UNIT 2 WS
SOLUTIONS

2.1)

$$y = A \sin kx \cos \omega t$$

$$\frac{\partial y}{\partial x} = Ak \cos kx \cos \omega t \qquad \frac{\partial^2 y}{\partial t^2} = -A\omega \sin kx \sin \omega t$$

$$\frac{\partial^2 y}{\partial x^2} = -Ak^2 \sin kx \cos \omega t \qquad \frac{\partial^2 y}{\partial t^2} = -A\omega^2 \sin kx \cos \omega t$$

WAVE EQN

$$\frac{\partial^2 y}{\partial t^2} = v^2 \frac{\partial^2 y}{\partial x^2}$$

$\Rightarrow$ y IS A SOLUTION IF $\omega^2 = v^2 k^2$

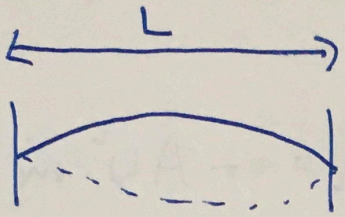
$$v = \frac{\omega}{k}$$

2.2) - SKETCH FS

$A_{max} = 5\,cm$ ~~FULL~~ ~~1.5s~~ (1.0s)

2.3) $m = 5 \times 10^{-3}\ kg$ $L = 1.4m$ $F = 968N$

a) $v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{FL}{m}} = 521\ m/s$

b) 

FUNDAMENTAL HAS $\lambda_1 = 2L = 2.8m$

$f_1 = \frac{v}{\lambda_1} = 186\ Hz.$

c) $f_2 = 2f_1 = 372\ Hz$ $f_3 = 3f_1 = 558\ Hz$

2.4) $y = 2A \sin kx \cos \omega t$

$A = 0.01\,m = 10\,cm \qquad k = \frac{\pi}{2}\,m^{-1} \qquad \omega = 40\pi\,s^{-1}$

a) $\sin\phi + \sin\theta = 2\sin\left(\frac{\phi+\theta}{2}\right)\cos\left(\frac{\phi-\theta}{2}\right)$

$\Rightarrow y = A\sin(kx - \omega t) + A\sin(kx + \omega t)$

b) $\lambda = \frac{2\pi}{k} = 4m$

NODAL SEPARATION $= \frac{\lambda}{2} = \underline{\underline{2m}}$

c) $x = 1m \Rightarrow \sin(kx) = \sin\frac{\pi}{2} = 1$

$\Rightarrow y(x=1m) = 2A\cos\omega t$

$v(x=1m) = \left.\frac{\partial y}{\partial x}\right|_{1m} = -2A\omega\sin\omega t$

$= -0.8\pi\sin(40\pi t)\ m/s$

$\underline{\underline{\qquad}}$

d) $a(x=1m) = \left.\frac{\partial^2 y}{\partial x^2}\right|_{x=1m} = -2A\omega^2\cos\omega t$

$= -32\pi^2\cos(40\pi t)\ ms^{-2}$

$\underline{\underline{\qquad}}$