PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

SIMPLE AND COMPOUND PENDULUM

Examples

1. A pendulam which keeps correct time at a place where g= 9.81ms^{-2} it taken to a place

where g=9.8 ms^{-2}. Calculate by how much it will lose or gain in a day.

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2. A simple pendulam 2m long is arranged in an elevator. What will be its time period when the elevator is (a) moving up with uniform velocity 2 m/s, (b) moving up with uniform acceleration 2 ms^{-2}, (c) going down with uniform acceleration 2 ms^{-2}?

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3. A simple pendulam swings with amplitude of 5 cm and time period 2 s. Calculate its maximum velocity, maximum acceleration and velocity when it is 2 cm away from its mean position.

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4. A simple pendulam loses 50 s in a day when taken to the bottom of a mine. Find the depth of the moine. (Radius of the earth=6400 km)

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5. The period of a disk orf radius 10 cm executing small oscillation about a piviot at its rim is measured to be 0.784 s. Find the value of g, the acceleration due to gravity

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6. A body of mass 0.2 kg oscillates about a horizental axis at a distance 20 cm from its

centre ofr gravity. Ifd the length of the equivalent simple pendulem be 0.35 m, find the moment of inertia about the axis of suspension.

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7. Show that the time period of a compound pendulam is minimum when it is suspended from a point at a distance equal to its radius of gyration.

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8. A circular loop of radius 60 cm and weight 4 kg is suspended on a horizentol nail at its circumference. (a) What is its frequency of oscillation for small displacement ffrom equilibrium? (b) What is the length of the equivalent simple pendulam?

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Exercise

1. Calculate the length of asecond pendulam at a place where g= 9.8 ms^{-2}.

[Hint: A seconds pendulam Is one with a time period of exactly 2 s]

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2. A hollow light cylinder of length 10 cm is suspended by a string of length 95 cm. Calculate the time period of this simple pendulam when the cylinder is

completely filled with mercury, (ii) half filled with mercury, (g=9.81 ms^{-2})

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3. A faultyu seconds pendulems loses 9 s per day. Find the required alteration in length for it to keep correct time.

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4. A simple pendulam which beats a second on the surface of the earth where g=9.8ms^{-2} is taken to the top of a hill where it is found to lose 2 s in an hour, What is the hight of the hill ?(Radius of the earth =`6.

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5. A simplependulam beats seconds on the earth (g=9.8 ms^{-2}) is taken to the moon

where g=3.96ms^{-2}. Find the number of seconds it will lose per day.

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6. The bob of a simple pendulam is of mass 50 g and radius 1.5 cm. It is suspended by a string of length 98.5 cm. Calculate its maximum kinetic energy if it is drawn to one side by 5 cm and then released.

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7. A simple pendulam loses 50 s when taken to the top of a hill. Find the height of the hill. Radiius of earth = 6400 km.

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8. Two simple pendulams of lengths 1 and 1.1 m rerspectively start swinging together with the same aplitude. Find the number of swings executed by the longer pendulam before again swing together.

[Hint: The longer pendulam will swing more

slowely than the shorter. Both will agin begain together after the faster pendulam gains by a complete number of oscillations. Let n be the number of oscillations the longer one makes before they again begain together.

$\therefore$ (n+x)$T_1 = nT_2$, where x is the number of oscillations by which the first gains over the second.]

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9. A simple pendulam of period 2 s is suspended from the cielieng of a car at rest. The car moves horizontally with acceleration 4.9 ms^{-2}. Find the period of oscillation of the pendulam.

[Hint: Bring the car to rest by applying inertia force. Consider the moition of the pendulam in this condition . $T = 2\pi\sqrt{\frac{l}{\sqrt{a^2+g^2}}}$.]

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10. A simple pendulam of length l is suspended from the ceiling of a moving lift. Find the time period of the pendulam when the lift is going up with accelerationF.

[Hint: Bring the pendulam to rest by applying inertia force (D' Alembert's principle) and consider its motion in this condition.]

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11. Show that the period of a simple pendium is given by $T = 2\pi\sqrt{\frac{m}{m}, \frac{1}{g}}$ where m is the 'internial mass' and m is the 'gravitional mass' of the bob.

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12. Show that the time period of a simplw pendulam of infinite length is given by $t = 2\pi\sqrt{\frac{R}{g}}$ where R is the radius of the earth

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13. A simple pendulum is secrured in a flat railway car and set oscillations. Its time period is $T_0 = 2s$. The car puhed on to a downward incline having inclination $\alpha = 30^\circ$ with the horizontal. What is the period of oscillation of the pendulum during th motion of the car on the incline? Assume it to be smooth.

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14. A pendulum clock is mounted in an elevator car which starts going up with a constant acceleration w, with $w < g$. At a height h the acceleration of the car reverses, its magnitude remaining constant. How soon after the start of the motion will the clock show the right time again ?

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15. A body of mass 0.42kg oscillates about a horizontal xis distant 0.25mm frim its CG. If the length of am equivalent simple pendulum be 0.35m, find its moment of inertia about its axis of suspension, and its period of oscillation. $\left(g = 9.8ms^{-2}\right)$

$[\text{Hint} L = \frac{k^2}{l} + l, l = mk^2 + ml^2.]$

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16. A uniform square amina of side 0.3m oscillates ina vertiacla plane about an axis perpendicular to the lamina. Find the minium periodic time of oscilliation. What is the locus of points about which the periodic time is minimum?

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17. Calculate the time period of oscillation of a uniform recctangular plate of length 96cm and

breath 10cm when it is oscillating freely about one of its corners. $\left(g = 9.8ms^{-2}\right)$.

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18. A thin uniform rod of lenth 120cm is made to oscillate about an axis passing through it end. Find the period and other points about which it has the same time period $\left(g = 9.8ms^{-2}\right)$.

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19. A uniform square lamina of side 10cm is hung up by a corner and swings in its won plane. Find the length of an equivalent simple pendulum.

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20. A disc of metal of raidus r with its plane vetical can be made to swing about a horiziontal axis passsing through any one of a series of holes bored along a diameter. Show

that the minimum period of oscillatin is given by $t = 2\pi \frac{\sqrt{1.414r}}{g}$

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21. A uniform cirucular disc of 25cm radius oscillates in its own plane about points on its circumference. Calculate the time of oscillation $\left(g = 9.8ms^{-2}\right)$

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22. In a Kater's pendulum the time periods about the knife edges at distance l_1 and l_2 from the centre of gravity are t and t+pi is very small. Show that $\frac{4\pi^2(l_1+l_2)}{g} = t\left(t + \frac{2l_2\tau}{l_2 - l_1}\right)$

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23. A Kater's pendulum of mass 5kg gives an equal oscillation period of 2.004 s about knife edges at distance 10cm and 89.4 cm on either

side of the centre of gravity Calculate the value of g and the moment of the pendulum about centre of gravity. "[" Hint length of equivalent simple pendulum=89.4+10=99.4cm"]"

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24. A compound pendulum consists of a rigid light rod having two spherical bobs of masses m_1 and m_2 at distance l_1 and l_2 from the

centre of suspension. Find the time period of oscillations of the pendulum

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