Ex 14.9 # 43, 40 ← use $v = \sqrt{\frac{F}{\mu}}$ 1st

Harmonics (sound waves)

$L = 2.46\text{m}$

$v = 345 \frac{m}{s}$

the different f that come out of pipe after a vibration is started.

find f_1, f_2, f_3

if $v = f\lambda$

then $v = f 2L$

$f = \frac{v}{2L}$

for $n=1$ (1st harmonic)

$f_1 = \frac{v}{\lambda_1} = \frac{v}{2L} = \frac{345}{2(2.46)} = 70\text{Hz}$

$\lambda_1 \rightarrow 2L$

$n=2$ $\lambda_2 = \frac{\lambda_1}{2}$ half of λ_1

$f_2 = \frac{v}{\frac{2L}{2}} = \frac{v}{L} = \frac{345}{2.46} = 140\text{Hz}$

$n=3$ $f_3 = \frac{v}{\frac{2L}{3}} = \frac{3v}{2L} = \frac{3(345)}{2(2.46)} = 210\text{Hz}$

B) lowest 3 f if one end gets closed! (will only get odd harmonics)

$f_1 = \frac{v}{4L} = \frac{345}{4(2.46)} = 35\text{Hz}$

$f_3 = 3f_1 = 3(35) = 105\text{Hz}$ $f_5 = 5(f_1) = 5(35) = 175\text{Hz}$

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$\lambda = 2L$ ← 2xL to make 1 cycle

if pipe open on both ends

$\lambda = 4L$ ← 4xL to make 1 cycle

if closed on one end