DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 9

Topic :- OSCILLATIONS

2 **(a)**

Potential energy is minimum (in the case zero) at mean position ($x = 0$) and maximum at extreme positions ($x = \pm A$). At time $t = 0$, $x = A$. Hence, PE should be maximum. Therefore, graph I is correct. Further in graph III, PE is minimum at $x = 0$. Hence, this is also correct.

3 **(b)**

$v_{\max} = a\omega$ and

Maximum acceleration = $\omega^2 a$

$$= \left(\frac{v}{a}\right)^2 a = \frac{v^2}{a}$$

4 **(b)**

When bigger pendulum of time period $(5T/4)$ completes one vibration, the smaller pendulum will complete $(5/4)$ vibrations. It means the smaller pendulum will be leading the bigger pendulum by phase $T/4$ sec $= \pi/2$ rad $= 90°$

5 **(b)**

Time period of simple pendulum

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

From this formula it can be predicted that time period does not depend on the mass of bob.

6 **(d)**

$$T \propto \sqrt{l} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}} \Rightarrow \frac{2}{T_2} = \sqrt{\frac{l}{4l}} \Rightarrow T_2 = 4\ s$$

7 **(c)**

$$y = a\sin\frac{2\pi}{T}t \Rightarrow \frac{a}{2} = a\sin\frac{2\pi t}{3} \Rightarrow \frac{1}{2} = \sin\frac{2\pi t}{3}$$

$$\Rightarrow \sin\frac{2\pi t}{3} = \sin\frac{\pi}{6} \Rightarrow \frac{2\pi t}{3} = \frac{\pi}{6} \Rightarrow t = \frac{1}{4}\text{ sec}$$

8 **(b)**

$$T = 2\pi\sqrt{\frac{m}{k}} \text{ or } k = \frac{4\pi^2}{T^2}m = \omega^2 m$$

9 **(b)**

So $a = 6cm, \omega = 100rad/s$

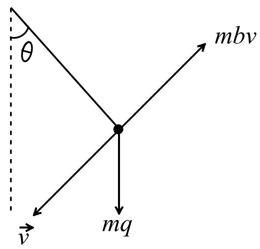
$$K_{\max} = \frac{1}{2}m\omega^2a^2 = \frac{1}{2} \times 1 \times (100)^2 \times (6 \times 10^{-2})^2 = 18\,J$$

10 **(d)**

As retardation $= bv$

$\therefore$ retarding force $= mbv$

$\therefore$ net restoring torque when angular displacement is θ is given by



$= -mg\ell\sin\theta + mbv\ell$

$\therefore I\alpha = -mg\ell\sin\theta + mbv\ell$

where, $I = m\ell^2$

$$\therefore \frac{d^2\theta}{dt^2} = \alpha = -\frac{g}{\ell}\sin\theta + \frac{bv}{\ell}$$

for small damping, the solution of the above differential equation will be

$\therefore \theta = \theta_0 e^{-\frac{bt}{2}}\sin(\omega t + \phi)$

$\therefore$ angular amplitude will be $= \theta . e^{-\frac{bt}{2}}$

According to question, in τ time (average life-time),

Angular amplitude drops to $\frac{1}{e}$ value of its original value (θ)

$$\therefore \frac{\theta_0}{e} = \theta_0 e^{-\frac{b\tau}{2}} \Rightarrow \frac{b\tau}{2} = 1$$

$$\therefore \tau = \frac{2}{b}$$

11 **(c)**

Effective value of acceleration due to gravity is zero in the satellite, *ie,* $g_{\text{eff}} = 0$.

Hence, time period of pendulum

$$T = 2\pi\sqrt{\frac{l}{g_{\text{eff}}}} = 2\pi\sqrt{\frac{l}{0}} = \infty$$

is infinite.

12 **(d)**

$$T \propto \frac{1}{\sqrt{k}} \Rightarrow \frac{T_2}{T_1} = \sqrt{\frac{k_1}{k_2}} = \sqrt{\frac{k}{4k}} = \frac{1}{2} \Rightarrow T_2 = \frac{T_1}{2}$$

13 **(c)**

The relation between acceleration (a) and displacement (x) for a body in SHM is

$$a = -\omega^2 x$$

Given, $a = -bx$

On comparing the two equations, we get

$$\omega^2 = b$$

$\therefore \quad \omega = \sqrt{b}$

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

$\therefore \quad \frac{2\pi}{T} = \sqrt{b}$

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

14 **(d)**

The lift is moving with constant velocity so, there will be no change in the acceleration hence time period will remain same.

15 **(a)**

Here, Mass of the body, $m = 500g = 500 \times 10^{-3} kg$

Spring constant, $k = 8\pi^2$ N m^{-1}

The frequency of oscillation is

$$v = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{8\pi^2 \text{ N m}^{-1}}{500 \times 10^{-3} \text{ kg}}} = 2 \text{ Hz}$$

16 **(c)**

Kinetic energy at mean position,

$$K_{\max} = \frac{1}{2}mv_{\max}^2 \Rightarrow v_{\max} = \sqrt{\frac{2K_{\max}}{m}}$$

$$= \sqrt{\frac{2 \times 16}{0.32}} = \sqrt{100} = 10 m/s$$

17 **(c)**

In SHM, the total energy=potential energy + kinetic energy

or $\quad E = U + K$

$$= \frac{1}{2}m\omega^2x^2 + \frac{1}{2}m\omega^2(A^2 - x^2)$$

$$= \frac{1}{2}m\omega^2A^2 = \frac{1}{2}kA^2$$

where k = force constant= $m\omega^2$

Thus, total energy depends on k and A.

18 **(a)**

$$n \propto \sqrt{\frac{k}{m}}$$

19 **(d)**

$$F_{\max} = m\omega^2 a = m\frac{4\pi^2}{T^2}a$$

$$= \frac{10}{1000} \times \frac{4 \times (\pi)^2}{(\pi/5)} \times 0.5 = 0.5 \text{ N}$$

20 **(a)**

Max, KE= Max. PE

$$= \frac{1}{2} mv^2 = \frac{1}{2} kx^2 = \frac{1}{2} \times 65 \times (0.11)^2$$

or $v^2 = \frac{65 \times (0.11)^2}{650 \times 10^{-3}}$ or $v = 1.1 \text{ ms}^{-1}$

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