DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH | **Solutions** | **SUBJECT : PHYSICS**

DATE : | | **DPP NO. : 8**

Topic :- OSCILLATIONS

1 **(b)**

The potential energy, $U = \frac{1}{2}kx^2$

$$2U = kx^2$$

$$2U = -Fx \qquad (\because F = -kx)$$

or $\frac{2U}{F} = -x$

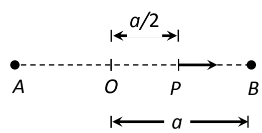
or $\frac{2U}{F} + x = 0$

2 **(d)**

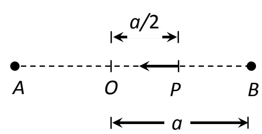
$y = a\sin(\omega t + \phi_0)$. According to the equation

$y = \frac{a}{2} \Rightarrow \frac{a}{2} = a\sin(\omega t + \phi_0) \Rightarrow (\omega t + \phi_0) = \phi = \frac{\pi}{6}$ or $\frac{5\pi}{6}$

Physical meaning of $\phi = \frac{\pi}{6}$: Particle is at point P and it is going towards B



Physical meaning of $\phi = \frac{5\pi}{6}$: Particle is at point P and it is going towards O



So phase difference $\Delta\phi = \frac{5\pi}{6} - \frac{\pi}{6} = \frac{2\pi}{3} = 120°$

3 **(c)**

Velocity = acceleration

$$\omega\sqrt{a^2 - y^2} = \omega^2 y$$

$$\sqrt{(2)^2 - (1)^2} = \omega(1)$$

$$\Rightarrow \quad \omega = \sqrt{3}$$

$$T = \frac{2\pi}{\omega}$$

$$\Rightarrow \quad T = \frac{2\pi}{\sqrt{3}}$$

4 **(c)**

If amplitude is large motion will not remain simple harmonic

5 **(d)**

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

$T = 2\pi\sqrt{\frac{1}{g+g/3}} = 2\pi\sqrt{\frac{3l}{4g}} = \left(\sqrt{\frac{3}{4}}\right)T'$

or $t' = \frac{2T}{\sqrt{3}}$

6 **(c)**

$y = A\sin PT + B\cos PT$

Let $A = r\cos\theta, B = r\sin\theta$

$\Rightarrow y = r\sin(PT+\theta)$ which is the equation of SHM

8 **(a)**

$T = 2\pi\sqrt{\frac{m}{k}} \Rightarrow \frac{T_2}{T_1} = \sqrt{\frac{m_2}{m_1}} \Rightarrow \frac{3}{2} = \sqrt{\frac{m+2}{m}} \Rightarrow \frac{9}{4} = \frac{m+2}{m}$

$\Rightarrow m = \frac{8}{5}kg = 1.6\ kg$

9 **(b)**

$v_{\max} = a\omega = a \times \frac{2\pi}{T} = (50 \times 10^{-3}) \times \frac{2\pi}{2} = 0.15\ \text{ms}^{-1}$

10 **(d)**

The displacement of particle, executing SHM,

$y = 5\sin\left(4t + \frac{\pi}{3}\right)$ ...(i)

Velocity of particle, $\frac{dy}{dt} = \frac{5d}{dt}\sin\left(4t+\frac{\pi}{3}\right)$

$= 5\cos\left(4t+\frac{\pi}{3}\right)4 = 20\cos\left(4t+\frac{\pi}{3}\right)$

Velocity at $t = \left(\frac{T}{4}\right)$

$\left(\frac{dy}{dt}\right)_{t=\frac{T}{4}} = 20\cos\left(4 \times \frac{T}{4} + \frac{\pi}{3}\right)$

$\Rightarrow u = 20\cos\left(T + \frac{\pi}{3}\right)$ ...(ii)

Comparing the given equation with standard equation of SHM $y = a\sin(\omega t + \phi)$,

we get $\omega = 4$

As $\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} \Rightarrow T = \frac{2\pi}{4} \Rightarrow T = \left(\frac{\pi}{2}\right)$

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

$u = 20\cos\left(\frac{\pi}{2} + \frac{\pi}{3}\right) = -20\sin\frac{\pi}{3}$

$= -20 \times \frac{\sqrt{3}}{2} = -10 \times \sqrt{3}$

The kinetic energy of particle,

$KE = \frac{1}{2}mu^2$

$\because m = 2g = 2 \times 10^{-3}kg$

$= \frac{1}{2} \times 2 \times 10^{-3} \times (-10\sqrt{3})^2$

$= 10^{-3} \times 100 \times 3 = 3 \times 10^{-1} \Rightarrow K.E. = 0.3J$

11 **(a)**

In first case, springs are connected in parallel, so their equivalent spring constant

$$k_p = k_1 + k_2$$

So, frequency of this spring-block system is

$$f_p = \frac{1}{2\pi}\sqrt{\frac{k_p}{m}}$$

or $f_p = \frac{1}{2\pi}\sqrt{\frac{k_1 + k_2}{m}}$

but $k_1 = k_2 = k$

$\therefore$ $f_p = \frac{1}{2\pi}\sqrt{\frac{2k}{m}}$ ..(i)

Now in second case, springs are connected in series, so their equivalent spring constant

$$k = \frac{k_1 k_2}{k_1 + k_2}$$

Hence, frequency of this arrangement is given by

$$f_s = \frac{1}{2\pi}\sqrt{\frac{k_1 k_2}{(k_1 + k_2)m}}$$

or $f_s = \frac{1}{2\pi}\sqrt{\frac{k}{2m}}$ ...(ii)

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

$$\frac{f_s}{f_p} = \frac{\frac{1}{2\pi}\sqrt{\frac{k}{2m}}}{\frac{1}{2\pi}\sqrt{\frac{2k}{m}}} = \sqrt{\frac{1}{4}}$$

or $\frac{f_s}{f_p} = \frac{1}{2}$

12 **(b)**

Using $F = kx \Rightarrow 10g = k \times 0.25 \Rightarrow k = \frac{10g}{0.25} = 98 \times 4$

Now $T = 2\pi\sqrt{\frac{m}{k}} \Rightarrow m = \frac{T^2}{4\pi^2}k$

$\Rightarrow m = \frac{\pi^2}{100} \times \frac{1}{4\pi^2} \times 98 \times 4 = 0.98\ kg$

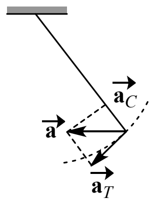
13 **(c)**

$n = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \Rightarrow n \propto \frac{1}{\sqrt{m}} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{m_2}{m_1}}$

$\Rightarrow \frac{n}{n_2} = \sqrt{\frac{4m}{m}} \Rightarrow n_2 = \frac{n}{2}$

14 **(c)**

When the displacement of bob is less than maximum, there will two compounding accelerations $\overrightarrow{a_I}$ and $\overrightarrow{a_c}$ of the bob as shown in figure. Their resultant acceleration $\vec{a}$ will be represented by the diagonal of the parallelogram



15 **(b)**

$K = \frac{1}{2} m\omega^2(a^2 - y^2)$

$\frac{3}{4} E = \frac{1}{2} m\omega^2(a^2 - y^2)$

$\frac{3}{4}\left(\frac{1}{2}\ m\omega^2 a^2\right) = \frac{1}{2} m\omega^2(a^2 - y^2)$

$y^2 = a^2 - \frac{3}{4} a^2 = \frac{a^2}{4}$

$\Rightarrow \quad y = \frac{a}{2}$

16 **(c)**

$T = 2\pi\sqrt{\frac{l}{g}}$. When lift is accelerated upwards with acceleration$a (= g/4)$. Then effective acceleration due to gravity inside the lift

$g_1 = g + a = g + \frac{g}{4} = \frac{5g}{4}$

$\therefore\ T_1 = 2\pi\sqrt{\frac{l}{5g/4}} = 2\pi\sqrt{\frac{l}{g}} \times \frac{2}{\sqrt{5}} = \frac{2T}{\sqrt{5}}$

17 **(c)**

The total time from A to C

$t_{AC} = t_{AB} + t_{BC}$

$= (T/4) + t_{BC}$

Where $T =$ time period of oscillation of spring mass system

t_{BC} can be obtained from, $BC = AB \sin(2\pi/T) t_{BC}$

Putting $\frac{BC}{AB} = \frac{1}{2}$ we obtain $t_{BC} = \frac{T}{12}$

$\Rightarrow\ t_{AC} = \frac{T}{4} + \frac{T}{12} = \frac{2\pi}{3}\sqrt{\frac{m}{k}}$

18 **(b)**

$\frac{aT}{x} = \frac{\omega^2 x T}{x} = \frac{4\pi^2}{T} \times T = \frac{4\pi^2}{T} =$ constant

20 **(b)**

Maximum force on body while in SMH

$= m\omega^2 a = 0.5 \times (2\pi/2)^2 \times 0.2 = 1\ N$

Maximum force of friction = μmg = $0.3 \times 0.5 \times 10 = 1.5$ N
Since the maximum force on the body due to SHM of the platform is less than the maximum possible frictional force, so the maximum force of friction will be equal to the maximum force acting on body due to SHM of platform *ie*, 1 N

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