1.

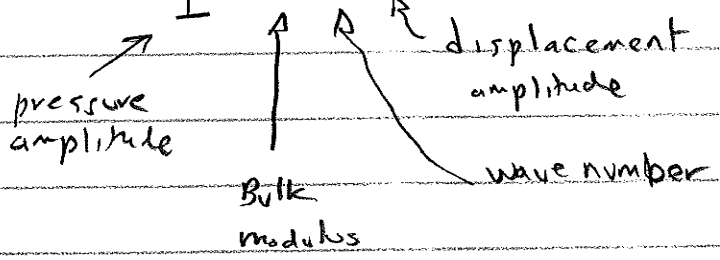
P9B FALL 2013

ASSIGNMENT 3

16- 3, 6, 25, 33, 37, 45, 73

16-3 The relation between pressure amplitude and displacement amplitude is:

$$P = BkA$$



Here $A = .02$ mm

$f = 150\,Hz, 1500\,Hz, 15000\,Hz$

$v_{sound} = 344$ m/s

$B = 1.42 \cdot 10^5$ Pa

a) $\lambda f = v \quad \lambda = 344/150 = 2.29$ m

$k = 2\pi/\lambda = 2.74\ m^{-1}$

$P = BkA = 1.42 \cdot 10^5\,Pa\,(2.74)(.02 \cdot 10^{-3}) = 7.78$ Pa

< PAIN THRESHOLD

b) $f = 1500 \rightarrow \lambda = 1/10$ as in (a)

$\rightarrow k = 10 \times$ as in (a) $\rightarrow P = 77.8$ Pa > PAIN

c) $f = 15000 \quad P = 778$ Pa > PAIN

16-6

a) $v = \sqrt{B/\rho} \rightarrow B = \rho v^2 = (1300)\left((400)8\right)^2 = 1{,}33 \cdot 10^{10}$ Pa

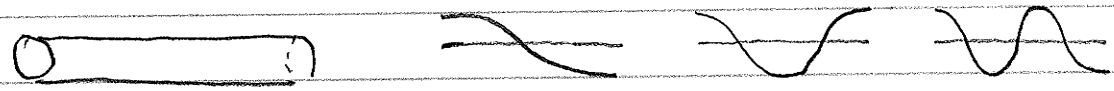
($v = f\lambda$)

b) $v = \sqrt{Y/\rho} \rightarrow Y = \rho v^2 = 6400(3846)^2 = 9{,}47 \cdot 10^{10}$ Pa

$v = \ell/t = 1{,}5/3{,}9 \cdot 10^{-4} = 3846$

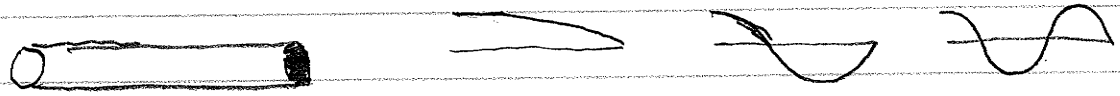
16-25

A) OPEN BOTH ENDS



$\ell = 1{,}2$ $\quad \frac{1}{2}\lambda = \ell$ $\quad \lambda = \ell$ $\quad \frac{3}{2}\lambda = \ell$

B) CLOSED ONE END



$\frac{1}{4}\lambda = \ell$ $\quad \frac{3}{4}\lambda = \ell$ $\quad \frac{5}{4}\lambda = \ell$

A)

DISPLACEMENT NODES	$x = 0.6$	$x = 0.3, 0.9$	$x = 0.2, 0.6, 1.0$
PRESSURE NODES	$x = 0, 1.2$	$x = 0, 0.6, 1.2$	$x = 0, 0.4, 0.8, 1.2$

B)

DISPLACEMENT NODE	$x = 1.2$	$x = 0.4, 1.2$	$x = 0.24, 0.72, 1.2$
PRESSURE NODE	$x = 0$	$x = 0, 0.8$	$x = 0, 0.48, 0.96$

3.

16-33 a) For constructive interference the extra distance traveled from A must be an integer # of wavelengths

$\ell = n\lambda$ ⇕ extra distance $\qquad \lambda = 2/n$

lowest frequency ⇒ largest λ so $n = 1$

$\lambda = 2$ m

$\lambda f = v = 344$

a) $f = 172 \text{ sec}^{-1}$

b) Destructive interference

$\ell = \frac{1}{2}\lambda, \frac{3}{2}\lambda, \ldots$

again largest λ gives lowest f

$\lambda_{max} = 4 \qquad \lambda f = v = 344$

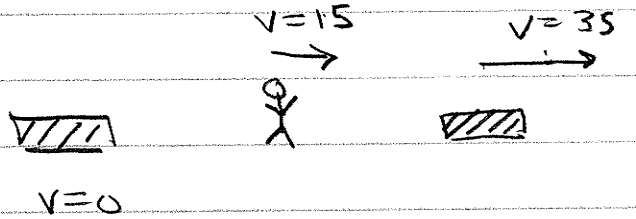
b) $f = 86 \text{ sec}^{-1}$

16-37 The difference in distance is 1.4 m

The wavelength $\lambda = v/f = 344/860 = 0.4$ m

Distance difference is $\frac{7}{2}\lambda$ ⟶ destructive.

16-45 $f = 392$ Hz



$V_{SOUND} = 344$

a) $f' = 392 \dfrac{344 - 15}{344} = 375$ Hz

b) $f' = 392 \dfrac{344 + 15}{344 + 35} = 371.2$ Hz

} beat = 4 Hz

16-73 $\frac{1}{2}mv^2 = mgh$

$v = \sqrt{2gh} = 49.5$ m/s

9.8 125

a) $f = 2500 \dfrac{344 - 49.5}{344 + 49.5} = 2186$ Hz

b) $f = 2500 \dfrac{344}{344 - 49.5} = 2920$ Hz.