5. The sound will resonate in the tube at certain length. The difference between two consecutive length is equal to the distance between two antinodes on the wave, which is equal to half its wavelength

$$\Delta L = \tfrac{1}{2}\lambda$$

$$2\Delta L = \lambda$$

$$v_{sound} = \lambda f = 2\Delta L f = 2(.664\text{m} - .219\text{m})(384\text{Hz})$$

$$= 341.76\ \text{m/s}$$

6. The wave approaching the observer directly from the boy undergoes a Doppler shift from the emitted frequency ν to a received ν_1 given by

$$\nu_1 = \nu \frac{|v|}{|v| - |v_s|}$$

$|v|$ ← velocity of boy

$|v_s|$ ← speed of sound

Since the boy is receding from the wall, the waves strike the wall with the frequency ν_2 given by

$$\nu_2 = \nu \left(\frac{|v|}{|v| + |v_s|}\right)$$

Since the wave are reflected without any change of frequency, the observer will perceive beats at a frequency

$$\Delta\nu = \nu_1 - \nu_2 = \nu|v|\left(\frac{1}{|v| - |v_s|} - \frac{1}{|v| + |v_s|}\right) = \nu|v|\left(\frac{2|v_s|}{|v|^2 - |v_s|^2}\right)$$

$$\Rightarrow \nu = \Delta\nu\,(|v| + |v_s|)(|v| - |v_s|)\,/\,2|v||v_s|$$

with $\Delta\nu = 4.0\,\text{Hz}$, $|v| = 340\,\text{m/s}$, $|v_s| = 1.0\,\text{m/s}$, $\Rightarrow$

$$\nu = 4.0 \cdot 341 \cdot 339\,/\,2(340)(1.0) = 680\,\text{Hz}.$$