Q. 6. $v^2 = \omega^2(A^2 - x^2)$. But $v = 24$ when $x = 5$.

$\therefore 576 = \omega^2(A^2 - 25)$ .... **Equation 1**

Also $a = -\omega^2 x$. But $a = -20$ when $x = 5$. (a and x are always of opposite sign)

$\therefore -20 = -\omega^2(5) \Rightarrow \omega = 2$

Putting this into equation **1** gives:

$576 = 4(A^2 - 25) \Rightarrow A^2 - 25 = 144$

$\Rightarrow A = 13$

(i) Amplitude $= A = 13$.

(ii) Periodic time $= \frac{2\pi}{\omega} = \frac{2\pi}{2} = \pi$ s

(iii) In π seconds it performs 1 oscillation.

In 1 second it performs $\frac{1}{\pi}$ oscillations.

In 60 seconds it performs $\frac{60}{\pi} = 19.1$ oscillations.

Answer: 19 complete oscillations.

Q. 7. When $x = \sqrt{2}$, $a = -4\sqrt{2}$, $\therefore a = -\omega^2 x$

$\Rightarrow -4\sqrt{2} = -\omega^2\sqrt{2} \Rightarrow \omega = 2$.

When $x = \sqrt{2}$, $v = 2$, and $\omega = 2$,
$\therefore v^2 = \omega^2(A^2 - x^2) \Rightarrow 4 = 4(A^2 - 2)$
$\Rightarrow A = \sqrt{3}$

Start the clock in the centre $\Rightarrow x = A \sin \omega t$
i.e. $x = \sqrt{3} \sin 2t$

To find t when $x = 1.5$: $1.5 = \sqrt{3} \sin 2t$
$\Rightarrow 3 = 2\sqrt{3} \sin 2t$

$\Rightarrow \sin 2t = \frac{3}{2\sqrt{3}} = \frac{\sqrt{3}}{2}$

$\Rightarrow 2t = \frac{\pi}{3} \Rightarrow t = \frac{\pi}{6}$ s

$F = ma$. But $a = -\omega^2 x = -4(1.5) = -6$
and $m = 2$ kg.

$\therefore F = (2)(-6) = -12$ N

The force is of magnitude 12 N.

Q. 8. Amplitude $= \frac{\text{Highest} - \text{Lowest}}{2}$

(i) $\Rightarrow A = \frac{13 - 3}{2}$

$\Rightarrow A = 5$ m

(ii) $\frac{T}{2} = \frac{11}{2}$

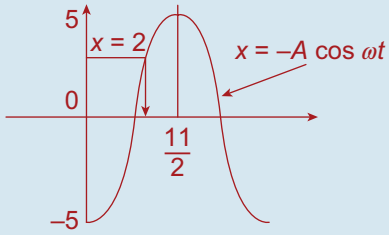
$\Rightarrow T = 11$ hrs

(iii) $T = \frac{2\pi}{\omega}$

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

$\Rightarrow \omega = \frac{2\pi}{11}$ rad/s

Graph:

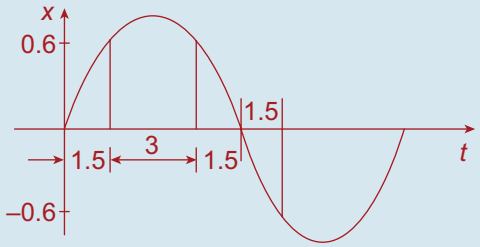


We have $x = -5 \cos \frac{2\pi}{11} t$

$\Rightarrow 2 = -5 \cos \frac{2\pi}{11} t$

$\Rightarrow t = 3.47$ hrs **OR** 3:29 PM

Q. 9. (i) Consider the Sine Curve:



$x = A \sin \omega t$

From the graph $\frac{T}{2} = 6$ s

$\Rightarrow T = 12$ s

(ii) But $T = \frac{2\pi}{\omega}$

$\Rightarrow \omega = \frac{2\pi}{12}$

$\Rightarrow \omega = \frac{\pi}{6}$

$0.6 = A \sin \frac{\pi}{6}(1.5)$

$\Rightarrow \frac{3}{5} = A \sin \frac{\pi}{4}$

$\Rightarrow \frac{3}{5} = A \frac{1}{\sqrt{2}}$

$\Rightarrow A = \frac{3\sqrt{2}}{5}$ m

Q. 10. **Periodic Time:**

$\frac{T}{2} = 6{:}58 - 0{:}58$

$\Rightarrow \frac{T}{2} = 6$ hrs

$\Rightarrow T = 12$ hrs

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

$\Rightarrow \omega = \frac{2\pi}{12}$

$\Rightarrow \omega = \frac{\pi}{6}$ rad/hr