Ch. 14

#1 (A) $y_1(1,1) + y_2(1,1) =$ **$-1.65\,cm$**

(B) $y_1(x,t) + y_2(x,t)$ @ $x = 1, t = 1/2$; $y_1 + y_2 =$ **$-6\,cm$**

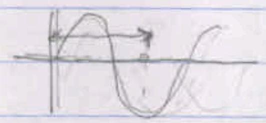
(C) **$1.15\,cm$**

#6 $\lambda = 3\,m$; $v = 2\,m/s$; $y_1 = A\sin(kx - \omega t)$ &

$y_2 = A\sin(kx - \omega t + \phi) \Rightarrow y_1 + y_2 = 2A\cos(\phi/2)\sin(kx - \omega t + \phi/2) = y$ final

$A_f = 2A\cos(\phi/2) = A$, solve for $\phi \Rightarrow \phi = \frac{2\pi}{3} =$ **$120° = \phi$**

time delay $= T/3 = \lambda/3v =$ **$1/2\,sec$**



Sine distance wave must start is

$kd = \phi = 120° = \frac{2\pi}{3} = \frac{2\pi}{\lambda} d \Rightarrow d = \lambda/3 \Rightarrow t = \frac{d}{v} = \frac{\lambda}{3v}$ ✓

#12 $y = y_1 + y_2 = 2A\sin(kx)\cos(\omega t)$ w/ $A = \frac{3}{2}\,m$

$k = 6.4/m$ & $\omega = 200/sec \Rightarrow \lambda = 2\pi/k =$ **$15.7\,m = \lambda$**

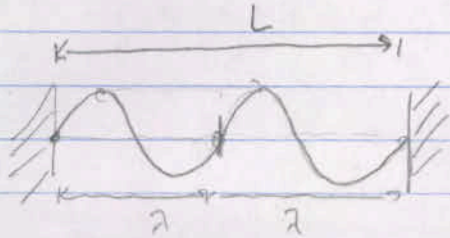
$f = \frac{\omega}{2\pi} =$ **$32\,Hz$** & $v = \lambda f =$ **$500\,m/s$**

#16 (A) $y = A\sin(kx - \omega t + \phi) + A\sin(kx + \omega t) = 2A\sin(kx + \frac{\phi}{2})\cos(\omega t - \frac{\phi}{2})$

Nodes @ $kx + \frac{\phi}{2} = n\pi \Rightarrow$ **$x = \frac{n\pi}{k} - \frac{\phi}{2k}$, shifted to the left**

(B) $\Delta x = x_{n+1} - x_n = \frac{(n+1)\pi}{k} - \frac{n\pi}{k} = \frac{\pi}{k} =$ **$\frac{\lambda}{2} = \Delta x$**

#18



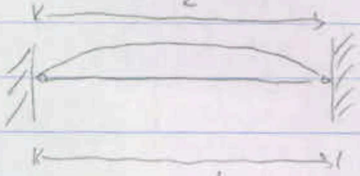
$L = 120\,cm$; 4 segments
$f = 120\,Hz$

(A) $L = 2\lambda \Rightarrow$ **$\lambda = 60\,cm$**

(B) $f_1 = \frac{v}{2L} =$ **$30\,Hz$**

$m = 1.2\,g$, $L = 70\,cm$ $\Rightarrow$ $\mu = \frac{m}{L}$

#23



1^{st} mode:

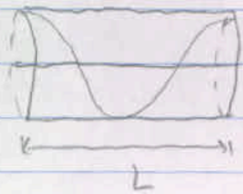
(A) standing wave frequencies $= f_n = v\left(\frac{n}{2L}\right)$ w/ $v = \left(T/\mu\right)^{\frac{1}{2}}$

$220\,Hz = f_1 = \frac{v}{2L} = \left(\frac{T}{\mu}\right)^{1/2}\frac{1}{2L}$ $\Rightarrow$ solve for T: $T = 163\,N$

(B)

$n = 3 \Rightarrow f_3 = v\frac{3}{2L} = 660\,Hz$

#35



2nd harmonic shown (n=2)

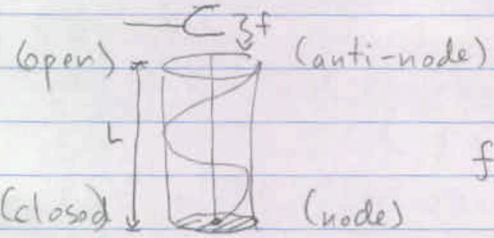
open pipe: $f_n = \left(\frac{v}{2L}\right)n$

solve for L:

$L_n = \left(\frac{v}{2f}\right)n$ w/ $f = 680\,Hz$

$\Rightarrow$ $L_1 = 0.252\,m$, $L_2 = 0.5\,m$ etc..

#37



$f = 384\,Hz$

$f_n = n\frac{v}{4L}$, $n = 1, 3, 5, \ldots$ (odd)

At (f_1, L_1) $f_1 = \frac{v}{4L_1} = 384 = \frac{v}{4(22.8\,cm)}$ &

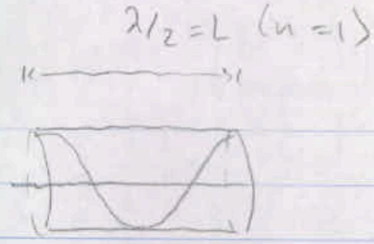
$\Rightarrow$ solve for v:

At (f_3, L_3) $f_3 = \left(\frac{v}{4L_2}\right) \cdot 3 = 384 = \frac{v}{4(0.683\,m)}$

$v = 350\,m/s$

Here, resonance is heard when the distance is changed.

#38



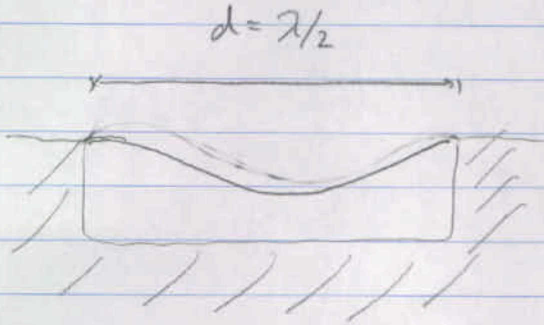
open @ both ends

(A) $f = 880\,Hz$ @ $T = 20°C$; $n = 1$: $L = \lambda/2 = \frac{v}{2f} = $ **0.2 m**

(B) $v = 331 + 0.6 \cdot (-5°C) = 328\ m/s \Rightarrow$

$f = v/\lambda = v/2L = $ **842 Hz**

#44



(A) $v = \frac{d_{tot}}{T_{tot}} = \frac{\lambda}{f} = $ **3.66 m/s**

(B) Anti-nodes @ ends $\Rightarrow d = \lambda/2 \Rightarrow \lambda = 18.3\,m$

(C) $f = v/\lambda = $ **0.2 Hz** w/ v = same for all wavelengths since v depends on the medium (water).