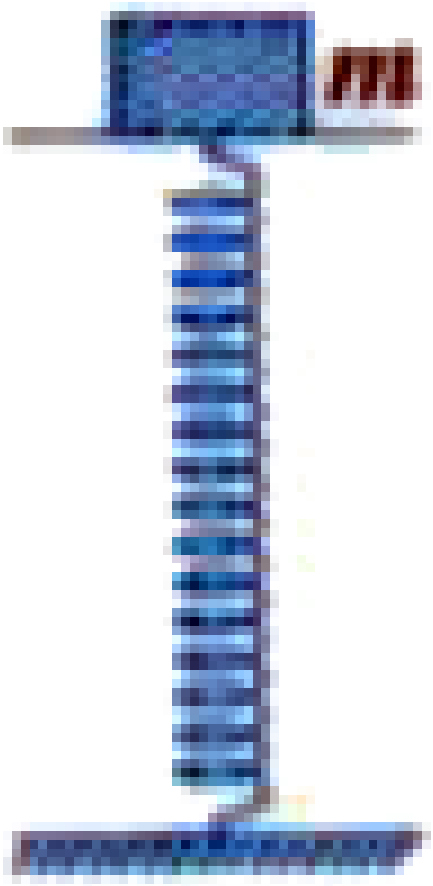
15. A mass of 2kg is put on a flat pan attached to a vertical spring fixed on the ground as shown in figure. The mass of the spring and the pan is negligible. When spring is pressed and released the mass executes a simple harmonic motion. The spring constant is $200N/m$. What should be the minimum amplitude of the motion so that the mass gets detached from the pan? (take

$g = 10m/s^2$)



A. $10.0cm$

B. less than $12.0cm$

C. $4.0cm$

D. $8.0cm$

Answer: A

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16. A point performs simple harmonic oscillation of period T and the equation of motion is given by $x = a\sin\left(\omega t + \frac{\pi}{6}\right)$. After the elapse of what fraction of the time period, the velocity of the point will be equal to half of its maximum velocity?

A. $\frac{T}{3}$

B. $\frac{T}{12}$

C. $\frac{T}{8}$

D. $\frac{T}{6}$

Answer: B

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17. Which one of the following equations of motion represent simple harmonic motion? Where k, k_0, k_1 and a are positive.

A. Acceleration $= -k(x+a)$

B. Acceleration $= k(x+a)$

C. Acceleration $= ka$

D. Acceleration $= -k_0 x + k_1 x^2$

Answer: A

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18. A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k. The mass is released from rest with spring initially unstretched. The maximum extension produced in the length of the spring will be.....

A. $\frac{2Mg}{k}$

B. $\frac{4Mg}{k}$

C. $\frac{Mg}{2k}$

D. $\frac{Mg}{k}$

Answer: D

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19. The displacement of particle along the X-axis is given by $x = a\sin^2 \omega t$. The motion of the particle corresponds to.....

A. Simple harmonic motion of frequency $\frac{\omega}{\pi}$

B. Simple harmonic motion of frequency $\frac{3\omega}{2\pi}$

C. Non-simple harmonic motion.

D. Simple harmonic motion of frequency $\frac{\omega}{2\pi}$

Answer: A

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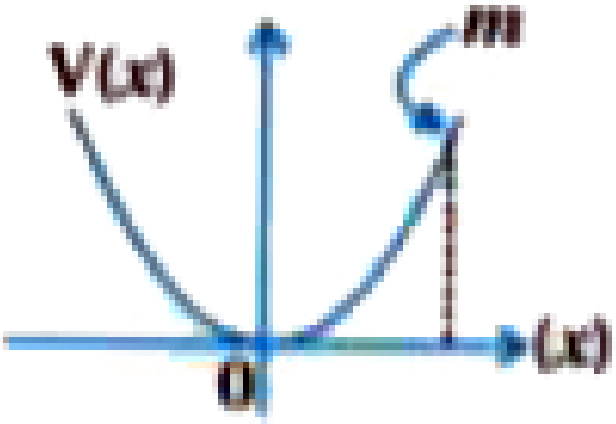
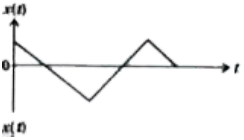
20. A particle of mass m is released from rest and follows a parabolic path as shown. Assuming that the displacement of the mass from the origin is small, which graph correctly depicts the position of the particle as a

function of time?



A. 

B. 

C. 

D. 

Answer: A

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21. Out of the following functions representing motion of a particle which represent SHM?

(a) $y = \sin \omega t - \cos \omega t$

(b) $y = \sin^2 \omega t$

(c) $y = 5 \cos \left(\frac{3\pi}{4} - 3\omega t \right)$

(d) $y = 1 + \omega t + \omega^2 t^2$

A. Only (a)

B. Only (d) does not represent SHM

C. Only (a) and (c)

D. Only (a) and (b)

Answer: C

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22. Two particle are oscillating along two close parallel straight lines side by side, with the same frequency and amplitude. They pass each other, moving on opposite directions when their displacement is half of the amplitude. The mean positions of the two particles lie on a straight line perpendicular to the paths of the two particles. The phase difference is.....

A. 0

B. $\frac{2\pi}{3}$

C. π

D. $\frac{\pi}{6}$

Answer: B

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23. What is the maximum speed of a particle executing SHM with amplitude of 3 cm and periodic time 6s ?

A. $\frac{\pi}{2}$

B. π

C. 2π

D. 3π

Answer: B

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24. A large horizontal surface moves up and down in SHM with an amplitude of 1 cm. If a mass of 10 kg which is placed on the surface is to remain continually in contact with it, the maximum frequency of SHM will be.....

A. $0.5Hz$

B. $1.5Hz$

C. $5Hz$

D. $10Hz$

Answer: C

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25. If a simple pendulum oscillates with an amplitude of 50 mm and time period of 2s, then its maximum velocity is.....

A. $0.10m/s$

B. $0.15m/s$

C. $0.8m/s$

D. $0.26m/s$

Answer: B

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26. If the period of oscillation of mass m suspended from a spring 2s, then period of mass 4 m will be....

A. $1s$

B. $2s$

C. $3s$

D. $4s$

Answer: D

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27. A particle executes simple harmonic motion with an angular velocity and maximum acceleration of $3.5\frac{rad}{\sec}$ and $7.5\frac{m}{s^2}$ respectively. Amplitude of the oscillation is.....

A. $0.28m$

B. $0.36m$

C. $0.53m$

D. $0.61m$

Answer: D

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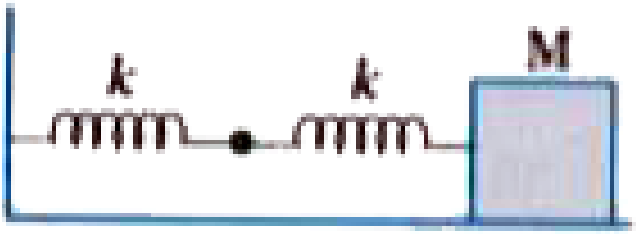
28. Two springs are connected to a block of mass M is placed on a frictionless surface as shown in figure. If both springs have a spring constant k, the frequency of oscillation of the block is.....



A. $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$

B. $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$

C. $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$

D. $\frac{1}{2\pi}\sqrt{\frac{M}{k}}$

Answer: B

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29. Which of the following functions of time represent (a) simple harmonic motion and (b) periodic but not simple harmonic? Give the period for each case.

(1) $\sin \omega t - \cos \omega t$

(2) $\sin^2 \omega t$

A. $\sin \omega t - \cos \omega t$

B. $\sin^2 \omega t$

C. $\sin \omega t + \sin 2\omega t$

D. $\sin \omega t - \sin 2\omega t$

Answer: A

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30. A horizontal surface moves up and down in SHM with an amplitude of 1 cm. If a mass of 10 kg which is placed on the surface is remain continuously in contact with it the maximum frequency of SHM will be.....

A. 5 Hz

B. $0.5Hz$

C. $1.5Hz$

D. $10Hz$

Answer: A

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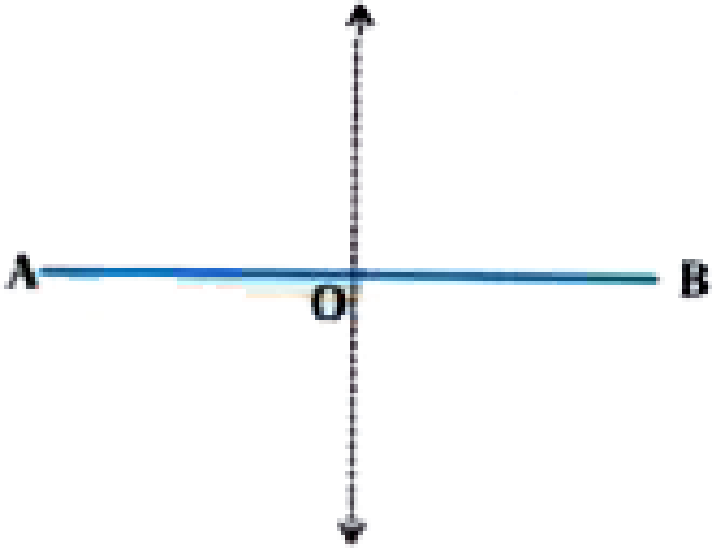
31. A particle executes SHM of period T and amplitude l along a rod AB of length 2l. The rod AB itself executes SHM of the same period and amplitude in a direction perpendicular to its length. Initially, both the particle and the rod are in their mean position. The path traced out by the particle will be.....



A. a circle of radius l

B. a straight line inclined at $\frac{\pi}{4}$ to the rod

C. an ellipse

D. a figure of eight

Answer: B

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32. A ball is suspended by a thread of length L at the point O on a wall which in indeed to the vertical by α. The thread with the ball is displaced by a small angle β away from the vertical and also away from the wall. If the

ball is released, the period of observation of the pendulum when $\beta > \alpha$ will be.....

A. $\sqrt{\frac{L}{g}}\left[\pi + 2\sin^{-1}\left(\frac{\alpha}{\beta}\right)\right]$

B. $\sqrt{\frac{L}{g}}\left[\pi - 2\sin^{-1}\left(\frac{\alpha}{\beta}\right)\right]$

C. $\sqrt{\frac{L}{g}}\left[2\sin^{-1}\left(\frac{\alpha}{\beta}\right) - \pi\right]$

D. $\sqrt{\frac{L}{g}}\left[2\sin^{-1}\left(\frac{\alpha}{\beta}\right) + \pi\right]$

Answer: A

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33. Let T_1 and T_2 be the time periods of spring A and B when mass M is suspended from the end of the spring. If

both springs are taken in series and the same mass M is suspended from the series combination, the time period is T, then

A. $T = T_1 + T_2$

B. $\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}$

C. $T^2 = T_1^2 + T_2^2$

D. $\frac{1}{T^2} = \frac{1}{T_1^2} + \frac{1}{T_2^2}$

Answer: C

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34. In the equation of motion of waves in x-direction is given by $y = 10^{-4}\sin\left(600t - 2x + \frac{\pi}{3}\right)$ where x and y

are in metre and t is in second, then the velocity of wave will be.....ms^{-1}.

A. 300

B. 600

C. 1200

D. 200

Answer: A

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35. Total energy of SHM particle.....

A. $\propto x$

B. $\propto x^2$

C. independent to x

D. $\propto x^{\frac{1}{2}}$

Answer: C

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36. Two springs of spring constant k_1 and k_2 are joined in series. Hence its equivalent spring constant of the combination is.....

A. $\frac{k_1 k_2}{k_1 + k_2}$

B. $k_1 k_2$

C. $\frac{k_1 k_2}{2}$

D. $k_1 + k_2$

Answer: A

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37. Two simple harmonic motion are represented by the equation $y_1 = 0.1 \sin\left(100\pi t + \frac{\pi}{3}\right)$ and $y_2 = 0.1 \cos \pi t$. The phase difference of the velocity of particle-1 with respect to the velocity of particle-2 is.....

A. $\frac{\pi}{6}$

B. $-\frac{\pi}{3}$

C. $\frac{\pi}{3}$

D. $-\frac{\pi}{6}$

Answer: D

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38. The circular motion of a particle with uniform speed is.....

A. periodic and simple harmonic

B. not simple harmonic but periodic

C. neither periodic nor simple harmonic

D. none of these

Answer: B

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39. A silver atom in a solid oscillaties in simple harmonic motion in some direction with frequency of $10^{(12)/\sec}$. What is the force constant of the bonds connecting one atom with the other? (Mole wt. of silver = 108 and Avagardo number $= 6.02 \times 10^{23} gm \text{mole}^{-1}$).

A. $6.4 N/m$

B. $7.1 N/m$

C. $2.2 N/m$

D. $5.5 N/m$

Answer: B

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40. A simple harmonic motion of a particle is represented by an equation $x = 0.01 \sin[100\pi(t + 0.05)]$. Where x is metre and t is in second respectively. The value of time period is.....

A. $0.01s$

B. $0.02s$

C. $0.1s$

D. $0.2s$

Answer: B

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41. A mass M is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes simple harmonic oscillation with a time period T. If the mass is increased by m, the time period becomes $\left(\frac{5}{4}T\right)$. The ratio of $\frac{m}{M}$ is.....

A. $\frac{9}{16}$

B. $\frac{25}{16}$

C. $\frac{4}{5}$

D. $\frac{5}{4}$

Answer: A

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42. A simple harmonic motion of a particle is represented by an equation $x = 5\sin\left(4t - \frac{\pi}{6}\right)$, where x is its displacement. If its displacement is 3 unit then find its velocity.

A. $\frac{2\pi}{3}$

B. $\frac{5\pi}{6}$

C. 20

D. 16

Answer: D

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43. A block of mass m be placed on a frictionless surface of a table. Spring constants of a spring joint on both side are k_1 and k_2 if block. Leave the block by slight displaced it, then its angular frequency will be.....

A. $\left(\frac{k_1+k_2}{m}\right)^{\frac{1}{2}}$

B. $\left(\frac{k_1k_2}{m(k_1+k_2)}\right)^{\frac{1}{2}}$

C. $\left(\frac{k_1k_2}{(k_1-k_2)m}\right)^{\frac{1}{2}}$

D. $\left(\frac{k_1^2+k_2^2}{(k_1+k_2)m}\right)^{\frac{1}{2}}$

Answer: A

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44. Acceleration of a particle $a = -bx$, where x is the displacement of particle from mean position and b is constant. What is the periodic time of oscillation ?

A. $2\pi\sqrt{b}$

B. $\frac{2\pi}{\sqrt{b}}$

C. $\frac{2\pi}{b}$

D. $2\sqrt{\left(\frac{\pi}{b}\right)}$

Answer: B

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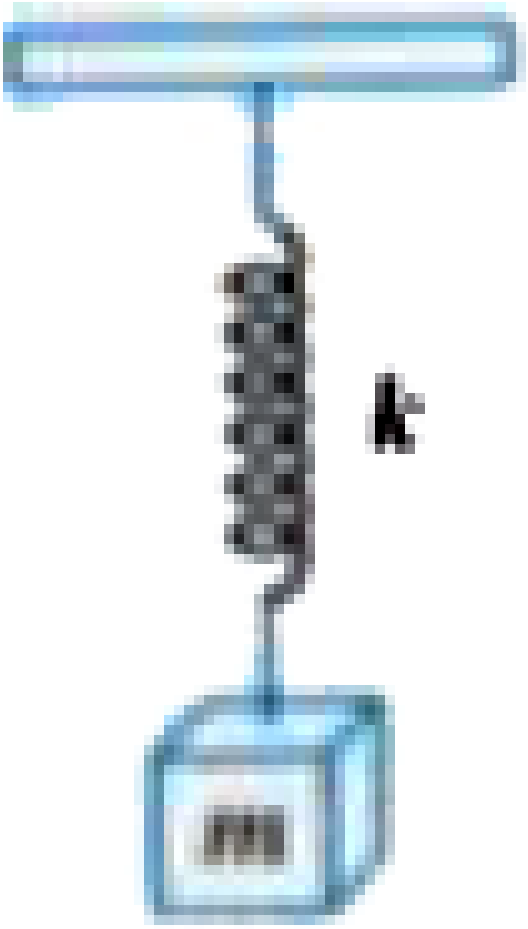
45. A mass m suspended at the end of spring of spring constant k and oscillate at periodic time T. If spring is cut into two part of equal length and tow pails are now connected in parallel and a block is suspended at the end of the combined spring and oscillate then find new

periodic time.



A. $2T$

B. T

C. $\frac{T}{\sqrt{2}}$

D. $\frac{T}{2}$

Answer: D

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46. The displacement of a particle performing SHM $x = 3\sin 2t + 4\cos 2t$. The amplitude and maximum velocity of a particle respectively are.....

A. $5, 10$

B. $3, 2$

C. $4, 2$

D. $3, 4$

Answer: A

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47. A body is moving in a room with velocity $20m/s$ perpendicular to the walls separated by 5 meter. There is no friction and collision with walls is elastic. The motion of body.....

A. is non-periodic

B. is periodic but not simple harmonic

C. is periodic and SHM

D. periodic with variable time period

Answer: B

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48. A lift is ascending with acceleration $\frac{g}{3}$. Find the time period of simple pendulum of length L kept in lift.

A. $2\pi\sqrt{\frac{3L}{g}}$

B. $\pi\sqrt{\frac{3L}{g}}$

C. $2\pi\sqrt{\frac{3L}{2g}}$

D. $2\pi\sqrt{\frac{2L}{3g}}$

Answer: C

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49. The ratio of maximum velocity and maximum acceleration of a particle of SHM having amplitude A and angular frequency ω.....

A. ω

B. $\frac{1}{\omega}$

C. ω^2

D. $A\omega$

Answer: B

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50. One fourth length of a spring of force constant k is cut away. The force constant of the remaining spring will be what ?

A. $\frac{3}{4}k$

B. $\frac{4}{3}k$

C. k

D. $4k$

Answer: B

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51. A simple pendulum suspended from the ceiling of a stationary van, has time period T. If then van stats moving with a uniform velocity, the periodic of the pendulum will be.....

A. less than T

B. equal to 2T

C. greater than T

D. unchanged

Answer: D

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52. A mass executes a simple harmonic motion of average potential energy $< U >$ and average kinetic energy $< E >$ over one time period are related to.....

A. $< E > = < U >$

B. $< E > = 2 < U >$

C. $< E > = -2 < U >$

D. $< E > = - < U >$

Answer: A

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53. For frequency of spring oscillator make doubly.....

A. mass has to made one forth

B. mass has to made four times

C. mass has to made twice

D. mass has to made halve

Answer: B

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54. The displacement of SHM particle is $x(t) = A\cos(\omega t + \phi)$. Its initial displacement is 1 cm and initial velocity is $\pi \frac{cm}{\sec}$ and angular frequency is πs^{-1}. Find amplitude.

A. $1cm$

B. $\sqrt{2}cm$

C. $2cm$

D. $2.5cm$

Answer: B

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55. A simple pendulum is taken from the equator to the pole. Its period.....

A. decreases

B. increases

C. remains same

D. decreases and then increases

Answer: A

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56. When the kinetic energy of the body executing SHM is $\frac{1}{3}$ of potential energy, the displacement is.....% of amplitude.

A. 33

B. 87

C. 67

D. 50

Answer: B

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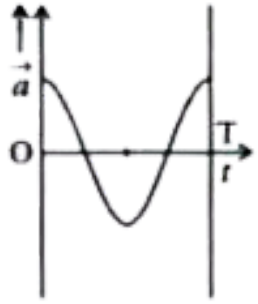
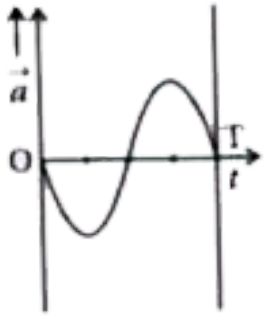
57. The oscillation of a body on a smooth horizontal surface is represented by the equation $x = A\cos\omega t$ where x = displacement at time t, $\omega =$ frequency of oscillation. Which of the following graphs shows the corrects variation of acceleration 'a' with time 't'.

A.



B.



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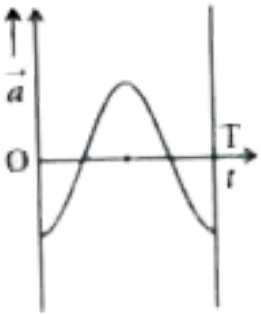
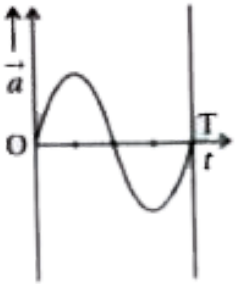


D.



Answer: C

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58. When two displacements represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed the motion is.....

A. not a simple harmonic motion.

B. simple harmonic with amplitude $\frac{a}{b}$

C. simple harmonic with amplitude $\sqrt{a^2 + b^2}$

D. simple harmonic motion with amplitude $\frac{(a+b)}{2}$

Answer: C

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59. A particle is executing SHM along a straight line. Its velocities at distance x_1 and x_2 form the mean position are v_1 and v_2, respectively. Its time period is.....

A. $2\pi\sqrt{\frac{x_1^2+x_2^2}{v_1^2+v_2^2}}$

B. $2\pi\sqrt{\frac{-x_1^2+x_2^2}{v_1^2-v_2^2}}$

C. $2\pi\sqrt{\frac{v_1^2+v_2^2}{x_1^2+x_2^2}}$

D. $2\pi\sqrt{\frac{v_1^2-v_2^2}{x_1^2-x_2^2}}$

Answer: B

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60. A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time period of vibration will be.....

A. $\frac{2\pi\beta}{\alpha}$

B. $\frac{\beta^2}{\alpha^2}$

C. $\frac{\alpha}{\beta}$

D. $\frac{\beta^2}{\alpha}$

Answer: A

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61. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass when the mass m is slightly pulled down and released, it oscillates with a time period of 3s. When the mass m is increased by 1 kg, the time period of oscillations becomes 5s. The value of m in kg is.....

A. $\frac{16}{9}$

B. $\frac{9}{16}$

C. $\frac{3}{4}$

D. $\frac{4}{3}$

Answer: B

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62. A spring of force constant k is cut into length 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''. That k' : k'' = ...

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63. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in second is.....

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64. A pendulum is hung from the rod of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is $20m/s^2$ at a distance of 5 m from the mean position. The period of oscillation is.....

A. $1s$

B. $2\pi s$

C. $2s$

D. πs

Answer: D

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65. A particle executes simple harmonic with an amplitude of 5 cm. When the particle is at 4 cm from the mean position the magnitude of its velocity in SI units is equal to that of its acceleration. Then, its periodic time in seconds is

A. $\frac{8\pi}{3}$

B. $\frac{4\pi}{3}$

C. $\frac{3}{8\pi}$

D. $\frac{7}{3\pi}$

Answer: A

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66. A cylindrical plastic bottle of negligible mass is filled with 310 ml of water and left floating in a pond with still water. If pressed downward slightly and released in starts performing simple harmonic motion at angular frequency ω. If the radius of the bottle is 2.5 cm then ω is close

A. $2.50 rad/s$

B. $3.75 rad/s$

C. $5.00 rad/s$

D. $1.25 rad/s$

Answer: C

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Section F Questions From Module Simple Questions

1. A particle executes simple harmonic motion with an amplitude A. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude form the equilibrium position is.....

A. $\frac{T}{2}$

B. $\frac{T}{4}$

C. $\frac{T}{8}$

D. $\frac{T}{12}$

Answer: D

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2. A spring of force constant k is cut into two parts such that length of one part is double to another part. What will be the force constant of larger part?

A. $\frac{2}{3}k$

B. $\frac{3}{2}k$

C. $3k$

D. $6k$

Answer: B

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3. What is the phase difference the velocity and acceleration of a particle executing SHM?

A. π

B. 0.707π

C. 0

D. 0.5π

Answer: D

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4. Two particle are oscillating along two close parallel straight lines side by side, with the same frequency and

amplitude. They pass each other, moving on opposite directions when their displacement is half of the amplitude. The mean positions of the two particles lie on a straight line perpendicular to the paths of the two particles. The phase difference is.....

A. 30°

B. 60°

C. 90°

D. 120°

Answer: D

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5. A horizontal platform with an object placed on it is executing SHM in the vertical direction. The amplitude of oscillation is $3.92 \times 10^{-3} m$. What must be the least period of these oscillations, so that the object is not detached from the platform?

A. $0.1256 s$

B. $0.1356 s$

C. $0.1456 s$

D. $0.1556 s$

Answer: A

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6. The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is.....

A. $42\ \%$

B. $10\ \%$

C. $11\ \%$

D. $21\ \%$

Answer: B

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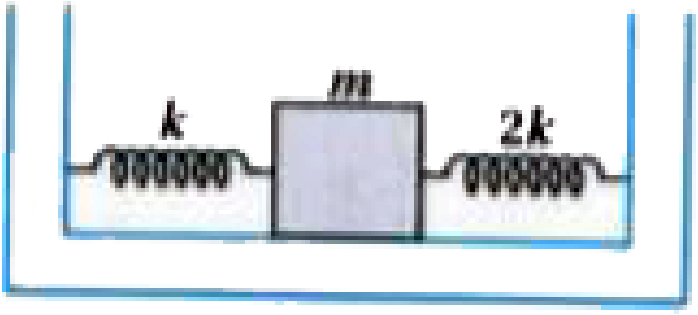
7. Two spring of force constants k and 2k are connected to a mass as shown in figure. The frequency of oscillation of the mass is.....



A. $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$

B. $\frac{1}{2\pi}\sqrt{\frac{2k}{m}}$

C. $\frac{1}{2\pi}\sqrt{\frac{3k}{m}}$

D. $\frac{1}{2\pi}\sqrt{\frac{m}{k}}$

Answer: C

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8. Two simple harmonic motions of angular frequency 100 and 1000 $rads^{-1}$ have the same displacement amplitude. The ratio of their maximum acceleration is.....

A. $1:10$

B. $1:10^2$

C. $1:10^3$

D. $1:10^4$

Answer: B

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9. A simple pendulum perform simple harmonic motion about $x = 0$ with an amplitude A and time period T. The speed of the pendulum at $x = \frac{A}{2}$ will be.....

A. $\frac{\pi A}{T}$

B. $\frac{3\pi^2 A}{T}$

C. $\frac{\pi A\sqrt{3}}{T}$

D. $\frac{\pi A\sqrt{3}}{2T}$

Answer: C

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10. The time period of mass suspended from a spring is T. If the spring is cut into four equal parts and the same

mass is suspended from one of the parts, then the new time period will be.....

A. $2T$

B. $\frac{T}{4}$

C. 2

D. $\frac{T}{2}$

Answer: D

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11. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is..... (where E is total (mechanical) energy)

A. $\frac{1}{2}E$

B. $\frac{2}{3}E$

C. $\frac{1}{8}E$

D. $\frac{1}{4}E$

Answer: D

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12. A particle executes simple harmonic motion with frequency f. The frequency of its potential and kinetic energy is.....

A. $\frac{f}{2}$

B. f

C. $2f$

D. $4f$

Answer: C

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13. A particle executing simple harmonic motion of amplitude 5 cm has maximum speed of $31.4cm/s$. The frequency of its oscillation is.....

A. 4 Hz

B. 3 Hz

C. 2 Hz

D. 1 Hz

Answer: D

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14. If maximum velocity of a particle executes simple harmonic motion v_m then its average velocity will be.....

A. $\frac{\pi}{2}v_m$

B. $\frac{2}{\pi}v_m$

C. $\frac{\pi}{4}v_m$

D. $\frac{v_m}{\sqrt{2}}$

Answer: B

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15. Two pendulums of lengths 100 cm and 121 cm suspended side by side. A suspended bobs suspended at its end stretched and leave together. After how many minimum oscillations of big pendulum, both are in same phase?

A. 11

B. 10

C. 21

D. 20

Answer: B

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16. A particle performs simple harmonic motion with speed v and acceleration a. Which of following statement is true ?

A. Velocity is maximum, whereas acceleration is zero.

B. When velocity is maximum, its acceleration is maximum

C. For any value of v, the value of a is zero

D. When v is zero, a is also zero.

Answer: A

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17. Find the maximum velocity of a SHM particle having amplitude 'A' and periodic time T.

A. $\frac{4A}{T}$

B. $\frac{2A}{T}$

C. $2\pi\sqrt{\frac{A}{T}}$

D. $\frac{2\pi A}{T}$

Answer: D

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18. The amplitude of a damped oscillator becomes half in one minute. The amplitude after three minutes will be $\frac{1}{x}$ times the original, then find the value of x.

A. 2×3

B. 2^3

C. 3^2

D. 3×2^2

Answer: B

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19. The period of oscillation of a mass m suspended from a spring of negligible mass is T. If along with it another mass m is also suspended the period of oscillation will now be.....

A. T

B. $\frac{T}{\sqrt{2}}$

C. $2T$

D. $\sqrt{2}T$

Answer: D

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20. The displacement of a SHM particle is $y = 3\sin\omega t + 4\cos\omega t$ then its amplitude will be.....

A. 7

B. 1

C. 5

D. 12

Answer: C

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Question Paper Section A

1. What is time period of a simple pendulum in a freely falling lift ?

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2. Obtain the formula of mechanical energy of damped oscillation for $b < < \sqrt{km}$.

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3. If $\frac{d^2y}{dt^2} + 4 = 0$ is the difference equation of SHM then period of oscillation is.....second.

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4. A particle oscillate according to $y = 7\sin 0.5\pi t$. Time taken by particle from equilibrium position to maximum displacement is.....

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5. Write the differential equation of natural oscillations.

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6. If for damped oscillations if $\frac{k}{m} = \left(\frac{b}{2m}\right)^2$, then is the oscillation exist?

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Question Paper Section B

1. Explain that simple harmonic motion is the projection of uniform circular motion on a diameter of the reference circle and obtain the velocity and acceleration.

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2. What is simple pendulum? Deduce an expression for the time period of simple pendulum.

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Question Paper Section C

1. A spring balance has a scale that reads from 0 to 50 kg. The length of the scale is 20 cm. A body suspended from this balance, when displaced and released, oscillates with a period of 0.6 s. What is the weight of the body ?

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2. 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 ?

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Question Paper Section D

1. A cylindrical piece of cork of density of base area A and height h floats in a liquid of density p_l. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period

$$T = 2\pi\sqrt{\frac{hp}{p_1 g}}$$

where p is the density of cork. (Ignore damping due to viscosity of the liquid).

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