DPP

DAILY PRACTICE PROBLEMS

CLASS : XIth
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 6

Topic :- OSCILLATIONS

1 **(c)**

Maximum force $= m\omega^2 a = m4\pi v^2 a$

$= 1 \times 4\pi^2 \times (60)^2 \times 0.02 = 288\pi^2$

2 **(a)**

The maximum velocity of a particle performing SHM is given by $v = A\omega$, where A is the amplitude and ω is the angular frequency of oscillation.

$\therefore \quad 4.4 = (7 \times 10^{-3}) \times 2\pi/T$

$\Rightarrow \quad T = \frac{7 \times 10^{-3}}{4.4} \times \frac{2 \times 22}{7} = 0.01 \text{ s}$

3 **(b)**

Maximum acceleration is given by

$= a\omega^2 = 24 \text{ ms}^{-2}$ ...(i)

Maximum velocity= $a\omega = 16 \text{ ms}^{-2}$ ...(ii)

Dividing Eq. (i) by Eq. (ii)

$$\frac{a\omega^2}{a\omega} = \omega = \frac{24}{16} = \frac{6}{4} = \frac{3}{2}$$

Now putting the value of ω in Eq. (ii), we get

$$a \times \frac{3}{2} = 16$$

$$a = \frac{32}{3} \text{ m}$$

4 **(b)**

$$\frac{U}{E} = \frac{\frac{1}{2} m\omega^2 y^2}{\frac{1}{2} m\omega^2 a^2} = \frac{y^2}{a^2} = \frac{\left(\frac{a}{2}\right)^2}{a^2} = \frac{1}{4} \Rightarrow U = \frac{E}{4}$$

5 **(b)**

Here, $\quad y_1 = \frac{1}{2}\sin \omega t + \frac{\sqrt{3}}{2}\cos \omega t$

$= \cos\frac{\pi}{3}\sin \omega t + \sin\frac{\pi}{2}\cos \omega t$

$\therefore \quad y_1 = \sin\left(\omega t + \frac{\pi}{3}\right)$

Similarly, $\quad y_2 = \sqrt{2}\sin\left(\omega t + \frac{\pi}{4}\right)$

∴ Phase difference $\Delta\phi = \frac{\pi}{3} - \frac{\pi}{4} = \frac{\pi}{12}$

6 **(c)**

We have, $T \propto \sqrt{l}$,

$\therefore \frac{T_1}{T} = \sqrt{\frac{0.01l}{l}}$

$= \left(1 + \frac{1}{100}\right)^{1/2} = \left[1 + \frac{1}{2 \times 100}\right]$

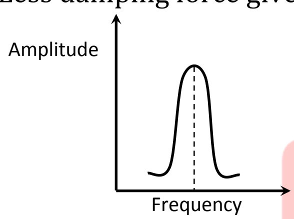
∴ % increase in time period

$= \left(\frac{T_1 - T}{T}\right) \times 100$

$= \frac{1}{2 \times 100} \times 100 = 0.5\%$

7 **(d)**

Less damping force gives a taller and narrower resonance peak



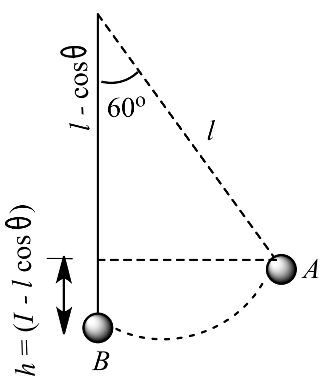
8 **(d)**

KE at the lowest position $= \frac{1}{2} mv^2$

$= \frac{1}{2} m(3)^2 = \frac{9}{2} m$

When the length makes an angle $\theta(= 60°)$ to the vertical, the bob of the pendulum will have both KE and PE. If v is the velocity of bob at this position and h is the height of the bob w.r.t. B, then total energy of the bob

$= \frac{1}{2} mv^2 + mg\text{h}$



But $\text{h} = l - l\cos\theta$

$= l(1 - \cos\theta)$

$= 0.5(1 - \cos 60°) = 0.5\left(1 - \frac{1}{2}\right) = \frac{1}{4}$

$E = \frac{1}{2}mv^2 + m \times 10 \times \frac{1}{4}$

$= \frac{1}{2}mv^2 + \frac{5}{2}m$

According to law of conservation of energy

$\frac{1}{2}mv^2 + \frac{5m}{2} = \frac{9}{2}m$

$\Rightarrow \frac{1}{2}mv^2 = \frac{9}{2}m - \frac{5}{2}m = 2m$

$\therefore \quad u = 2\ \text{ms}^{-1}$

9 **(b)**

$T = 2\pi\sqrt{l/g};$

$\log T = \log 2 + \log \pi + \frac{1}{2}\log l - \frac{1}{2}\log g$

Differentiating it we get

$\frac{dT}{T} = \frac{1}{2}\frac{dl}{l} - \frac{1}{2}\frac{dg}{g} = -\frac{1}{2}\frac{dg}{g}$ ($\because l$ is constant)

% change in time period

$= \frac{dT}{T} \times 100 = -\frac{1}{2}\frac{dg}{g} \times 100$

$= -\frac{1}{2}\left(\frac{-2}{100}\right) \times 100 = 1\%$ (increase)

10 **(b)**

The spring-mass system oscillates in SHM, its time period is given by

$T = 2\pi\sqrt{\frac{m}{k}}$

When spring is cut in ratio 1:3, the new time constant is $k' = 3k$

$\therefore \quad \frac{T}{T'} = \sqrt{\frac{3k}{k}}$

$\Rightarrow \quad T' = \frac{T}{\sqrt{3}}$

11 **(a)**

System is equivalent to parallel combination of springs

$\therefore K_{eq} = K_1 + K_2 = 400$ and

$T = 2\pi\sqrt{\frac{m}{K_{eq}}} = 2\pi\sqrt{\frac{0.25}{400}} = \frac{\pi}{20}$

13 **(c)**

The average acceleration of a particle performing SHM over one complete oscillation is zero.

16 **(a)**

It is required to calculate the time from extreme position

Hence, in this case equation for displacement of particle can be written as $x = a \sin\left(\omega t + \frac{\pi}{2}\right) = a \cos \omega t$

$\Rightarrow \frac{a}{2} = a \cos \omega t \Rightarrow \omega t = \frac{\pi}{3} \Rightarrow \frac{2\pi}{T}.t = \frac{\pi}{3} \Rightarrow t = \frac{T}{6}$

17 **(a)**

$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T \propto \sqrt{l}$, hence if l made 9 times T becomes 3 times.

Also time period of simple pendulum does not depend on the mass of the bob

18 **(b)**

Let T_1 and T_2 be the time period of the two pendulums $T_1 = 2\pi\sqrt{\frac{100}{g}}$ and $T_2 = 2\pi\sqrt{\frac{121}{g}}$

$[T_1 < T_2$ because $l_1 < l_2]$

Let at $t = 0$, they start swinging together. Since their time periods are different, the swinging will not be in unision always. Only when number of completed oscillation differs by an integer, the two pendulum will again begin to swing together.

Let longer length pendulum complete n oscillation and shorter length pendulum complete $(n + 1)$ oscillation, for the unision swinging, then $(n + 1)T_1 = nT_2$

$$(n + 1) \times 2\pi\sqrt{\frac{100}{g}} = n \times 2\pi\sqrt{\frac{121}{g}} \Rightarrow n = 10$$

20 **(c)**

$$Kx = mg \Rightarrow \frac{m}{K} = \frac{x}{g}$$

So $T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\sqrt{\frac{x}{9}} = 2\pi\sqrt{\frac{0.2}{9.8}} = \frac{2\pi}{7}s$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	C	A	B	B	B	C	D	D	B	B

Q.	11	12	13	14	15	16	17	18	19	20
A.	A	C	C	B	A	A	A	B	B	C