Chapter ***15*** *(Bueche & Jerde)* ***Sound***

P01 $\ell = v\,t$ = (343)(5.50) = 1890 (m) .

P03 For f = 530 Hz, $\lambda = v/f$ = 343/530 = 0.647 (m). For f = 180 Hz, $\lambda = v/f$ = 343/180 = 1.91 (m). For f = 1550 Hz, $\lambda = v/f$ = 343/1550 = 0.221 (m) .

P09 $B = \rho v^2$ = (1850)(34552) = 2.21×1010 (Pa) .

P11 (**a**) v_w = 1482m/s, so $t = x/v_w$ = 2(3.85)/1482 = 5.20×10^{-3} (s); (**b**) $f = 1/\tau = 1/t = 1/(5.20\times10^{-3})$ = 192 (Hz). For shallower depths the times t decreases and so the frequency increases .

P12 Take railroad as iron. $t_{rail} = \ell/v_{iron} = \ell/5130$. $t_{air} = \ell/343$. $t_{air} - t_{rail}$ = 2.56 . We obtain ℓ = 932 m .

P19 63.0 = 10 log(35I/I_0) and 57.0 = 10× log[(35–x)I/I_0] give x = 26 .

P21 β = 25 dB. $I = 10^{\beta/10}\times I_0 = 10^{2.5}\times(1.00\times10^{-12})$ = 3.16×10^{-10} (W/m^2) .

P29 (**a**) For constructive interference, $L - (L-x) = x = \pm n\lambda$. $\lambda = v/f$ = 343/3400 = 0.1019 (m), so x = ±10.0n cm; (**b**) For destructive interference, $L - (L-x) = x = (1/2 \pm n)\lambda$. So x = (5.00±10.0$n$) cm .

P31 Let x be the distance from detector to source at x = 0, then minimum sounds occurs at x – (4.60–x) = ±(1/2 + n)λ . So x = 2.30 ± (1/4 + n/2)(0.42) m with n = 0, 1, 2, 3,…, 10 .

P34 $f_b = |f_1 - f_2| \Rightarrow f_2 = f_1 \pm f_b$; f_2 = 276.3 or 273.7Hz .

P35 $f_b = |f_1 - f_2|$ = 321.1 – 320.4 = 0.7 (Hz) .

P41 (**a**) 747 – 581 = 581 – 415 = 166 . But 415/166 is *not* an integer, f_1 = 166/2 = 83 (Hz). (**b**) 415 : 581 : 747 = 5 : 7 : 9, so the tube is that one end is open and the other is closed .

P43 $f \propto v$, $f_{27}/f_{18} = v_{27}/v_{18}$, f_{27} = (630)[331.45+(0.610)(27.0)]/[331.45+(0.610)(18.0)] = 640 (Hz). f_b = 640 – 630 = 10 (Hz) .

P48 At wall, $f_w = f_o\, v/(v - v_s)$ = (440)[343/(343–12.5)] = 457 (Hz). The frequency of reflected wave is $f_r = f_w(v + v_L)/v$ = (457)(343+12.5)/343 = 474 (Hz) .

P50 $f_1 = f_o\, v/(v - v_1)$ = (550)(343)/(343–32.0) = 607 Hz. $f_b = |f_1 - f_2|$ = 4.4 Hz . So f_2 = 607 ± 4.40 Hz. For f_2 = 611.4 Hz, 611.4 = (550)(343)/(343–v_2) leads to v_2 = 34.1m/s and for f_2 = 602.6 Hz, we have v_2 = 29.7 m/s .

P54 v_{30} = 331.45 + 0.610(30.0) = 349.75 (m/s). The frequency of the standing wave on the wire is f_5 = $(5/2L)(F/\mu)^{1/2}$ = $(5/8.00)(340/0.00220)^{1/2}$ = 246 (Hz). Since the tube has one open end and one closed, $f = n\, v_{30}/4L$ = 246 . Solving this we have n = 3 .

P57 $t_1 = (2h/g)^{1/2}$ and $t_2 = h/v$. So $t_1 + t_2 = (2h/g)^{1/2} + h/v$ = 3.34 gives h = 50.4 m .

P56 v_L = 100 km/h = 27.8 m/s and v_{23} = 345.48 m/s. $f_A = f_o(v + v_L)/v$ = 1.08 f and $f_B = f_o(v - v_L)/v$ = 0.920f . $f_b = f_A - f_B$ = 1.08 f_o – 0.920 f_o = 20 Hz gives f_o = 125 Hz