DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 2

Topic :- OSCILLATIONS

1 **(b)**

As here two masses are connected by two springs, this problem is equivalent to the oscillation of a reduced mass m_r of a spring of effective spring constant

$$T = 2\pi\sqrt{\frac{m_r}{K_{eff.}}}$$

Here $m_r = \frac{m_1 m_2}{m_1 + m_2} = \frac{m}{2} \Rightarrow K_{eff.} = K_1 + K_2 = 2K$

$$\therefore n = \frac{1}{2\pi}\sqrt{\frac{K_{eff.}}{m_r}} = \frac{1}{2\pi}\sqrt{\frac{2K}{m} \times 2} = \frac{1}{\pi}\sqrt{\frac{K}{m}} = \frac{1}{\pi}\sqrt{\frac{0.1}{0.1}} = \frac{1}{\pi} Hz$$

2 **(b)**

The acceleration of a particle in SHM is,

$$\alpha_{\max} = -\omega^2 A$$

Where ω is angular velocity and A the amplitude.

Given, $y = 2\sin\left[\frac{\pi t}{2} + \emptyset\right]$ ...(i)

Standard equation of a wave in SHM is

$y = A\sin(\omega t + \emptyset)$ ...(iii)

Comparing Eq. (i) with Eq. (ii), we get

$$A = 2 \text{ cm}, \omega = \frac{\pi}{2}$$

$$\therefore \quad \alpha_{\max} = -\left(\frac{\pi}{2}\right)^2 \times 2$$

$$= \frac{\pi^2}{2} \text{ cms}^{-2}$$

3 **(c)**

When $t = 0, x = r\cos\frac{\pi \times 0}{2} = r;$

When $t = 3s, x = r\cos\frac{\pi \times 3}{2} = 0$

Here $\omega = \frac{\pi}{2}$ or $\frac{2\pi}{T} = \frac{\pi}{2}$ or $T = 4s$

$\therefore$ In 3 sec, the particle goes from one extreme to other extreme and then back to mean position. So the distance travelled $= 2r + r = 3r$

4 **(a)**

Time period $T = 2\pi\sqrt{\frac{L}{g}}$

5 **(b)**

Force constant of a spring is given by $F = kx$

$6.4 = k(0.1)$ or $k = 64N/m$

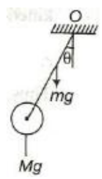
$\because T = 2\pi\sqrt{\frac{m}{k}} \Rightarrow \frac{\pi}{4} = 2\pi\sqrt{\frac{m}{64}}; \frac{m}{64} = \left(\frac{1}{8}\right)^2; m = 1kg$

6 **(d)**

$\tau_A = \tau_B = (mg\frac{L}{2}\sin\theta + M\,gL\sin\theta)$

= Restoring torque about point O.

In case A, moment of inertia will be more. Hence, angular acceleration $(\alpha = \tau/I)$ will be less. Therefore angular frequency will be less. Note Question is difficult because this type of SHM is rarely.



7 **(d)**

Function of wrist watch depends upon spring action so it is not effected by gravity but pendulum clock has time period, $T = 2\pi\sqrt{\frac{l}{g}}$. During free fall effective acceleration becomes zero, so time period comes out to be infinity, i.e., the clock stops

8 **(d)**

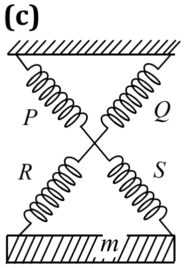
If m is the mass, r is the amplitude of oscillation, then maximum kinetic energy,

$K_0 = \frac{1}{2}m\omega^2 r^2 \;\; or \;\; r = \left(\frac{2K_0}{m\omega^2}\right)^{\frac{1}{2}}$

The displacement equation can be

$y = r\sin\omega t = \left(\frac{2K_0}{m\omega}\right)^{\frac{1}{2}}\sin\omega t$

9 **(c)**



Spring P and Q,R and S are in parallel

then, $x = k + k = 2k$ [for P,Q]

and $y = k + k = 2k$ [for R,S]

x and y both in series

$\therefore \frac{1}{k''} = \frac{1}{x} + \frac{1}{y} = \frac{1}{k}$

Time period $T = 2\pi\sqrt{\frac{m}{k''}} = 2\pi\sqrt{\frac{m}{k}}$

10 **(a)**

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

$= 2\pi\sqrt{\frac{0.2}{80}} = 0.315$

11 **(b)**

Total potential energy $= 0.04\,J$

Resting potential energy $= 0.01\,J$

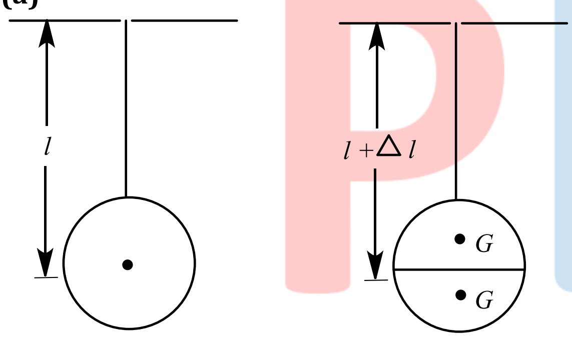
Maximum kinetic energy $= (0.04 - 0.01)$

$= 0.03J = \frac{1}{2}m\,\omega^2 a^2 = \frac{1}{2}ka^2$

$0.03 = \frac{1}{2} \times k \times \left(\frac{20}{1000}\right)^2$

$k = 0.06 \times 2500\ N/m = 150\ N/m$

12 **(a)**

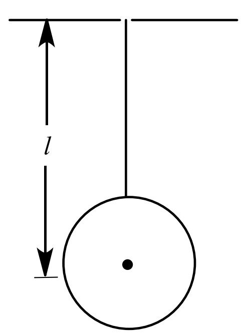


Spherical hollow ball filled with water

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

Spherical hollow ball half filled with water

$T_1 = 2\pi\sqrt{\frac{l+\Delta l}{g}}$



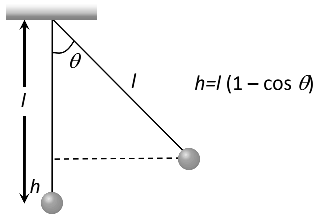
Spherical hollow ball

$T_2 = 2\pi\sqrt{\frac{l}{g}}$

and $T_1 > T_2$

Hence, time period first increases and then decreases to the original value.

13 **(d)**



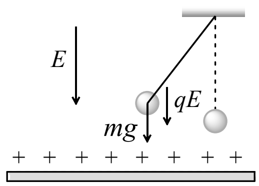
Kinetic energy will be maximum at mean position.

From law of conservation of energy maximum kinetic energy at mean position = Potential energy at displaced position

$\Rightarrow K_{\max} = mgh = mgl(1 - \cos\theta)$

14 **(a)**

In this case time period of pendulum becomes



$$T'' = 2\pi\sqrt{\frac{l}{\left(g + \frac{qE}{m}\right)}}$$

$\Rightarrow T'' < T$

15 **(c)**

$y = 0.25 \sin 200t$;

Speed, $\frac{dy}{dt} = 0.25 \times 200 \cos 200t$

Max. speed $= 0.25 \times 200 = 50$ cm s^{-1}

16 **(d)**

In simple harmonic motion

$y = a\sin\omega t$ and $v = a\omega\cos\omega t$ from this have $\frac{y^2}{a^2} + \frac{v^2}{a^2\omega^2} = 1$, which is a equation of ellipse

17 **(b)**

$x = 3\sin\omega t + 4\sin(\omega t + \pi/3)$

Comparing it with the equations

$x = r_1 \sin\omega t + r_2 \sin(\omega t + \phi)$

We have, $r_1 = 3$ cm, $r_2 = 4$cm and $\phi = \pi/3$

The amplitude of combination is

$r = \sqrt{r_1^2 + r_2^2 + 2r_1r_2\cos\phi}$

$= \sqrt{3^2 + 4^2 + 2 \times 3 \times 4 \times \cos\pi/3}$

$= \sqrt{37} = 6$ cm

18 **(c)**

Time period is independent of mass of pendulum

19 **(b)**

A total restoring force, $F = kX = mg$

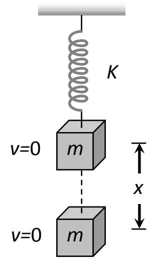
Or $k = mg/X$

Total mass that oscillates $= (M + m)$

$$\therefore \quad T = 2\pi\sqrt{\frac{(M+m)}{mg/X}} = 2\pi\sqrt{\frac{(M+m)X}{mg}}$$

20 **(b)**

Let x be the maximum extension of the spring. From energy conservation



Loss in gravitational potential energy

$=$ Gain in potential energy of spring

$$Mgx = \frac{1}{2}Kx^2$$

$$\Rightarrow x = \frac{2Mg}{K}$$

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