Serway + Vuille 8th Edition
Chapter 14 Homework

4. $h = 150m$ $\quad V = \frac{d}{t} \therefore t = d/V$

$d = 2h = 300m$ $\quad t = \frac{300m}{1530 m/s} = 0.196s$

$t' = 25°C$

$V_{seawater} = 1530 m/s$

12. $I_1 = 100.0 W/m^2$ $\quad R_1 = R_2$ (same distance)

2nd sound is 10dB greater $\quad I_2 = ?$

$$\beta_1 = 10 \log\left(\frac{I_1}{I_0}\right) = 10 \log\left(\frac{10^2}{10^{-12}}\right) = 140 dB$$

$$\therefore \beta_2 = \beta_1 + 10 dB = 150 dB = 10 \log\left(\frac{I_2}{10^{-12}}\right)$$

$$15 = \log\left(\frac{I_2}{10^{-12}}\right) \quad \therefore I_2 = 10^3 W/m^2$$

24. $v_s = 172 m/s = \frac{v}{2}$

$f_s = 5.00 kHz$

$v_0 = 0$

Let v = velocity of sound

a) $f' = f_s\left(\frac{v}{v - v/2}\right)$

$= (5.00 kHz)\left(\frac{v}{v/2}\right)$

$= 10.0 kHz$

b) $f' = 5.00 kHz\left(\frac{v}{v + v/2}\right) = \frac{v}{(\frac{3}{2})v}(5.00 kHz)$

$f' = \frac{2}{3}(5.00 kHz) = 3.33 kHz$

The frequency seems lower as the sound moves away from the listener.

25. $V_1 = 130\ km/h = V_o$

$V_2 = 90.0\ km/h = V_s$

$f = 500\ Hz$

$V = 345\ m/s$

$$f' = f\left(\frac{V + V_o}{V - V_s}\right)$$

$$V_o = 130\ \frac{km}{h}\left(\frac{1\ h}{3600\ s}\right)\left(\frac{1000\ m}{1\ km}\right) = 36.1\ m/s$$

and $V_s = 90.0\ \frac{km}{h} = 25.0\ m/s$

$$f' = 500\ Hz\left(\frac{345 + 36.1}{345 - 25}\right) = 595\ Hz$$

38. $L = 0.7000\ m$

$m = 4.300 \times 10^{-3}\ kg$

$f_c = 261.6\ Hz$

$L = \lambda/2 \Rightarrow \lambda = 1.400\ m$

$V = f\lambda = (261.6\ Hz)(1.400\ m) = 366.2\ m/s$

$\mu = m/L = 6.143 \times 10^{-3}\ kg/m$

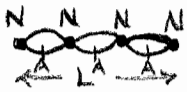
$V = \sqrt{T/\mu}\ \therefore\ T = \mu V^2$

$T = \left(6.143 \times 10^{-3}\ \frac{kg}{m}\right)(366.2\ m/s)^2 = 824.0\ N$

39. $m = 40.0\ g = 4.00 \times 10^{-2}\ kg$

$L = 8.00\ m$

$T = 49.0\ N$

a) 

3rd harmonic

$\frac{3}{2}\lambda$

$\therefore 8.00\ m = 1.5\lambda \Rightarrow \lambda = 5.33\ m$

Nodes occur at 0, 2.67m, 5.33m and 8.00m. The antinodes occur ½ way between Nodes ∴ at 1.33m, 4.00m, and 6.67m

b) $f = ?$

$$\mu = \frac{m}{L} = \frac{4.00 \times 10^{-2}\ kg}{8.00\ m} = .00500\ kg/m$$

$$V = \sqrt{F/\mu} = \sqrt{\frac{49.0\ N}{.00500\ kg/m}} = 99.0\ m/s$$

$$f = \frac{V}{\lambda} = \frac{99.0\ m/s}{5.33\ m} = 18.6\ Hz$$

58. $L_1 = L_2$ $f_1 = 480\,Hz$ at 300K (closed pipes)

$T' = 305\,K$ The speed of sound varies with temperature:

$$V = (331\,m/s)\sqrt{T/273k}$$

$$\therefore V_1 = 331\,m/s\sqrt{\frac{300}{273}} = 347\,m/s$$

$$V_2 = 331\,m/s\sqrt{\frac{305}{273}} = 350\,m/s$$

$L = \lambda/4$ (fundamental) $\therefore \lambda = 4L$ for both pipes

$V_1 = f_1\lambda_1$ and $V_2 = f_2\lambda_2$ but $\lambda_1 = \lambda_2$

$$\frac{V_1}{f_1} = \frac{V_2}{f_2} \quad \therefore f_2 = \frac{f_1 V_2}{V_1} = \frac{(480\,Hz)(350\,m/s)}{(347\,m/s)}$$

$$f_2 = 484\,Hz$$

$$\therefore f_{Beat} = |f_2 - f_1| \approx 4.00\,beats/s$$

if you keep v's as $331\,m/s\sqrt{T/273}$:

$$f_2 = 480Hz\left(\sqrt{\frac{305}{300}}\right) = 483.98\,Hz$$

$$\approx 3.98\,beats/s$$