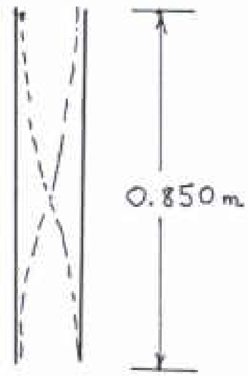
Name________________________________

Phys 121
Quiz #6

1. The fundamental standing (sound) wave in a pipe which is open at both ends "looks like" the diagram shown here. Suppose the pipe has a length of 0.85 m.



a) What is the wavelength of the standing wave?

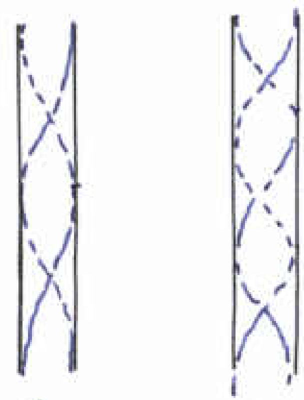
Pipe "contains" a half-wavelength ; $L = \frac{\lambda}{2} = 0.850\ m$

$\rightarrow \quad \lambda = 2(0.850\,m) = \boxed{1.70\ m}$

b) What is the frequency of the wave?

$$f = \frac{v_{sound}}{\lambda} = \frac{343\ m/s}{1.70\,m} = \boxed{202\ Hz}$$

c) Sketch the "pictures" of the next two standing waves in the space given here.



A B

d) What are the frequencies of the harmonics which you sketched in part (c)?

For mode A, $\lambda = L = 0.850\ m$, so

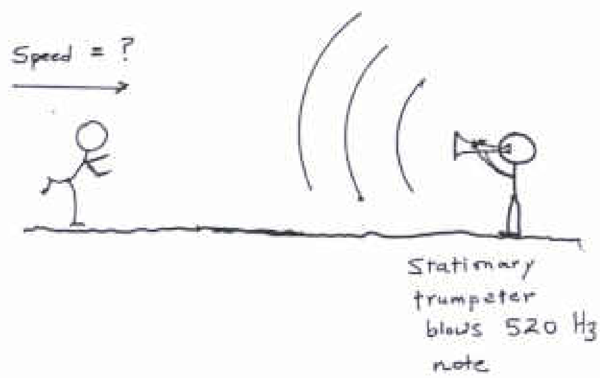
$$f_2 = \frac{343\ m/s}{0.850\ m} = \boxed{404\ Hz}$$

For mode B, $L = \frac{3}{2}\lambda$ so $\lambda = \frac{2}{3}(0.85\,m) = 0.567\,m$

and

$$f_3 = \frac{343\ m/s}{0.567\,m} = \boxed{605\ Hz}$$

2. A man runs toward a trumpet player who blows a note of frequency 520 Hz; the runner *hears* a note of frequency 532 Hz. How fast is the man running?



$f' = 532\ Hz \quad f = 520\ Hz$

$v_s = 0 \quad v = 343\ \frac{m}{s}$

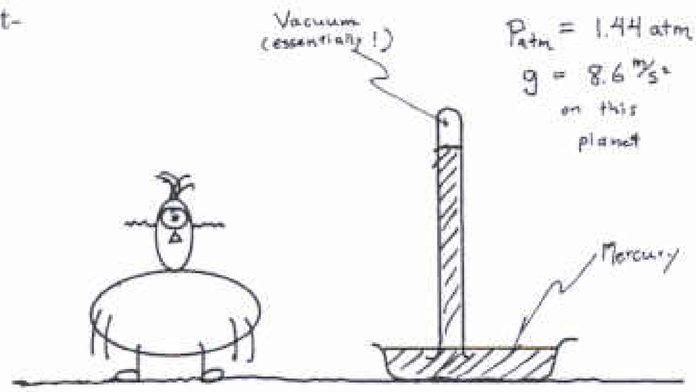
$$(532\ Hz) = (520\ Hz)\left(\frac{1 + v_o/v}{1}\right)$$

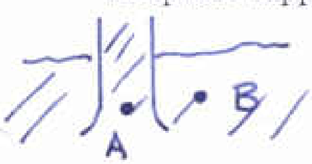
$$1 + \frac{v_o}{v} = \frac{532\ Hz}{520\ Hz} = 1.023$$

$$\Rightarrow v_o/v = 0.023 \qquad v_o = (0.023)(343\ \tfrac{m}{s}) = \boxed{7.9\ \tfrac{m}{s}}$$

3. The planet Št̗ól̆–Ģîḅ has a surface pressure of 1.44 atm and a gravitational acceleration of 8.6 $\frac{m}{s^2}$.

If we take a standard mercury barometer to Št̗ól̆–Ģîḅ, how tall a column of mercury will the atmosphere support?





Pressures of A and B (just below surface) are equal.

$P_A = P_B$

$$\rightarrow \rho_{merc}\, g_{xe}\, h = P_{atm} = 1.44\ atm$$

Solve for h:

$$h = \frac{(1.44\ atm)}{\rho_{merc}\ g_{xe}} \cdot \frac{1.013 \times 10^5\ N/m^2}{1\ atm} = \frac{1.46 \times 10^5\ N/m^2}{(13.6 \times 10^3\ kg/m^3)(8.6\ m/s^2)} = \boxed{1.25\ m}$$

$= 1250\ mm$

You must show all your work!

$$\lambda f = v \qquad \text{Use } v_{\text{sound}} = 343\,\frac{\text{m}}{\text{s}} \qquad v = \sqrt{\frac{F}{\left(\frac{m}{L}\right)}}$$

$$f_{\text{beat}} = |f_2 - f_1| \qquad f' = f\left(\frac{1 \pm \frac{v_o}{v}}{1 \mp \frac{v_s}{v}}\right) \qquad \rho = \frac{M}{V} \qquad \rho_{\text{Merc}} = 13.6 \times 10^3\,\frac{\text{kg}}{\text{m}^3}$$

$$P_2 - P_1 = \rho_{\text{fluid}}\, g h \qquad P = P_{\text{atm}} + \rho g h \qquad 1\ \text{atm} = 1.013 \times 10^5\,\frac{\text{N}}{\text{m}^2}$$