

$$7e) \quad x = 6 \sin\left(2t + \frac{\pi}{2}\right)$$

$$t=0, x=6$$

$$\sin\left(2t + \frac{\pi}{2}\right) = 1$$

$$2t + \frac{\pi}{2} = \frac{\pi}{2}, \frac{5\pi}{2}, \frac{9\pi}{2}$$

$$2A = 0, 2\pi, 4\pi$$

$$A = 0, \pi, 2\pi$$

$$\frac{10}{T} = \frac{\pi}{2} \Rightarrow \frac{2\pi}{n} = \frac{\pi}{2}$$

$$t=0, v=0, x=4$$

$$a) \underline{x = 4 \cos 4t}$$

$$\underline{v = -16 \sin 4t}$$

10b)ii)

$$x = 4 \cos 4t$$

$$v = -16 \sin 4t$$

$$x = -2$$

$$\cos 4t = -\frac{1}{2}$$

$$4t = \frac{2\pi}{3}$$

$$t = \frac{\pi}{6}$$

$$v = \pm 8$$

$$\sin 4t = \pm \frac{1}{2}$$

$$4t = \frac{\pi}{6}, \frac{5\pi}{6},$$

$$t = \frac{\pi}{24}, \frac{5\pi}{24}$$

c) $v = \pm 8$

$$-16 \sin 4t = \pm 8$$

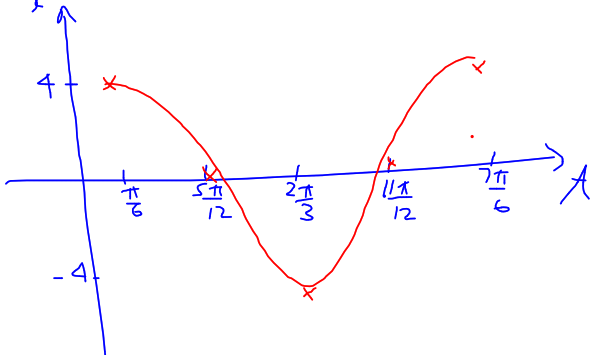
$$\sin 4t = \pm \frac{1}{2}$$

$$4t = \frac{\pi}{6}, \frac{5\pi}{6}$$

$$t = \frac{\pi}{24}, \frac{5\pi}{24}$$

$$\begin{aligned} 12a) \quad x &= 3 - 2 \cos^2 2t \\ x &= 3 - 2 \left(\frac{1}{2} (1 + \cos 4t) \right) \\ x &= \underline{2 - \cos 4t} . \end{aligned}$$

14a) $x = 4 \cos\left(2t - \frac{\pi}{3}\right)$
 amplitude = 4 \uparrow
 $2\left(t - \frac{\pi}{6}\right)$
 period = π
 shift = $\frac{\pi}{6}$ right



at $x=0$, 4 times in
 first 2π seconds.

$$\frac{18}{x} = a \cos\left(\frac{\pi}{8}t + \alpha\right)$$

$$A = 4, v = -4$$

$$v = -\frac{\pi a}{8} \sin\left(\frac{\pi}{8}t + \frac{\pi}{4}\right)$$

$$-4 = -\frac{\pi a}{8} \sin\left(\frac{3\pi}{4}\right)$$

$$4 = \frac{\pi a}{8} \times \frac{1}{\sqrt{2}}$$

$$a = \frac{32\sqrt{2}}{\pi}$$

$$A = 2, x = 0$$

$$0 = a \cos\left(\frac{\pi}{4} + \alpha\right)$$

$$\cos\left(\frac{\pi}{4} + \alpha\right) = 0$$

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

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

$$19 \quad T = 8\pi \Rightarrow \frac{2\pi}{n} = 8\pi$$
$$n = \frac{1}{4}$$

$$x = a \sin(nt + \alpha)$$

$$t = 1, x = 3, v = -1$$

$$3 = a \sin\left(\frac{t}{4} + \alpha\right)$$

$$v = \frac{a}{4} \cos\left(\frac{t}{4} + \alpha\right)$$

$$t = 1, x = 3$$

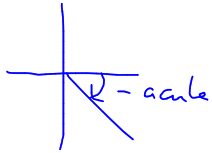
$$3 = a \sin\left(\frac{1}{4} + \alpha\right) \quad (1)$$

$$t = 1, v = -1$$

$$-1 = \frac{a}{4} \cos\left(\frac{1}{4} + \alpha\right) \quad (2)$$

$$\frac{\textcircled{1}}{\textcircled{2}} \rightarrow \frac{a \sin\left(\frac{1}{4} + \alpha\right)}{\frac{a}{4} \cos\left(\frac{1}{4} + \alpha\right)} = \frac{3}{-1}$$

$$\tan\left(\frac{1}{4} + \alpha\right) = -\frac{3}{4}$$



$$\frac{1}{4} + \alpha = \tan^{-1}\left(-\frac{3}{4}\right)$$

$$\alpha = -\frac{1}{4} + \tan^{-1}\left(-\frac{3}{4}\right)$$

$$\therefore \text{acute } \alpha = -0.8935$$

$$= 0.8935$$

$$\sin > 0$$

$$\cos < 0$$

$$\therefore \textcircled{2}$$

$$\alpha = \pi - 0.8935$$

$$a \sin\left(\frac{1}{4} + \alpha\right) = 3$$

$$a \cos\left(\frac{1}{4} + \alpha\right) = -4$$

$$a^2 \left[\sin^2\left(\frac{1}{4} + \alpha\right) + \cos^2\left(\frac{1}{4} + \alpha\right) \right]$$

$$= 25$$

$$a = \pm 5$$

$$\dots a = 5, \alpha = \pi - 0.8935$$

22

t	0	7	9	11	18
x	0	2	$\frac{162}{77}$	2	0

a) $\ddot{x} = k$

$$\dot{x} = kt + c$$

$$x = \frac{1}{2}kt^2 + ct + a$$

$$x = k t(t-18)$$

$$x = 2, t = 7$$

$$2 = 7k(-11)$$

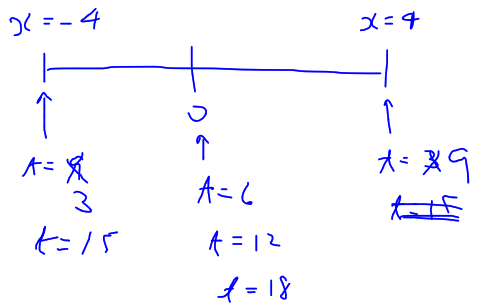
$$k = \frac{2}{-77}$$

22

t	0	7	9	11	18
x	0	2	4	2	0

$$\frac{2\pi}{n} = 12$$

$$n = \frac{\pi}{6}$$



$$x = a \sin \frac{\pi}{6} t$$

$$2 = a \sin \frac{11\pi}{6}$$

$$2 = -\frac{1}{2} a$$

$$a = -4$$

$$x = -4 \sin \frac{11\pi}{6}$$

$$t = 7$$

$$x = -4 \sin \frac{7\pi}{6}$$

$$x = 2$$

$$t = 9$$

$$x = 4 \sin \frac{3\pi}{2}$$

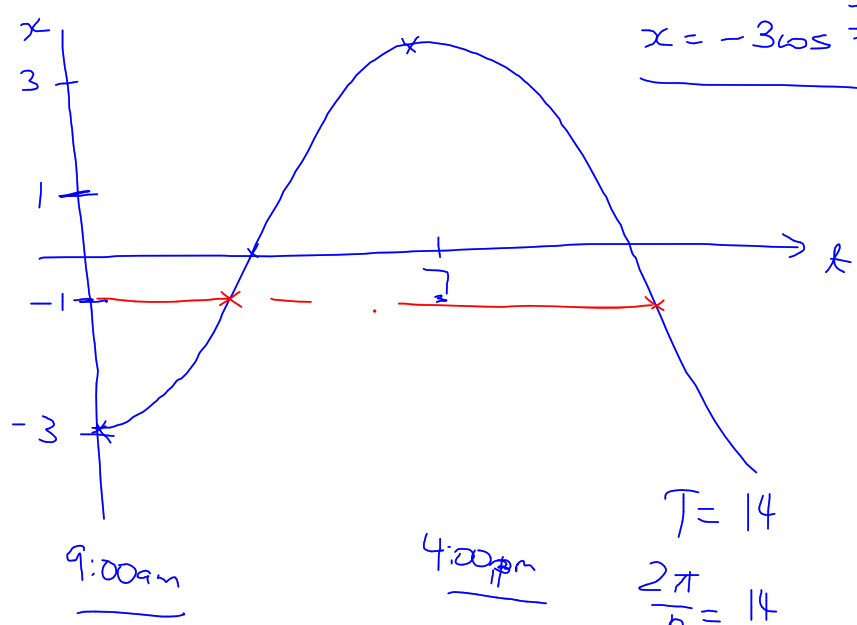
$$x = -4$$

24

(16m)

(12m)

(10m)



$x = -3 \cos \frac{\pi t}{7}$

9:00am

4:00pm

$T = 14$
 $\frac{2\pi}{\omega} = 14$
 $\omega = \frac{\pi}{7}$

$$x = -3 \cos \frac{\pi}{7} t$$

$$\underline{x = -1}$$

$$\cos \frac{\pi}{7} t = \frac{1}{3}$$

$$\frac{\pi}{7} t = \cos^{-1} \frac{1}{3}, 2\pi - \cos^{-1} \frac{1}{3}$$

$$t = \frac{7 \cos^{-1} \frac{1}{3}}{\pi}, \frac{7(2\pi - \cos^{-1} \frac{1}{3})}{\pi}$$

$$= 2.74, 11.26$$

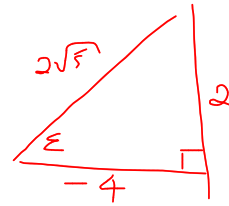
Times are 11:44 am and 8:16 pm

25

$$\cos \alpha \cos \beta + \sin \alpha \sin \beta$$

$$x = -4 \cos 3\pi t + 2 \sin 3\pi t$$

$$x = 2\sqrt{5} \cos(3\pi t - 2.678)$$



$$\tan \epsilon = -\frac{1}{2}$$

$$\epsilon = 2.678$$

b)

$$x = 3$$

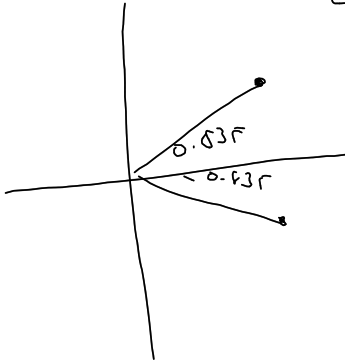
$$3 = 2\sqrt{5} \cos(3\pi t - 2.678)$$

$$\cos(3\pi t - 2.678) = \frac{3}{2\sqrt{5}}$$

$$3\pi t - 2.678 = -0.835, 0.$$

$$3\pi t = 1.843, 3.513$$

$$t = 0.195,$$



$$(iii) v = -6\pi\sqrt{5} \sin(3\pi t - 2.678)$$

$$v = -1$$

$$\sin(3\pi t - 2.678) = \frac{1}{6\pi\sqrt{5}}$$

$$3\pi t - 2.678 = 0.02372$$

$$3\pi t = 2.7017$$

$$t = \underline{\underline{0.287s}}$$

