DPP

DAILY PRACTICE PROBLEMS

Class : XIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 3

Topic :- OSCILLATIONS

1 **(c)**

Under the influence of one force $F_1 = m\omega_1^2 y$ and under the action of another force, $F_2 = m\omega_2^2 y$

Under the action of both the forces $F = F_1 + F_2$

$\Rightarrow m\omega^2 y = m\omega_1^2 y + m\omega_2^2 y$

$$\Rightarrow \omega^2 = \omega_1^2 + \omega_2^2 \Rightarrow \left(\frac{2\pi}{T}\right)^2 = \left(\frac{2\pi}{T_1}\right)^2 + \left(\frac{2\pi}{T_2}\right)^2$$

$$\Rightarrow T = \sqrt{\frac{T_1^2 T_2^2}{T_1^2 + T_2^2}} = \sqrt{\frac{\left(\frac{4}{5}\right)^2 \left(\frac{3}{5}\right)^2}{\left(\frac{4}{5}\right)^2 + \left(\frac{3}{5}\right)^2}} = 0.48s$$

2 **(b)**

$$T = 2\pi\sqrt{\frac{m}{k}}, T' = 2\pi\sqrt{\frac{m}{4k}} = \frac{T}{2} = \frac{5}{2}\,\text{s} = 2.5\text{ s}$$

3 **(c)**

If v and v' are the velocities of the block of mass M and $(M+m)$ while passing from the mean position when executing SHM

Using law of conservation of linear momentum, we have

$mv = (M+m)v'$ *or* $v' = mv/(M+m)$

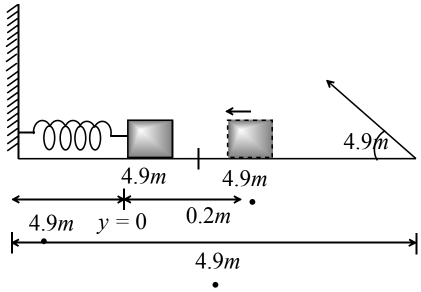
Also, maximum PE= maximum KE

$$\therefore \frac{1}{2} k A'^2 = \frac{1}{2}(M+m)v'^2$$

or $A' = \left(\frac{M+m}{k}\right)^{1/2} \times \frac{mv}{(M+m)}$

$$= \frac{mv}{\sqrt{(M+m)k}}$$

4 **(a)**



The block is released from A

$x=4.9m+(0.2m)\sin\left(\omega t+\frac{\pi}{2}\right)$

at $t=1s; x=5m$

so range of projectile will be $5m$

Now $5=\frac{v^2\sin 90°}{g}\Rightarrow v^2=50\Rightarrow v=\sqrt{50}$

5 **(c)**

On comparing with standard equation $\frac{d^2y}{dt^2}+\omega^2 y=0$

we get $\omega^2=K\Rightarrow\omega=\frac{2\pi}{T}=\sqrt{K}\Rightarrow T=\frac{2\pi}{\sqrt{K}}$

6 **(c)**

$y=A\sin\left(\frac{2\pi}{T}\right)t$

$\frac{A}{2}=A\sin\left(\frac{2\pi}{T}\right)t=\frac{2\pi}{T}t=\pi/6$

Time period $t=\frac{T}{12}=\frac{6}{12}=\frac{1}{2}$ s

7 **(d)**

Potential energy of particle performing SHM is given by: $PE=\frac{1}{2}m\omega^2y^2$, *i.e.*, it varies parabolically such that at mean position it becomes zero and maximum at extreme positions

9 **(c)**

A particle oscillating under a force $\vec{F}=-k\vec{x}=b\vec{v}$ is a damped oscillator. The first term $-k\vec{x}$ represents the restoring force and second term $-b\vec{v}$ represents the damping force

10 **(c)**

Effective force constant is equal to the reciprocal of the sum of individual force constant, hence

$$\frac{1}{k_e}=\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_3}+\ldots$$

Given, $k_1=k, k_2=2k, k_3=3k, \ldots..$

$$\therefore \quad \frac{1}{k_e}=\frac{1}{k}+\frac{1}{2k}+\frac{1}{4k}+\frac{1}{8k}+\ldots$$

The given series a geometric progression series, hence sum is

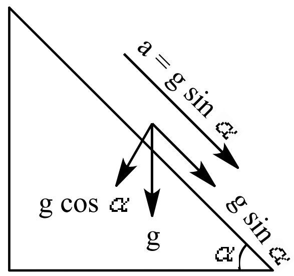
$$S_\infty=\frac{a}{1-r}$$

where a is first term of series and r the common difference.

$\Rightarrow \qquad \frac{1}{k_e} = \frac{1}{k} \times \frac{1}{\left(1 - \frac{1}{2}\right)} = \frac{2}{k} \Rightarrow k_e = \frac{k}{2}$

11 **(a)**

Time period $\qquad T = 2\pi\sqrt{\frac{l}{g_{eff}}}$



$$T = 2\pi\sqrt{\frac{l}{g\cos\alpha}}$$

12 **(d)**

$x_1 + x_2 = A$ and $k_1x_1 = k_2x_2$ or $\frac{x_1}{x_2} = \frac{k_2}{k_1}$

Solving these equations, we get

$$x_1 = \left(\frac{k_2}{k_1 + k_2}\right)A$$

13 **(c)**

The effective acceleration in a lift descending with acceleration $\frac{g}{3}$ is $g_{eff} = g - \frac{g}{3} = \frac{2g}{3}$

$\therefore T = 2\pi\sqrt{\left(\frac{L}{g_{eff}}\right)} = 2\pi\sqrt{\left(\frac{L}{2g/3}\right)} = 2\pi\sqrt{\left(\frac{3L}{2g}\right)}$

14 **(b)**

Time period of simple pendulum is given by

$$T = 2\pi\sqrt{\frac{l}{g}} \qquad \text{...(i)}$$

When the lift is moving up with an acceleration a, then time period becomes

$$T' = 2\pi\sqrt{\frac{l}{g + a}}$$

Here, $\quad T' = \frac{T}{2}$

$\Rightarrow \qquad \frac{T}{2} = 2\pi\sqrt{\frac{l}{g + a}} \qquad \text{...(ii)}$

Dividing Eq.(ii) by Eq. (i), we get

$$a = 3g$$

16 **(d)**

$n = \frac{1}{2\pi}\sqrt{\frac{K_{eq}}{m}} = \frac{1}{2\pi}\sqrt{\frac{K_1K_2}{(K_1 + K_2)m}}$

17 **(b)**

$m_1 = 1$ kg, extension $l_1 = 5$ cm $= 5 \times 10^2$ m

$\therefore \quad m_1 g = k l_1$

$k =$ force constant of the spring

$$k = \frac{m_1 g}{l_1} = \frac{1 \times 10}{5 \times 10^{-2}} = 200 \text{ Nm}^{-1}$$

Time period of the block of mass 2 kg.

$$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{2}{200}} = 2\pi \times \frac{1}{10} = \frac{\pi}{5} \text{ s}$$

Maximum velocity $v_{\max} = A\omega$

where $A =$ Amplitude

$$= 10 \text{ cm} = 10 \times 10^{-2} \text{ m}$$

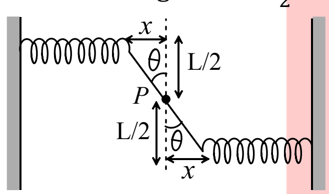
$$v_{\max} = A \times \frac{2\pi}{T} = 10 \times 10^{-2} \times \frac{2\pi}{\pi/5}$$

$$= 10^{-1} \times 2 \times 5 = 1 \text{ ms}^{-1}$$

18 **(c)**

Torque about $P = -(kx)\frac{L}{2} + \left(-kx\frac{L}{2}\right) = -kxL = -k\frac{L^2}{2}\theta$

For small angle θ, $x = \frac{L}{2}\theta$; $\tau = -I\alpha$



$$\Rightarrow -\frac{KL^2}{2}\theta = \frac{ML^2}{12}\alpha$$

$$\Rightarrow \frac{-6K\theta}{M} = \alpha$$

$$\Rightarrow \omega = \sqrt{\frac{6K}{M}} \text{ and } f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{6K}{M}}$$

19 **(c)**

If first equation is

$$y_1 = a_1 \sin \omega t \Rightarrow \sin \omega t = \frac{y_1}{a_1} \qquad \text{...(i)}$$

Then second equation will be

$$y_2 = a_2 \sin(\omega t + \frac{\pi}{2})$$

$$= a_2[\sin \omega t \cos\frac{\pi}{2} + \cos \omega t \sin\frac{\pi}{2}] = a_2 \cos \omega t$$

$$\Rightarrow \quad \cos \omega t = \frac{y_2}{a_2} \qquad \text{...(ii)}$$

By squaring and adding Eqs. (i) and (ii)

$$\sin^2 \omega t + \cos^2 \omega t = \frac{y_1^2}{a_1^2} + \frac{y_2^2}{a_2^2}$$

$$\Rightarrow \quad \frac{y_1^2}{a_1^2} + \frac{y_2^2}{a_2^2} = 1;$$

This is equation of an ellipse.

20 **(c)**

By using conservation of mechanical energy

$$\frac{1}{2}kx^2 = \frac{1}{2}mv^2 \Rightarrow x = v\sqrt{m/k}$$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	C	B	C	A	C	C	D	C	C	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	D	C	B	B	D	B	C	C	C