Reading 1/17 Solutions

① (a) The higher mode corresponds to the lower wavelength $\lambda = 1.500\ m$. As m increases, more wavelengths "fit" in the pipe.

(b) Assuming (17.17) applies

$$2.000\ m = \lambda_m = \frac{2L}{m}$$
$$1.500\ m = \lambda_{m+1} = \frac{2L}{m+1}$$
$$\Rightarrow \frac{4}{3} = \frac{m+1}{m}$$
$$4m = 3(m+1)$$
$$\boxed{m = 3}\ \checkmark$$

Assuming 17.18 applies

m must be odd

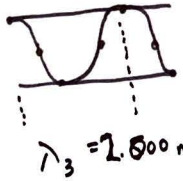
$$2.000\ m = \lambda_m = \frac{4L}{m}$$
$$1.5000\ m = \lambda_m = \frac{4L}{m+2}$$
$$\frac{4}{3} = \frac{m+2}{m}$$
$$4m = 3(m+2)$$
$$m = 6 \quad (m+2 = 8)$$

but m was odd!

contradiction ✗

Since (17.18) leads to a contradiction, it must be (17.17) and the pipe is **open-open**

(c) $m = 3$



Length of the pipe is

$$\boxed{L = \frac{3}{2}\lambda_3 = \frac{3}{2}(2.000\ m) = 3.000\ m}$$

fund. wavelength is $\boxed{\lambda_1 = 6.000\ m}$

② We hear about 5 "beats" in 2 seconds so beat frequency is about 2.5 Hz. One fork is 288 Hz so the other is either

$$\boxed{\begin{matrix} 285.5\ Hz \\ \text{or} \\ 290.5\ Hz \end{matrix}}$$

Extra: We know he lowered the frequency (relative to 288 Hz) so it must be $\boxed{285.5\ Hz}$