1.

a. $12 = \sqrt{\frac{T}{0.4}}$ so $T = 57.6$N

b. $12 = (2)(\nu)$ so $\nu = 2$Hz

c.

i. $\lambda_n = \frac{2L}{n}$ and $\lambda_{n+1} = \frac{2L}{n+1}$

$4 = \frac{2L}{n}$ and $3.2 = \frac{2L}{n+1}$

$n = 4$ so $L = 8$m

ii. $0.4\text{kg/m} = \frac{m}{8}$ so $m = 3.2$kg

2.

a. $\lambda = 0.60m$

b. $v = \lambda \cdot \nu = (0.60m)(120Hz) = 72m/s$

c. Doubling the number of loops requires lessening the wavelength by one-half. If the frequency is constant, a lesser wavelength requires a lesser wave velocity, so the mass should be reduced.

d. 1cm

3.

a. 343m/s = (λ)(300Hz) so λ = 1.14m

b. (343m/s)(0.06s) = 2d so d = 102.9m

c. 600m/s = (λ)(300Hz) so λ = 2m and the string will hold one full wave

d. If mass is quadrupled, the velocity will halve to 300m/s, making λ = 1m, so the string will hold two full waves.

4.

a. If all strings have the same length, but different fundamental frequencies, they must have different wave velocities in them. If the lengths and tensions are all the same, the strings must have different masses.

b. v = $\lambda \cdot \nu$ and all strings have a fundamental wavelength of 2L, so

$\sqrt{\frac{T}{\mu}}$ = (2L)(ν) which shows frequency is not linearly related to the inverse of mass density. The graph will not be linear.

c. From left to right, there are eleven dashed lines between the oscillator and pulley. Lines three and nine will be antinodes and have the greatest average speed.

5.

a. $\lambda = 2L$

b. $v = (2L)(f_0)$

c. $v = (L)(f_1)$ so $(2L)(f_0) = (L)(f_1)$ and $f_1 = 2f_0$

d. $h = \frac{1}{4}\lambda = \frac{L}{2}$

e. Because the speed of sound is constant, as frequency rises, fundamental wavelength decreases, so h would be less than previously.

f. The third harmonic could resonate at $h = \frac{3L}{2}$.

6.

a and b. Push the piston fully to the left so that L = 0. Set the sine-wave generator to emit a frequency *f*. Slowly pull the piston to the right until the waveform display shows a steady standing wave form with only one antinode. This indicates the glass tube is resonating at its fundamental frequency. With the meterstick, measure the distance between the closed left-end of the tube and the piston. Multiply this by two to find the fundamental wavelength and multiply this by *f* to find the speed of sound.

c. Vary the frequency emitted by the sine-wave generator (independent variable) and the distance as measured by the meterstick (dependent variable) will also vary. Double this distance to find λ for each *f*. Graph λ on the y-axis and f^{-1} on the x-axis. The slope of this graph is the speed of sound in air.