BB 1.2

(1) $x(t) = A\cos(\omega_0 t) + B\sin(\omega_0 t)$ ← general solution

(2) $v(t) = -\omega_0 A \sin\omega_0 t + \omega_0 B\cos(\omega_0 t)$ ← velocity

At $t=0$, take the position to be $x=0$, so $A = 0$.

At $t = 0$, take the velocity to be maximum. So

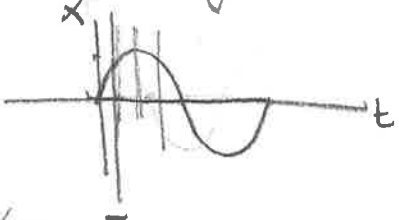
$$5\ m/s = \omega_0 B$$

- Since $\frac{100}{60\,sec} = \text{frequency} = \frac{5}{3}\ Hz$, $T = \frac{3}{5}\ sec$, $\omega_0 = \frac{10\pi}{3}\ \frac{rad}{sec}$.
- Thus $B = \dfrac{5\ m/s}{10\pi/3\ \frac{rad}{sec}} = \dfrac{15}{10\pi}\ meter = \dfrac{3}{2\pi}$
- So the velocity when $x = \frac{B}{2}$ is given by eqn (1)

$$\frac{B}{2} = B\sin\omega_0 t \implies \arcsin\left(\tfrac{1}{2}\right) = \omega_0 t^* \implies \omega_0 t^* = 0.52\ rad.$$

and $v = \omega_0 B\cos(0.52\ rad) = \left(\frac{10\pi}{3}\right)\left(\frac{3}{2\pi}\right)(0.87) = \boxed{4.4\ m/s}$

- What is speed at time equal to ½ the time needed to get to extreme? That is, at $t = \frac{1}{8}T$ (1 period)



$$v\left(\tfrac{1}{4}T\right) = \omega_0 B\cos\left(\omega_0 \tfrac{T}{8}\right) = 5\cos\left(\frac{10\pi}{3}\cdot\frac{3}{5}\cdot\frac{1}{8}\right)$$

$$= 5\cos\left(\frac{\pi}{4}\right)$$

$$= 5(0.707) = \boxed{3.5\ m/s}$$