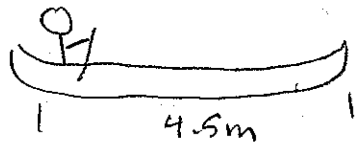
## Optics 2-4




$$v = \frac{4.5\,m}{1.5\,s} = 3.0\ m/s$$

$$\nu = 0.5\ s$$

$$v = \lambda\nu \qquad \lambda = \frac{v}{\nu} = \frac{3.0\,m/s}{0.5\,s} = 6\ m$$

## 2-5

$$\lambda = 4.3\ m$$

$$v = 3.5\ km/s = 3500\ m/s$$

$$v = \lambda\nu = \frac{\lambda}{T}$$

$$T = \frac{\lambda}{v} = \frac{4.3\,m}{3500\,m/s} = 1.26\times10^{-3}\,s$$

2-13 (a) from graph $\lambda \approx 5\ m$

(b) $\nu = \frac{v}{\lambda} = \frac{20\,m/s}{4\,m} = 5\ Hz$

(c) $k = \frac{2\pi}{\lambda} = \frac{2\pi}{4\,m} = \frac{\pi}{2}\ m^{-1}$

$A = 0.020\,m$

Using eq. 2.13 but looks like $-\cos$ fn.
could write

$$\psi(x,t) = -(0.20\,m)\cos[0.4\pi(x - 20\,m/s)t]$$

which could also be written

$$\psi(x,t) = (0.20\,m)\cos[0.4\pi(x - 20\,m/s)t + \pi]$$

2.13 (c) Another way – write w/ sin

$\psi(x,t) = A\sin(kx - \omega t + \epsilon)$

$A = 0.020\,m$

$k = \frac{\pi}{2}\ m^{-1}$ $\qquad \nu = 5\,s^{-1}$

$\omega = 2\pi\nu = 10\pi\ s^{-1}$

$\psi = (0.020\,m)\sin\left(\frac{\pi}{2}x - 10\pi t + \epsilon\right)$

what is $\epsilon$?

$\psi(0,0) = -1.0$ (by graph)

so $\sin(\epsilon) = -1$

$\Rightarrow \epsilon = -\pi/2$

so

$\psi(x,t) = (0.020\,m)\sin\left(\frac{\pi}{2}x - 10\pi t - \pi/2\right)$

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2.19 $\psi(x,t) = A\cos(kx - \omega t)$

$\frac{\partial\psi}{\partial x} = -kA\sin(kx - \omega t)$

$\frac{\partial^2\psi}{\partial x^2} = -k^2A\cos(kx - \omega t) = -k^2\psi$

$\frac{\partial\psi}{\partial t} = -\omega(-A\sin(kx - \omega t)) = \omega A\sin(kx - \omega t)$

$\frac{\partial^2\psi}{\partial t^2} = -\omega^2A\cos(kx - \omega t) = -\omega^2\psi$

Wave eqn (plugging in)

$-k^2\psi = \frac{-\omega^2\psi}{v^2}$

$v^2 = \frac{\omega^2}{k^2}$ ✓ $\qquad$ phase speed $v = \frac{\omega}{k}$