Class XI

Oscillations and Waves worksheet 1

1. The girl sitting on a swing stands up. What will be the effect on periodic time of swing? 1

Ans. The periodic time T is directly proportional to the square root of effective length of pendulum (l). When the girl starts up, the effective length of pendulum (i.e. Swing) decreases, so the Time period (T) also decreases.

2. At what distance from the mean position, is the kinetic energy in a simple harmonic oscillator equal to potential energy? 1

Ans. $K = \frac{1}{2} m w^2 \left(a^2 - y^2\right)$

$P = \frac{1}{2} m w^2 y^2$

$If \qquad K = P$

$\frac{1}{2} m w^2 \left(a^2 - y^2\right) = \frac{1}{2} m w^2 y^2$

$a^2 - y^2 = y^2$

$a^2 = 2y^2$

$y = \frac{a}{\sqrt{2}}$

3. A simple harmonic oscillator is represented by the equation : Y = 0.40 Sin (440t+0.61).Find the values of 1) Amplitude 2) Angular frequency 3) Frequency of oscillation 4) Time period of oscillation, 5) Initial phase. 1

Ans. $y = a \sin\left(wt + \phi_0\right)$

1) $a = 0.4m$

2) $w = 440Hz$

3) $\nu = \frac{w}{2\pi} = \frac{440}{2 \times 3.14} = 70Hz$

4) $T = \frac{1}{\nu} = \frac{1}{70} = 0.0143s$

5) $\phi_0 = 0.61rad.$

4. The soldiers marching on a suspended bridge are advised to go out of steps. Why? 1

Ans. The soldiers marching on a suspended bridge are advised to go out of steps because in such a case the frequency of marching steps matches with natural frequency of the suspended bridge and hence resonance takes place, as a result amplitude of oscillation increases enormously which may lead to the collapsing of bridge.

5. The springs of spring factor k, 2k, k respectively are connected in parallel to a mass m. If the mass = 0.08kg m and k = 2N|m, then find the new time period? 2

Ans. $K = K_1 + K_2 + K_3 = k + 2k + k = 4k = 4 \times 2 = 8Nm^{-1}$

$T = 2\pi\sqrt{\frac{m}{K}} = 2 \times \frac{22}{7} \times \sqrt{\frac{0.08}{8}} = 2 \times 3.14 \times 0.1 = 0.628s$

6. The bob of a vibrating simple pendulum is made of ice. How will the period of swing change when the ice starts melting? 2

Ans. The period of swing of simple pendulum will remain unchanged till the location of centre of gravity of the bob left after melting of the ice remains at the fixed position from the point of suspension. If centre of gravity of ice bob after melting is raised upwards, then effective length of pendulum decreases and hence time period of swing decreases. Similarly, if centre of gravity shifts downward, time period increases.

7. An 8 kg body performs S.H.M. of amplitude 30 cm. The restoring force is 60N, when the displacement is 30cm. Find: - a) Time period b) the acceleration c) potential and kinetic energy when the displacement is 12cm? 2

Ans. $m = 8kg$

$a = 30cm = 0.3m$

$a)\ f = 60N$

$y = 0.3m$

$F = ky$

$60 = k \times 0.3$

$k = 200Nm^{-1}$

$w = \sqrt{\frac{k}{m}} = \sqrt{\frac{200}{8}} = 5$

$T = \frac{2\pi}{w} = \frac{2 \times 22}{5 \times 7} = 1.256s$

$b)\ y = 0.12m$

$A = w^2 y = 5^2 \times 0.12 = 3ms^{-2}$

$P = \frac{1}{2} ky^2 = \frac{1}{2} \times 200 \times (0.12)^2 = 1.44J$

$E = \frac{1}{2} k(a^2 - y^2) = \frac{1}{2} \times 200 \times (0.3^2 - 0.12)^2 = 7.56J$

8. What is Simple pendulum? Find an expression for the time period and frequency of a simple pendulum? 3

Ans.

9. A particle executing SH.M has a maximum displacement of 4 cm and its acceleration at a distance of 1 cm from its mean position is 3 cm/s^2. What will be its velocity when it is at a distance of 2cm from its mean position? 3

Ans. $A = 3cms^{-2}$

$y = 1cm$

$A = w^2(1)$

$w = \sqrt{3}\, rad.s^{-1}$

$v = w\sqrt{a^2 - y^2} = \sqrt{3}\sqrt{4^2 - 2^2} = \sqrt{3}\sqrt{12}$

$= 6cms^{-1}$