Azizul Islam Nayem
011 201 262
section A.

Assignment 01

Question-01

Here given,

$$m = 25\,gm = 25 \times 10^{-3}\,kg$$
$$= 0.025\,kg.$$
$$K = 400\,dynes/cm$$
$$= 400 \times 10^{-3}\,N/m = 0.4\,N/m.$$
$$A = 10\,cm = 10 \times 10^{-2}\,m$$
$$= 0.1\,m$$

(i) the time Period,

$$T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\sqrt{\frac{0.025}{0.4}}$$
$$= 1.57\,S.$$

(Result)

(ii) frequency,

$$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{K}{m}} = \frac{1}{2\pi}\sqrt{\frac{0.4}{0.025}}$$
$$= 0.637\,Hz.$$ (Result)

(iii) angular frequency,

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{0.4}{0.025}}$$

$$= 4 \text{ rad/s.}$$

(Result)

* If we want we can use $\omega = 2\pi f$.

(iv) maximum velocity,

$$V_{max} = A\omega$$

$$= A\sqrt{\frac{k}{m}}$$

$$= A\sqrt{\frac{0.4}{0.025}}$$

$$= 0.1\sqrt{\frac{0.4}{0.025}}$$

$$= 0.4 \text{ m/s}$$

(Result)

011201262

(v) maximum acceleration,

$$a_{max} = A\omega^2$$

$$= A.\frac{k}{m}$$

$$= 0.1 \times \frac{0.4}{0.025}$$

$$= 1.6 \ m/s^2$$

(Result)

Question - 02

Here given,

$$x = 2mm = 2 \times 10^{-3} m.$$

$$f = 120 \ Hz$$

$$A = ?$$

(i) The amplitude is half the range of the displacement, that is,

$$A = \frac{x}{2} = \frac{2 \times 10^{-3}}{2} = 10^{-3} m$$

(Result)

Scanned with CamScanner

011201262

(ii) The maximum blade speed V_{max} is related to the amplitude by

$V_{max} = A\omega$ but, $\omega = 2\pi f$, so,

$$V_{max} = A.2\pi f$$

$$= (10^{-3}) \times 2 \times 3.1416 \times 120$$

$$= 0.75 \text{ m/s.}$$ (Result)

(iii) The maximum acceleration is,

$$a_{max} = A\omega^2$$

$$= (10^{-3}).(2\pi f)^2$$

$$= (10^{-3}).(2\pi.120)^2$$

$$= 568.49 \text{ m/s}^2.$$

(Result)

011201262

Question-03

Here given,

$m = 0.12 kg.$

$A = 8.5 cm = 8.5 \times 10^{-2} m$

$T = 0.2 s.$

(i) maximum force,

$$F_{max} = m\, a_{max}$$

$$= m\,(A\omega^2)$$

$$= m.\,A.\left(\frac{2\pi}{T}\right)^2$$

$$= 0.12 \times 8.5 \times 10^{-2} \times \left(\frac{2\pi}{0.2}\right)^2$$

$$= 10\,N.$$ (প্রায়) (Result)

01120126 2

(ii) When anybody with mass 'm' moves under the influence of a Hookes law restoring force given by exhibits simple harmonic motion where the force is given by, $F_{max} = -KA$. Where k is the spring constant. By solving for k we get

so,

$$k = \frac{F_{max}}{A}$$

$$= \frac{10N}{8.5 \times 10^{-2}}$$

$$= 117.65 \text{ N/m}$$

$F_{max} = 10N$
From (i).

$A = 8.5 \text{ cm}$
$= 8.5 \times 10^{-2}$

∴ spring constant $k = 117.65$ N/m. (Result)

* We can also use $k = m\omega^2$.

Scanned with CamScanner

<u>Question-04</u> 011201262

Here given,

$m = 1.68 \times 10^{-27}$ kg.

$f = 10^{14}$ Hz.

$A = 10^{-10}$ m.

$F_{max} = ?$

we know,

$F_{max} = m.a_{max}$

$= m.(A\omega^2)$

$= m.A.(2\pi f)^2$

$= (1.68 \times 10^{-27}) \times 10^{-10} \times (2\pi.10^{14})^2$

$= 6.63 \times 10^{-8}$ N.

(Result).

Question-05

01/20/2022

Here given,

$v_{max} = 1\ m/s$

$a_{max} = 1.57\ m/s^2$

In the mean position velocity is maximu and acceleration is also maximum.

So, $v_{max} = A\omega$ --- (i)

$a_{max} = A\omega^2$ --- (ii)

② ÷ ①

$$\frac{A\omega^2}{A\omega} = \frac{1.57}{1}$$

$$\Rightarrow \omega = 1.57\ rad/s$$

Now, we know, $\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega}$

$$\therefore T = \frac{2\pi}{1.57} = 4\ s.$$

The time Period of oscillation is 4S.

(Result)

Scanned with CamScanner

Question - 06   011201262

Here given,

$$A = 5m$$

when, $x = 3m$, $a = 48\, m/s^2$ [in the mean Position]

We know that,

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

but in the mean Position,

$$a = \omega^2 x$$

$$\Rightarrow \omega = \sqrt{\frac{a}{x}} = \sqrt{\frac{48}{3}} = 4\, rad/s.$$

(i) velocity,

$$v = \omega\sqrt{A^2 - x^2}$$
$$= 4\sqrt{5^2 - 3^2}$$
$$= 16\, m/s$$

$A = 5m$
$x = 3m$
$\omega = 4\, rad/s.$

$\therefore$ velocity is 16 m/s. (Result)

011201262

(ii) time Period,

we know,

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

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

$$= \frac{2\pi}{4}$$

$$= 1.57 \text{ s.}$$ (Result)

$\omega = 4$ Rad/s

(iii) Maximum velocity,

$$V_{max} = A\omega$$

$$= 5 \times 4$$

$$= 20 \text{ m/s}$$

$A = 5$ m.
$\omega = 4$ Rad/s.

$\therefore$ maximum velocity is 20 m/s.

011201262

Question - 07

Here given,

$f = 0.25\,Hz$ about the point $x = 0$.

At $t=0$, the displacement of the particle is $x = 0.37\,cm = 0.37 \times 10^{-2}\,m$ and its velocity is zero.

(i) time Period,

$$T = \frac{1}{f} = \frac{1}{0.25} = 4\,S. \text{ (Result)}$$

(ii) The angular frequency,

$$\omega = 2\pi f = 2\pi \times (0.25)$$
$$= 1.57\ rad/S.$$

(Result)

(iii) the amplitude is the maximum displacement that the particle makes from the equilibrium point, or when the speed of the particle is zero, that is

$$A = 0.37\ cm = 0.37 \times 10^{-2}\,m.$$

(Result)

01120126L

(IV) The displacement at $t = 3S$.

we know,

$x = A\cos(\omega t + \phi)$

$x = A\cos(\omega t)$

$= 0.37\times10^{-2}\cos(\frac{\pi}{2}\times3)$

$= 0\ m$.

$A = 0.37\ cm$

$= 0.37\times10^{-2}\ m$

$\omega = 1.57\ Rad/s$

but, In this case $\frac{\pi}{2} = 90 = \omega$.

$\therefore$ The displacement is 0m.

(V) The velocity at, $t = 3S$

we know,

$v = \frac{dx}{dt} = -A\omega\sin(\omega t)$

$= -0.37\times10^{-2}\times1.57\sin(\frac{\pi}{2}\times3)$

$= 5.81\times10^{-3}\ ms^{-1}$

$\therefore$ The velocity is $5.81\times10^{-3}\ ms^{-1}$, when $t = 3S$.

Question - 08 01/20/262

Here given,

$x = 10 \cos\left(3\pi t + \frac{\pi}{3}\right)$

| Here, $\omega = 3\pi$, $\phi = \frac{\pi}{3}$

(i) Displacement at $t = 2.5S$

$x = 10 \cos\left(7.5\pi + \frac{\pi}{3}\right)$

$= 8.66$ m. (Result)

(ii) velocity at $t = 3S$.

$v = -A\omega \sin(\omega t + \phi)$

$= -10 \times 3\pi \sin\left(3\pi \times 3 + \frac{\pi}{3}\right)$

$= -81.62 \ ms^{-1}$

$\therefore$ velocity is $81.62 ms^{-1}$

(iii) Acceleration when $t = 2S$.

$a = -A\omega^2 \cos(\omega t + \phi)$

$= -10 \times (3\pi)^2 \cos\left(3\pi \times 2 + \frac{\pi}{3}\right)$

$= -444.13 \ ms^{-2}$

$\therefore$ acceleration is $-444.13 \ ms^{-2}$. (Result)

Scanned with CamScanner

Question - 09

011201262

Here given,

$L = 0.4h$

$C = 0.0020\mu F$

$= 2\times10^{-9} F$ $\quad R = ?$

We know,

$$\omega_0^2 > \left(\frac{r}{2}\right)^2$$

So, $\frac{1}{LC} > \frac{R^2}{4L^2}$

$$\Rightarrow \frac{1}{C} > \frac{R^2}{4L}$$

$$\Rightarrow R^2 < \frac{4L}{C}$$

$$\Rightarrow R < \sqrt{\frac{4\times0.4}{2\times10^{-9}}}$$

$$\therefore R \leq 28284.27\,\Omega$$

$\therefore$ Maximum R must be less than or equal to $28284.27\,\Omega$ to be oscillatory

Question - 10 011201262

Given,

$m = 250 gm = 250 \times 10^{-3} kg$

$= 0.25 kg.$

$K = 85 N/m.$

$b = 70 gm/s = 70 \times 10^{-3} m/S.$

(i) we know,

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

$$= 2\pi \sqrt{\frac{0.25}{85}}$$

$= 0.34 S.$ (Result).

(ii) we know that, $e^{-\frac{\gamma t}{2}} = 1/2$

So,

$$-\frac{bt}{2m} = \ln\left(\frac{1}{2}\right) = \frac{-(70 \times 10^{-3}) \times t}{2 \times 0.25} = \ln(0.5)$$

$$\therefore t = \frac{\ln(0.5)}{-0.14} = 4.95 S.$$

(Result)

01120126L

Question - 11

Here given,

$y = 4.0 \sin(0.10x - 2t)$

Considering with $y = A \sin(kx - \omega t)$

(i) Amplitude.

$A = 4\, m$. (Result)

(ii) wavelength,

$k = \frac{2\pi}{\lambda}$ | λ is wavelength, $k = 0.10$

$\Rightarrow \lambda = \frac{2\pi}{k}$

$= \frac{2\pi}{0.10} = 62.83\, m$. (Result)

(iii) speed, | $f = 0.318$ (iv) হতে,

$v = f\lambda$

$= 0.318 \times 62.83$

$= 19.9799\, m/s$.

(Result)

Scanned with CamScanner

011201262

(iv) frequency of wave

$\omega = 2$

$$\omega = 2\pi f$$

$$\Rightarrow 2 = 2\pi f$$

$$\Rightarrow f = \frac{2}{2\pi} = 0.318 \text{ Hz}$$ (Result)

(v) $$T = \frac{1}{f} = \frac{1}{0.318} = 3.14 \text{ S}.$$ (Result)

———— ∘ End ∘ ————