PHYSICS

BOOKS - MAXIMUM PUBLICATION

OSCILLATION

Example

1. Show that linear S.H.M. is the projection of uniform circular motion on any diameter.

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2. Derive a differential equation for a damped harmonic oscillation.

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Exercise

1. Fill in the blanks:

A girl is swinging on a swing in a sitting

position. When she stands up, the period of the swing will.....

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2. A particle executes a simple harmonic motion with a frequency f. What is the frequency with which its kinetic energy oscillates?

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3. Can a simple pendulum vibrate at centre of earth?

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4. A glass window may be broken by a distant explosion. Why?

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5. A simple pendulum is transferred from earth to moon. Will it grow faster or slower?

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6. A girl is swinging in sitting position. What shall be the effect of frequency of oscillation if she stands up?

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7. A girl is swinging a swing in sitting position. What shall be the effect of frequency of oscillation if another girl sits gently by her side?

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8. A student is advised to study the variation of period of oscillation with the length of a simple pendulum in the laboratory. Accordingly he recorded the period of

oscillation for different lengths of the pendulum.

If he plots a graph between the length and period of oscillation ,what will be the shape of the graph?

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9. A student is advised to study the variation of period of oscillation with the length of a simple pendulum in the laboratory. Accordingly he recorded the period of

oscillation for different lengths of the pendulum.

How would you determine the value of acceleration due to gravity using $L - T^2$ graph?

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10. A simple pendulum has a bob of mass m is suspended from the ceiling of a lift which is lying at the ground floor of a multistoried building.

Find the period of oscillation of pendulum when the lift is stationary.

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11. A simple pendulum has a bob of mass m is suspended from the ceiling of a lift which is lying at the ground floor of a multistoried building.

What is the tension of the string of the pendulum when it is ascending with an acceleration 'a'?

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12. A simple pendulum has a bob of mass m is suspended from the ceiling of a lift which is lying at the ground floor of a multistoried building.

What is the period of oscillation of the pendulum while the lift is ascending?

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13. A body tied a spherical pot with a string and suspended it on a clamp. He then filled it with water. Length of the string if $90cm$ and diameter of the pot is $20cm$. The pot is slightly displaced to one side and leave it to oscillate. Considering the above example as a simple pendulum ($g = 9.8ms^{-2}$)

What is the length of the pendulum?

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14. A body tied a spherical pot with a string and suspended it on a clamp. He then filled it with water. Length of the string if $90cm$ and diameter of the pot is $20cm$. The pot is slightly displaced to one side and leave it to oscillate. Considering the above example as a simple pendulum ($g = 9.8ms^{-2}$)

Calculate the period of oscillation of the pendulum.

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15. Motion repeated at regular intervals of time is called periodic. Explain the simple harmonic motion with a figure.

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16. A particle executes a simple harmonic motion with a period 2 seconds, starting from its equilibrium at time $t = 0$. Find the minimum time in which it is displaced by half the amplitude.

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17. A spring of spring constant 'k' is used to suspend a mass 'm' at its free end while the other end of the spring is rigidly fixed.

If the mass is slightly depressed and released, then name the motion of the mass.

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18. The motions that repeat themselves are called periodic motions but for a simple harmonic motion, the force must be

proportional to the displacement and it is directed towards the centre of motion. Write the expression for a period of oscillation of a loaded spring.

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19. A spring of spring constant 'k' is used to suspend a mass 'm' at its free end while the other end of the spring is rigidly fixed.

If this system is taken into outer space then what happens to its period?Why?

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20. Motion repeated at regular intervals of time is called periodic. Explain the simple harmonic motion with a figure.

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21. A simple harmonic motion is represented by $x(t) = A\cos\omega t$A SHM has ampliitude A and the time period T, what is the time take to travel from $x = A$ to $x = \frac{A}{2}$

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22. Define simple harmonic motion for a particle moving in a straight line.

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23. Use your definition to explain how simple harmonic motion can be represented by the equation $y = a \sin \omega t$

Show that the above equation is dimensionally correct

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24. A mechanical system is known to perform simple harmonic motion. What quantity must be measured in order to determine frequency for the system?

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25. A particle executes simple harmonic motion according to the equation $x = 5\sin\left(\frac{2\pi}{3}t\right)$ Find the period of the oscillation

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26. A particle executes simple harmonic motion according to the equation $x = 5\sin\left(\frac{2\pi}{3}t\right)$ what is the minimum time required for the particle to move between two

points 2.5 cm on either side of the mean position?

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27. a mass m is suspended at one end of a spring and the other end of the spring is fimly fixed on the celling. if the mass is slightly depressed and released it will execute oscillation. write down the expression for the frequency of oscillation of the mass.

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28. a mass m is suspended at one end of a spring and the other end of the spring is fimly fixed on the celling. if the mass is slightly depressed and released it will execute oscillation. If the spring is cut into two equal halves and one half of the spring is used to suspend the same mass then obtain an expression for the ratio of periods of oscillation in two cases.

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29. a mass m is suspended at one end of a spring and the other end of the spring is fimly fixed on the celling. if the mass is slightly depressed and released it will execute oscillation. if this system is completely immersed in water then what happens to the oscillation?

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30. Motion repeated at regular intervals of time is called periodic. Explain the simple

harmonic motion with a figure.

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31. Starting from the mean position, a body oscillates simple harmonically with an amplitude of $2m$ and a period of $2s$. draw the variation of displacement with time for the above motion.

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32. starting from the mean position a body oscillates simple harmonically with an amplitude of $2m$ and a period of $2s$. after what time will its kinetic energy be $75\,\%$ of the total energy?

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33. What do you mean by spring constant?

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34. A spring of spring constant 'k' is used to suspend a mass 'm' at its free end while the other end of the spring is rigidly fixed.

Write down the expression for the period of oscillation of the mass .

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35. A particle executes simple harmonic motion according to the equation $x = 5\sin\left(\frac{2\pi}{3}t\right)$ Find the period of the oscillation

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36. A particle executes simple harmonic motion according to the equation. $x = 5\sin\left(\frac{2\pi}{3}t\right)$ write an expression for velocity and acceleration of the above particle.

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37. Arrive the differential equation of SHM.

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38. What do you mean by a seconds pendulum?

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39. SHM is a type of motion in which both speed and acceleration change continuously. which of the following condition is sufficient for SHM? (i) $a = ky$, (ii) $a = -ky$,(iii)$a = ky^2$

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40. SHM is a type of motion in which both speed and acceleration change continuously. draw a graph of SHM between displacement-time

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41. SHM is a type of motion in which both speed and acceleration change continuously draw a graph of SHM between speed-time

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42. SHM is a type of motion in which both speed and acceleration change continuously. Draw a graph of SHM between acceleration-time

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43. Is oscillation of a mass suspended by a spring is simple harmonic?

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44. A spring of spring constant 'k' is used to suspend a mass 'm' at its free end while the other end of the spring is rigidly fixed.

Write down the expression for the period of oscillation of the mass .

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45. There are two springs. One delicate and another stiffer. Same mass m is attached to

both. For which spring the frequency of oscillation will be more?

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46. two unequal springs of same material are loaded with same load which one will have large value of time period?

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47. What is the time period of a second's pendulum?

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48. Deduce an expression for the period of oscillation of a simple pendulum.

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49. Which of the following condition is sufficient for the simple harmonic motion? Where 'a -acceleration y-displacement

A. $a = \omega y$

B. $a = \omega y^2$

C. $a = -\omega y$

D. $a = -\omega^2 y$

Answer: A

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50. Show that linear S.H.M. is the projection of uniform circular motion on any diameter.

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51. Represent graphically the variations of potential energy, kinetic energy and total energy as a function of position 'y' for a simple harmonic oscillator. Explain the graph.

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52. The spring has a scale that reads from zero to $30kg$. The length of the scale is$30cm$. Calculate the force constant K.

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53. The spring balance has a scale that reads from zero to $30kg$. The length of the scale is $30cm$. If the period of oscillation is $1\,\text{sec}$. Calculate mass of the body attached to the spring.

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54. If a spring is cut into two halves. What is the force constant of each half?

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55. Which of the following examples represent periodic motion ?

A. A swimmer completing one (return) trip from one bank of a river to the other

and back.

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

C. A hydrogen molecule rotating about its centre of mass.

D. An arrow released from a bow.

Answer: A::B::C::D

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

A. $a = 0.7x$

B. $a = 200x^2$

C. $a = 10x$

D. $a = 100x^2$

Answer: C

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57. A spring having spring constant $1200Nm^{-1}$ is mounted on a horizontal table as shown in figure. A mass of $3kg$ is attached to the free end of the spring. The mass is the pulled sideways to a distance of $2.0cm$ and released. Determine the frequency of oscillations.

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58. A spring having spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in figure. A mass of$3kg$ is attached to the free end of the spring. The mass is the pulled sideways to a distance of $2.0cm$ and released. Determine maximum acceleration of the mass.

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59. A spring having spring constant $1200 Nm^{-1}$ is mounted on a horizontal table as shown in figure. A mass of$3kg$ is attached to the free end of the spring. The mass is the pulled sideways to a distance of $2.0cm$ and released. Determine the maximum speed of the mass.

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

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61. A circular disc of mass $10kg$ is suspended by a wire attached to its centre. The wire is twisted by rotating the disc and released. The

perod of torsional oscillations is found to be $1.5s$. The radius of the disc is $15cm$. Determine the torsional spring constant of the wire. (Torsional spring constant α is defined by the relation $J = -\alpha\theta$, where J is the restoring couple and θ the angle of twist).

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62. The motions that repeat themselves are called periodic motions but for a simple harmonic motion, the force must be

proportional to the displacement and it is directed towards the centre of motion. Write an example for a periodic motion that is not simple harmonic.

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63. The motions that repeat themselves are called periodic motions but for a simple harmonic motion, the force must be proportional to the displacement and it is directed towards the centre of motion. Write

the expression for a period of oscillation of a loaded spring.

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64. Deduce an expression for the period of oscillation of a simple pendulum.

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65. The motion that repeat themselves are called periodic motions but for a simple

harmonic motion, the force must be proportional to the displacement and it is directed towards the centre of motion. A particle executes a SHM of amplitude 'a'. At what distance from the mean position is its kinetic energy equal to its potential energy?

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66. A particle executes a SHM of amplitude 'a'. At what point is its speed half the maximum speed?

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67. The amplitude of a simple harmonic oscillation is doubled. What change will you observe in the following physical quantities of the oscillator? Period.

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68. The amplitude of a simple harmonic oscillation is doubled. What change will you

observe in the following physical quantity of the oscillator? Maximum velocity.

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69. The amplitude of a simple harmonic oscillation is doubled. What change will you observe in the following physical quantity of the oscillator? Maximum acceleration.

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70. The amplitude of a simple harmonic oscillation is doubled. What change will you observe in the following physical quantities of the oscillator? Total energy.

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71. Under what conditions for the amplitude, are the oscillations of the pendulum simple harmonic?

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72. A simple pendulum is an object suspended by a weightless and inextensible string fixed rigidly to a support. The period of oscillation of the pendulum is T. What will be the period if the pendulum is suspended in a lift moving down with an acceleration equal to $\frac{g}{3}$.

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73. Represent graphically the variations of potential energy, kinetic energy and total

energy as a function of position 'y' for a simple harmonic oscillator. Explain the graph.

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74. The amplitude of oscillation of a harmonic oscillator oscillating in air decreases continuously. This is because of damping. If the damping force is proportional to the velocity of the oscillator, give the expression for its frequency.

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75. Say True or False: Greater the mass of the pendulum bob shorter is its frequency of oscillation.

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76. What do you mean by simple harmonic motion?

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77. The motions that repeat themselves are called periodic motions but for a simple harmonic motion, the force must be proportional to the displacement and it is directed towards the centre of motion. Write the expression for a period of oscillation of a loaded spring.

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78. Oscillations of a loaded spring are simple harmonic motion. A body oscillates with S.H.M

is given by $x = 5\cos\left[2\pi t + \frac{\pi}{4}\right]$. Calculate the displacement at time, $t = 1.5s$.

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79. Represent Simple Harmonic Motion graphically.

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80. Write the differential equation representing Simple Harmonic Motion.

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81. Name two examples for simple harmonic motion.

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82. A spring having spring constant $1200Nm^{-1}$ is mounted on a horizontal table as shown in figure. A mass of $3kg$ is attached to the free end of the spring. The mass is the

pulled sideways to a distance of $2.0cm$ and released. Determine the frequency of oscillations.

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

released. Determine maximum acceleration of the mass.

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84. What do you mean by a seconds pendulum?

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85. Time period of a particle in SHM is $T = 2\pi\sqrt{\frac{m}{k}}$. A simple pendulum executes

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

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

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87. Which one of the following examples closely represents SHM? Substantiate your answer. i) The rotation of the earth about its axis. ii) Oscillations of a swing.

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88. A vibrating simple pendulum of period T is placed in a lift which is accelerating downwards. What is the effect of this on the time period of the pendulum?

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89. The motion represented by the equation $y(t) = A\cos(\omega t + \phi)$ is called simple harmonic motion (SHM). The displacement of y (in cm) of an oscillating particle varies with time t (in sec) according to the equation. $y = 2\cos\left(0.5\pi t + \frac{\pi}{3}\right)$. Find the amplitude and period of the particle.

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90. What do you mean by simple harmonic motion?

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91. Deduce an expression for the period of oscillation of a simple pendulum.

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92. A girl is swinging on a swing in the sitting position. How will the period of swing be affected if she stands up?

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93. What are damped oscillations?

Watch Video Solution

94. Time period of a particle in SHM is $T = 2\pi\sqrt{\frac{m}{k}}$. A simple pendulum executes SHM approximately. Why then is the time period of pendulum is independent of mass?

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95. Time period of a particle in simple harmonic motion (SHM) depends on the force constant K and mass m of the particle.

A man with his wristwatch on his hands falls

from the top of a tower.Does the watch give the correct time during the free fall?Why?

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

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97. A particle executing SHM is an example of _____.

(i)acceleration of constant magnitude and direction.

(ii)acceleration of changing magnitude and direction.

(iii)acceleration of changing magnitude but constant direction.

(iv)acceleration of constant magnitude but changing direction.

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98. Which of the following condition is sufficient for the simple harmonic motion? Where 'a -acceleration y-displacement

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99. An SHM is given by $x = 8\sin\left(10\pi t + \frac{\pi}{4}\right)m$.At which position will its kinetic energy become equal to its potential energy?

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100. Deduce an expression for the period of oscillation of a simple pendulum.

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101. A simple pendulum is an object suspended by a weightless and inextensible string fixed rigidly to a support. The period of oscillation of the pendulum is T. What will be the period if the pendulum is suspended in a lift moving down with an acceleration equal to $\frac{g}{3}$.

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

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

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

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

Answer: A

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102. What do you mean by simple harmonic motion?

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103. Motion of a simple pendulum is an example for simple harmonic motion.

The acceleration due to gravity on the surface of the moon is $1.7\frac{m}{s^2}$.What is the time period of a simple pendulum on the moon,if its time period on the earth is $3.5\,\text{sec}\,onds$?

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104. For SHM,time period $T = 2s$.If displacement from the mean position is $10cm$,calculate the instantaneous acceleration.

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105. Represent graphically the variations of potential energy, kinetic energy and total energy as a function of position 'y' for a simple harmonic oscillator. Explain the graph.

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106. Among the following which are examples of simple harmonic motion?

i)the rotation of earth about its axis,

ii)vertical oscillation of a loaded spring,

iii)Oscillations of simple pendulum,

iv)Uniform circular motion.

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107. The displacement in simple harmonic motion can be represented as

$x(t) = A\cos(\omega t + \phi)$,where ϕ is the phase constant.

Define A in the equation.

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