PHYSICS

BOOKS - CHETANA PUBLICATION

Oscillations.

Examples

1. Explain the term 'periodic motion'.

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2. State examples of periodic motion.

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3. Explain the term 'oscillatory motion'.

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4. State examples of S.H.M

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5. Define linear simple harmonic motion.

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6. State examples of S.H.M

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7. Define force constant? State its units and dimension.

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8. Define restoring force. Explain the concept of a restoring force in a spring mass oscillator.

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9. From the differential equation of linear S.H.M. obtain expressions for acceleration, velocity and displacement of particle performing S.H.M.

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10. A particle performs S.H.M. of period 4 seconds and amplitude 4 cm. If initially the particle is at positive extremity, how much time will it take to cover a distance of 1 cm from the extreme position?

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11. A particle performing linear S.H.M. with period 6 second ,is at the positive extreme position at t = 0. The particle is found to be at

a distance of 3 cm from the extreme position at time t = 7 sec, before reaching the mean position. Find the amplitude of the S.H.M.

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12. The speeds of a particle performing linear S.H.M are 8 cm/s and 6 cm/s at a respective displacements of 6 cm and 8 cm. Find its period and amplitude.

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13. The maximum velocity of a particle performing S.H.M is 6.28 $\frac{cm}{s}$. If the length of the path is 8 cm. Calculate its period.

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14. The maximum speed of a particle performing linear S.H.M is 0.08 $\frac{cm}{s}$. If its maximum acceleration is $0.32\frac{m}{s^2}$. Calculate the period and amplitude.

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15. At what distance from the mean position is the speed of the particle, performing S.H.M half its maximum speed. Given path length of S.H.M is10 cm .

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16. A needle of a sewing machine moves along a path of amplitude 4 cm with frequency 5 Hz. Find itsacceleration $\frac{1}{30}$ second after it crossed its mean position.

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17. At what distance from the mean position is the KE of a particle performing S.H.M of amplitude 8 cm three times its PE.

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18. A particle performing linear S.H.M. of period 2π seconds, about the mean position O, is observed to have a speed at $b\sqrt{3}m/s$, when at a distance of b (metre) from O. If the

particle is moving away from O at that instant , find the time required by the particle to travel a a further disatnce b .

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19. Explain the combination of springs in series. Derive expression for the same.

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20. Explain the combination of springs in parallel Derive expression for the same.

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21. The period of oscillation of a body of mass m_1 suspended from a lightspring is T. When the body of mass m_2, is tied to the first body and the system is made to oscillate, the period is 2T. Compare the masses m_1 and m_2.

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22. Show that the average speed of a particle performing S.H.M. in one oscillation is $\frac{2}{\pi}$ max $speed.$

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23. Show that the average speed of a particle performing S.H.M. in one oscillation is $\frac{2}{\pi}$ max $speed.$

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24. With the help of proper diagrams Explain Projection of velocity :

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25. With the help of proper diagrams ExplainProjection of acceleration

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26. Define the following terms periodic motion

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27. Define the following term - oscillation

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28. Define the following terms amplitude of S.H.M.

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29. Define the following terms period of S.H.M.

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30. Define the following terms frequency of S.H.M.

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31. Define the following terms phase of S.H.M.

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32. Define the following terms epoch of S.H.M.

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33. Explain the special cases pf phase of S.H.M

when $\theta = 0^\circ, 180^\circ, 90^\circ, 270^\circ$

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34. Describe the state of oscillation, if the phase angle is 1110°

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35. While completing its third oscillation, during linear S.H.M, a particle is at `-frac (sqrt3) (2)A, heading to the mean position. Determine the phase angle.

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36. Derive an expression for time period of a particle performing S.H.M.

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37. Particle performing S.H.M. starts from mean position. Plot a graph of displacement, velocity and acceleration.

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38. Obtain expressions for Kinetic Energy, Potential Energy and Total Energy of a particle performs linear S.H.M.

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39. Show that total energy of the particle performing linear S.H.M. is constant.

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40. Show that total energy of the particle performing linear S.H.M. is constant.

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41. Show that Total Energy of a particle can be expressed as $TE \propto n^2$

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42. The potential Energy of a particle performing linear S.H.M is $0.1nx2$ joule. If mass of the particle is 20 g, Find the frequency of S.H.M.

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43. The total energy of a body of mass2kg. performing S.H.M is 40 J. Find the speed while crossing the centre of the path.

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44. Discuss analytically, the composition of two S.H.M.S of same period and parallel to each other. Find the resultant amplitude when phase difference is $\frac{\pi}{2}$

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45. Two parallel S.H.M's represented by

x_1= 5sin $\left[4\pi t + \frac{\pi}{3}\right]$ cm

x_2 = 3sin [4pi t _+frac (pi)(4)]cm are

superposed on a particle.Determine the amplitude and epoch of the resultant S.H.M.

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46. Define a Practical Simple Pendulum and an Ideal Simple Pendulum.

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47. Show that under certain conditions , a simple pendulum performs linear S.H.M.

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48. Deduce the expression for period of simple pendulum . Hence state the factors on which its period depends.

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49. The period of oscillations of a simple pendulum increses by 10%, when its length is

increased by 21 cm. Find its initial length and initial period.

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50. A simple pendulum performs S.H.M of period 4 seconds. How much time after crossing the mean position , will the displacement of the bob be one third of its amplitude.

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51. A simple pendulum of length 100 cm performs S.H.M. Find the restoring force acting on its bob of mass 50 g when the displacement from the mean position is 3 cm.

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52. Find the change in length of a second 's pendulum , if the acceleration due to gravity at the place changes from $9.75\frac{m}{s^2}$ to $9.8\frac{m}{s^2}$.

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53. State the laws of a simple pendulum. What is seconds pendulum? Calculate its length.

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54. In summer season, pendulum clock is regulated as a second's pendulum and it keeps the correct time. During winter, the length of the pendulum decreases by 1%. How much will the clock gain or loose in one day. $\left[g = 9.8\frac{m}{s^2}\right]$

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55. Show that motion of a damped harmonic oscillator is S.H.M. Hence derive the formula for time period of damped oscillations.

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56. Derive an expression for the time period of a magnet vibrating in a uniform magnetic field.

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57. A bar magnet of mass 120 g, in the form of a rectangular parallelopiped has dimensions l = 40 mm, b = 10 mm and h = 80 mm. With the dimensions h vertical, the magnet performs angular oscillations, in the plane of a magnetic field with period πs. If its magnetic moment is $3.4 Am^2$, determine the influencing magnetic field.

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58. Two magnets with the same dimensions and mass, but of magnetic moments $\mu_1 = 100Am^2$and $\mu_2 = 50Am^2$are jointly suspended in the earth's magneticfield. So as to perform angular oscillations in a horizontal plane.When their like poles are joinedtogether the period of their angular S.H.M is 5s. Find the period of angular S.H.M, when theirunlike poles are joined together.

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59. A 20 cm wide thin circular disc of mass 200 g is suspended to a rigid support, from a thin metallic string. By holding the rim of the disc, the string is twisted through 60° and released.It now performs angular oscillations of period 1 second.Calculate the maximum restoring torque generated in the string under undamped condition. $\left(\pi^3 \approx 31\right)$

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60. Find the number of oscillations performed per minute by a magnet vibrating in the plane of a uniform field of $1.6 \times 10^{-5} \frac{wb}{m^2}$. The magnet has a moment of inertia $3 \times 10^{-6} \frac{kg}{m^2}$ and magneticmoment$3Am^2$.

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61. A wooden block of mass m is kept on a piston that can perform vertical vibrations of adjustable frequency and amplitude. During

vibrations, we don't want the block to leave the contact with the piston How much maximum frequency is possible if the amplitude of vibrations is restricted to 25 cm ? In this case , how much is the energy per unit mass of the block ? $\left(g \approx 10 m s^{-2}\right)$

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62. Distinguish between conical pendulum and simple pendulum .

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Exercise

1. Two parallel S.H.M's are given by $x_1 = 20\sin 8\pi t$ and $x_2 = 10\sin\left[8\pi t + \frac{\pi}{6}\right]$. Find the resultant amplitude and phase.

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2. A bar magnet is vibrating in a uniform magnetic induction, the magnitude of which can be changed, its frequency is found to

reduce to quarter of the original frequency, when the magnetic induction changes to $1.25 \times 10^{-5} \quad \frac{wb}{m^2}$. Calculate the original magnetic induction.

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3. A bar magnet is vibrating in a uniform magnetic induction, the magnitude of which can be changed. If the frequency is found to reduce to half of its original frequency when the magnetic induction changes to

1.25×10^{-5} $\frac{wb}{m2}$. Calculate the original magnetic induction.

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4. A bar magnet ,freely suspended in a magnetic induction H makes 20 oscillates per minute. When another magnet X is brought near it, the number of oscillations are found to be 10 per minute. What is the influencing induction of magnet X, in terms of H (where H >X)

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5. A bar magnet of moment $2Am^2$ and having a moment of inertia $10^{-6}kg - m^2$ about a transverse axis passing through its centre is performing S.H.M in a magnetic induction $0.8 \times 10^{-(5)} \frac{wb}{m^2}$. Calculate the period of the bar magnet.

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6. The period of a simple pendulum is found to increase by $50\,\%$, when the length of the pendulum is increased by 0.6 m. Calculate the initial length and initial period of oscillation at a place where $g = 9.8\frac{m}{s^2}$

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7. The maximum velocity of a particle performing S.H.M is 6.28 $\frac{cm}{s}$. If the length of the path is 8 cm. Calculate its period.

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8. Determine the length of a seconds pendulum at a place, where the acceleration due to gravity is $9.77\frac{m}{s^2}$

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9. A particle performs S.H.M of amplitude 10 cm. Its maximum velocity during oscillations is $100(cm)(s)$ What isits displacement, when the velocity is $60(cm)(s)$.

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10. A particleis performinglinearS.H.Mof amplitude a. What fraction of the total energy is kinetic, if the displacement is half of the amplitude?

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11. A spring of a negligible mass is stretched by a force of 20 g wt through a distance of 5 cms.

A total mass of 50 g. is attached to the spring and set into oscillations. Find the periodic time of oscillation. Given $g = 9.8\frac{m}{s^2}$

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12. A particle executing S.H.M. has velocities v_1 and v_2 when at distances x_1 and x_2 from the centre of the path. Show that the time period given by

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13. Any motion which repeats itself after a definiteinterval of time is called a _____motion.

A. Linear

B. Rotational

C. Periodic

D. Translational

Answer:

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14. If the force constant is 10 towards negative X-axis , a body of mass 0.4 kg is displaced by 80 m in 4 sec its acceleration is

A. $(-2)\frac{m}{s}$

B. $(4)\frac{m}{s}$

C. $(-6)\frac{m}{s}$

D. $(-10)\frac{m}{s}$

A. $(-2)\frac{m}{s}$

B. $(4)\frac{m}{s}$

C. $(-6)\frac{m}{s}$

D. $(-10)\frac{m}{s}2$

Answer:

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15. A particle of mass 200 gm, performs S.H.M ofamplitude 0.1 m and period 3.14 sec.. Its PE when it is at a distance of 0.03 m from the mean position is

A. $1.64 \times 10^{-4} J$

B. $2.64 \times 10^{-4} J$

C. $3.64 \times 10^{-4} J$

D. $4.64 \times 10^{-4} J$

Answer:

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16. A particle of mass 200 gm, performs S.H.M ofamplitude 0.1 m and period 3.14 sec.. Its PE when it is at a distance of 0.03 m from the mean position is

A. $1.64 \times 10^4 J$

B. $2.64 \times 10^{-4} J$

C. $3.64 \times 10^{-4} J$

D. $4.64 \times 10^{-4} J$

Answer:

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17. For 'n' no of (massless) springs in series, the effective value of the spring constant is

A. $k_s = \frac{k}{n}$

B. $k_s = \frac{n}{k}$

C. $k_s = k_n$

D. $k_s = \frac{1}{k_n}$

Answer:

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18. For 'n' no of (massless) springs in series, the effective value of the spring constant is

A. $k_p = \frac{k}{m}$

B. $k_p = \frac{m}{k}$

C. $k_p = mk$

D. $k_p = \frac{1}{k_m}$

Answer:

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19. The state of oscillation of a particle, that gives displacement and direction at that instant is called _____ of S.H.M.

A. velocity

B. differential equation

C. acceleration

D. phase

Answer:

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20. When we graphically represent velocity from the mean position at frac(T)(2) its value is

A. $(-A_\omega)$

B. $A\omega$

C. A

D. (-A)

Answer:

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21. When we graphically represent acceleration from the extreme position at frac(3T)(4) its value is

A. 0

B. $(A_\omega \_ 2)$

C. $(- A_\omega \_ 2)$

D. $A\omega$

Answer:

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22. The expression in S.H.M [2pi^2 frac(mA^2) (T^2)] represents its

A. Kinetic energy

B. Total energy

C. Potential energy

D. Translation energy

Answer:

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23. The total energy of a particle of mass $200g$, performing S.h.m.is $10^{-2}J$. Find its maximum velocity and period if the amplitude is 7 cm.

A. $0.2162\frac{m(s)}{}$

B. $0.3162\frac{m(s)}{}$

C. $0.4162\frac{m(s)}{}$

D. $0.5162\frac{m(s)}{}$

Answer:

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24. A simple pendulum, whose time period is _____ seconds, is called a seconds pendulum.

A. 1second

B. 2second

C. 3second

D. 4second

Answer:

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25. The length of a seconds pendulum at a place where g = 9.8 frac(m)(s^2)` is 0.994m If the amplitude is 0.15m, its maximum velocity is

A. $0.371\frac{m}{s}$

B. $0.471\frac{m}{s}$

C. $0.571\frac{m}{s}$

D. $0.671\frac{m}{s}$

Answer:

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26. A bar magnet is vibrating in a uniform magnetic induction, the magnitude of which can be changed. If the frequency is found to

reduce to half of its original frequency when the magnetic induction changes to $1.25 \times 10^{-5} \quad \frac{wb}{m2}$. Calculate the original magnetic induction.

A. $5 \times 10^{-5} a(wb)\left(m^2\right)$.

B. $10 \times 10^{-5} a(wb)\left(m^2\right)$.

C. $15 \times 10^{-5} a(wb)\left(m^2\right)$.

D. 120xx10^(-5)fra(wb)(m^2)`.

Answer:

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27. At what distance, is the KE of a particle, performing S.H.M of amplitude 10 cms is three times its PE

A. 5 cms

B. 10 cms

C. 15 cms

D. 20 cms

Answer:

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28. The maximum velocity of a particle performing a linear S.H.M is $0.16\frac{m}{s}$, if its maximum acceleration is $0.64(m)\left(s^2\right)$ it period is

A. 1.55 sec

B. 1.57 sec

C. 1.59 sec

D. 1.60 sec

Answer:

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29. The maximum velocity of a particle performing a linear S.H.M is $0.16(m)(s)$, if its maximum acceleration is `0.64(m)(s^2) its amplitude is

A. 0.02 m

B. 0.04 m

C. 0.06 m

D. 0.08 m

Answer:

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30. A particle performs linear S.H.M. starting from the mean position. Its amplitude is A and time period is T. At the instance when its speed is half the maximum speed , its displacement x is

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

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

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

D. $\frac{)}{1}(\sqrt{2})$

Answer:

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31. A body of mass 1 kg is performing linear S.H.M. its displacement x (cm) at t (second) is given by $x = 6\sin\left(100t + \frac{\pi}{4}\right)$.Maximum kinetic energy of the body is

A. 36 J

B. 9 J

C. 27 J

D. 18 J

Answer:

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32. The length of second 's pendulum on the surface of earth is nearly 1 m . Its length on the surface of moon should be [Given :

acceleration due to gravity (g) on moon is $\frac{1}{6}th$ of that on the earth 's surface]

A. `frac(1)(6) m

B. 6m

C. $\frac{1}{36}m$

D. $\frac{1}{\sqrt{6}}m$

Answer:

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33. Two identical springs of constant k are connected , first in series and then in parallel. A matal block of mass m is suspended from their combination. The ratio of their frequencies of vertical oscillations will be in a ratio

A. $1:4$

B. $1:2$

C. $2:1$

D. $4:1$

Answer:

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34. The period of angular S.H.M when their unlike poles are joined together is

A. $2\pi\sqrt{\frac{I}{(\mu_1+\mu_2)B_H}}$

B. $2\pi\sqrt{\frac{I}{(\mu_1-\mu_2)B_H}}$

C. `2pi sqrtfrac (I)(mu_B)

D. $2\pi\sqrt{\frac{\mu_B}{I}}$

Answer:

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35. The differential equation $m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + k(x) = 0$ represent

A. Linear S.H.M

B. Angular S.H.M

C. Free Oscillation

D. Damped Oscillations

Answer:

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36. A bar magnet ,freely suspended in a magnetic induction H makes 20 oscillates per minute. When another magnet X is brought near it, the number of oscillations are found to be 10 per minute. What is the influencing induction of magnet X, in terms of H (where H >X)

A. X=frac(2)(3)H

B. X=frac(3)(2)H

C. X=frac(3)(4)H

D. X=frac(4)(3)H

Answer:

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37. A bar magnet of moment $2Am^2$ and having a moment of inertia $10^{-6}kg - m^2$ about a transverse axis passing through its centre is

performing S.H.M in a magnetic induction $0.8 \times 10^{-(5)} \frac{wb}{m^2}$. Calculate the period of the bar magnet.

A. 1.37 sec

B. 1.47 sec

C. 1.57 sec

D. 1.67 sec

Answer:

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38. A simple pendulum of length 1 m has a mass of 10 gm and oscillates freely with an amplitude of 2 cm. The potential energy at the extreme point $\left(g = 980\frac{cm}{s^2}\right)$ is

A. 192 ergs

B. 194 ergs

C. 196 ergs

D. 198 ergs

Answer:

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39. The maximum velocity of a particle performing S.H.M is 6.28 $\frac{cm}{s}$. If the length of the path is 8 cm. Calculate its period.

A. 2 sec

B. 4 sec

C. 6 sec

D. 8 sec

Answer:

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40. The total energy of a particle of mass 200 gm. performing S.H.M is $10^{-3}J$, if the amplitude is 5cm. The maximum velocity is

A. $10^{-1}\frac{m}{s}$

B. $10^{-2}\frac{m}{s}$

C. $10^{-3}\frac{m}{s}$

D. $10^{-4}\frac{m}{s}$

Answer:

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41. The total energy of a particle of mass 200 gm. performing S.H.M is $10^{-3}J$, if the amplitude is 5cm. The period is

A. 3.14 sec

B. 6.28 sec

C. 3 sec

D. 6 sec

Answer:

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42. When the displacement in S.H.M is one third of the amplitude, the fraction of the potential energy to total energy is

A. $\frac{7}{9}$

B. $\frac{8}{9}$

C. $\frac{9}{7}$

D. $\frac{9}{8}$

Answer:

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43. When the displacement in S.H.M is one third of the amplitude, the fraction of the potential energy to total energy is

A. $\frac{1}{3}$

B. $\frac{1}{6}$

C. $\frac{1}{9}$

D. $\frac{1}{5}$

Answer:

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44. A particle performs SHM of amplitude 10 cm. Its maximum velocity during oscillation is 100 cm/s. What is its displacement, when the velocity is 60 cm/s.

A. 2 cm

B. 4 cm

C. 6 cm

D. 8 cm

Answer:

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45. A particle is performing linear S.H.M of amplitude a. What fraction of the total energy is kinetic, given the displacement is half the amplitude

A. $\frac{KE}{TE} = \frac{1}{2}$

B. $\frac{KE}{TE} = \frac{1}{4}$

C. $\frac{KE}{TE} = \frac{3}{4}$

D. $\frac{KE}{TE} = \frac{3}{5}$

Answer:

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46. The period of a simple pendulum of infinite length is

A. $T = \sqrt{2\pi}\frac{R}{g}$

B. $T = \sqrt{2\pi}\frac{2R}{g}$

C. $T = \sqrt{2\pi}\frac{R}{2g}$

D. $T = \infty$

Answer:

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47. A particle moves such that its acceleration a is given by a = (-b)x, Then, the period of oscillation is

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

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

C. $2\pi b$

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

Answer:

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48. The average speed of a particle in S.H.M of amplitude A and angular velocity (ω) is

A. zero

B. $\frac{A\omega}{\pi}$

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

D. $\frac{A\omega}{2}$

Answer:

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49. The velocity of the particle performing simple harmonic motion, when it passes through the mean position is

A. zero

B. maximum

C. Infinity

D. minimum

Answer:

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50. The acceleration of a particle executing S.H.M, when it is at its mean position is

A. zero

B. maximum

C. varies

D. Infinity

Answer:

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51. A particle is executing a simple harmonic motion. Its maximum acceleration is $\propto$ 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. $\frac{\beta^2}{\alpha}$

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

Answer:

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52. If the oscillations are highly damped the amplitude of the oscillations

A. increases with time

B. decreases in time

C. first increases, then decreases

D. remains constant with time

Answer:

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53. The average speed of a particle in S.H.M of amplitude A and angular velocity (ω) is

A. zero

B. $\frac{A\omega}{\pi}$

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

D. $\frac{A\omega}{2}$

Answer:

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54. Which one of the following is a simple harmonic motion?

A. wave moving through a fixed string at both ends.

B. Earth spinning about the axis.

C. Ball bouncing between two rigid vertical walls.

D. Particle moving in a circle with uniform speed.

Answer:

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55. The period of a simple pendulum of infinite length is

A. $T = 2\pi\sqrt{\frac{R}{g}}$

B. $T = 2\pi\sqrt{\frac{2R}{g}}$

C. $T = 2\pi\sqrt{\frac{R}{2g}}$

D. $T = \infty$

Answer:

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56. A particle moves such that its acceleration a is given by a = (-b)x, Then, the period of oscillation is

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

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

C. $2\pi b$

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

Answer:

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57. Define linear simple harmonic motion.

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58. State any two laws of simple pendulum.

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59. Define frequency of S.H.M and write the formula.

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60. What is meant by damped oscillation?

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61. A simple pendulum of length 100 cm performs S.H.M. Find the restoring force acting on its bob of mass 50 g when the displacement from the mean position is 3cm.

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62. A body of mass 0.2 kg performs linear S.H.M. It experiences a restoring force of 0.2 N, when its displacement from the mean position is 4 cm. Determine force constant.

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63. A body of mass 0.2 kg performs linear S.H.M. It experiences a restoring force of 0.2 N, when its displacement from the mean position is 4 cm. Determine period of S.H.M when the displacement from the mean position is 1cm.

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64. Two parallel S.H.M's are given by $x_1 = 20 \sin 8\pi t$ and $x_2 = 10 \sin\left[8\pi t + \frac{\pi}{6}\right]$. Find the resultant amplitude and phase.

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65. A needle of a sewing machine moves along a path of amplitude 4 cm with frequency 5 Hz.

Find itsacceleration $\frac{1}{30}$ second after it crossed its mean position.

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66. A particle performs SHM of amplitude 10 cm. Its maximum velocity during oscillation is 100 cm/s. What is its displacement, when the velocity is 60 cm/s.

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67. The period of a simple pendulum is found to increase by $50\,\%$, when the length of the pendulum is increased by 0.6 m. Calculate the initial length and initial period of oscillation at a place where $g = 9.8\frac{m}{s^2}$

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68. The speeds of a particle performing linear S.H.M are 8 cm/s and 6 cm/s at a respective

displacements of 6 cm and 8 cm. Find its period and amplitude.

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69. Derive an expression for the time period of a magnet vibrating in a uniform magnetic field.

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