$v = -2A$ when $x = \frac{3A}{5}$ and $A = A$

$v^2 = \omega^2(A^2 - x^2)$

$\Rightarrow 4A^2 = \omega^2\left(A^2 - \frac{9A^2}{25}\right)$

$\Rightarrow 4A^2 = \omega^2\left(\frac{16A^2}{25}\right)$

$\Rightarrow \omega^2 = \frac{25}{4}$

$\Rightarrow \omega = \frac{5}{2}$

Also $x = \frac{34}{5}$ when $t = 0$

$\therefore x = A\cos(\omega t + \alpha)$

$\Rightarrow \frac{3A}{5} = A\cos(\alpha)$

$\Rightarrow \cos\alpha = \frac{3}{5} = 0.6$

$\Rightarrow \alpha = 0.9273$ radians

(ii) Now, $A\cos(\omega t + \alpha) = 0$

$\Rightarrow \omega t + \alpha$

$= \frac{\pi}{2}$ **OR** $\frac{3\pi}{2}$ **OR** $\frac{5\pi}{2}$ etc.

$\Rightarrow \frac{5}{2}t + 0.9273 = \frac{\pi}{2} = 1.571$

$\Rightarrow t = 0.2575$ s

Q. 9. Maximum acceleration must be not greater than g if the bodies are to stay on the platform.

$\Rightarrow \omega^2 A \leqslant 9.8$

$\Rightarrow \omega^2(0.2) \leqslant 9.8$

$\Rightarrow \omega \leqslant 7.$

Taking ω at its maximum value, 7.

$T = \frac{2\pi}{\omega} = \frac{2\pi}{7} = 0.8977$ s

Number of oscillations per minute

$= \frac{60}{0.8977} = 66$ complete oscillations

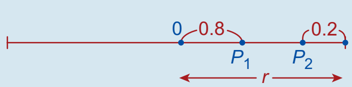
Q. 10. (a) $x = r\cos\omega t$

$\therefore \frac{dx}{dt} = -r\omega\sin\omega t$

$\therefore \frac{d^2x}{dt^2} = -r\omega^2\cos\omega t = -\omega^2 x$

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

(b) (i)



When $x = 0.8$, $v = 6$. When $x = r - 0.2$, $a = -24$ (because a must be negative if x is positive)

$v^2 = \omega^2(A^2 - x^2)$.

Put $x = 0.8$, $v = 6$, $A = r$

$\Rightarrow 36 = \omega^2(r^2 - 0.64)$

.... **Equation 1**

$a = -\omega^2 x$.

Put $x = t - 0.2$, $a = -24$

$\Rightarrow -24 = -\omega^2(r - 0.2)$

$\Rightarrow 24 = \omega^2(r - 0.2)$ ... **Equation 2**

Dividing equation **2** by equations **1** gives:

$\frac{24}{36} = \frac{\omega^2(r - 0.2)}{\omega^2(r^2 - 0.64)}$

$\Rightarrow \frac{r - 0.2}{r^2 - 0.64} = \frac{2}{3}$

(ii) $2r^2 - 1.28 = 3r - 0.6$

$\Rightarrow 2r^2 - 3r - 0.68 = 0.$

$\Rightarrow 200r^2 - 300r - 68 = 0$

$\Rightarrow 50r^2 - 75r - 17 = 0$

$\Rightarrow (5r + 1)(10r - 17) = 0$

$\Rightarrow r = -0.2$ **OR** $r = 1.7$

$r = -0.2$ has no meaning, so $r = 1.7$

Putting this result into equation **2** gives: $24 = \omega^2(1.7 - 0.2)$

$\Rightarrow 24 = \omega^2(1.5) \Rightarrow \omega^2 = 16$

$\Rightarrow \omega = 4$

$\therefore$ Period $= \frac{2\pi}{4} = \frac{\pi}{2}$ s

(iii) Start clock at centre: $x = A\sin\omega t$ i.e. $x = 1.7\sin 4t$

At P_1, $x = 0.8$

$\Rightarrow 0.8 = 1.7\sin 4t$

$\Rightarrow \sin 4t = \frac{8}{17} = 0.4706$

$\Rightarrow 4t = \sin^{-1}(0.4706) = 0.4900$

$\Rightarrow t = 0.1225$ s

At P_2, $x = 1.5$

$\Rightarrow 1.5 = 1.7\sin 4t$

$\Rightarrow \sin 4t = \frac{15}{17} = 0.8824$

$\Rightarrow 4t = \sin^{-1}(0.8824) = 1.0809$

$\Rightarrow t = 0.2702$ s

Time to travel from P_1 to P_2

$= 0.2702 - 0.1225$

$= 0.1477$ s

$= 0.15$ s