Physics 1B HW#4

16.39) $f_{beat} = f_a - f_b$

a) $f = 446\,Hz$

$\therefore f_{violin} = 446\,Hz$ or $454\,Hz$

$\lambda f = \sqrt{\frac{T}{\mu}}$

if $T\uparrow$, $f\uparrow$

$\therefore$ **$f_{violin} = 446\,Hz$**

b) $446\,Hz > 440\,Hz$

$\therefore T\downarrow$, $f\downarrow$

Loosen

16.40) Mixed: $f = n\frac{v}{4L}$

$L_1 = 1.03m$

$L_2 = 1.06m \rightarrow$ lower f

$f_{L1} = \frac{v}{4L} = \frac{v}{4.12m}$

$f_{L2} = \frac{v}{4L} = \frac{v}{4.24m}$

$v = \lambda f$

$f_{L1} = \frac{344\frac{m}{s}}{4.12m} = 83.5\,Hz$

$f_{L2} = 81.13\,Hz$

$f_{beat} = 2.37\,Hz$

16.42) $\lambda_{front} = \frac{v - v_s}{f_s}$

a) $\lambda_{front} = \frac{344\frac{m}{s} - 26\frac{m}{s}}{450\,Hz}$

$\lambda_{front} = 0.707m$

b) $\lambda_{back} = \frac{v + v_s}{f_s}$

$\lambda_{back} = \frac{344\frac{m}{s} + 26\frac{m}{s}}{450\,Hz}$

$\lambda_{back} = 0.622m$

c) $f_L = \frac{v \pm v_{ear}}{v \pm v_s} f_s$

$f_L = \frac{344\frac{m}{s}}{344\frac{m}{s} - 26\frac{m}{s}} (450\,Hz)$

$f_L = 486.79\,Hz$

d) $f_L = \frac{344\frac{m}{s}}{344\frac{m}{s} + 26\frac{m}{s}} (450\,Hz)$

$f_L = 418.58\,Hz$

16.43) $f_{whistle} = 392\,Hz$

a) $v_A = 0\frac{m}{s}$

$v_D = 35\frac{m}{s}$

$v_L = 15\frac{m}{s}$

$f_L = \frac{344 - 15\frac{m}{s}}{344\frac{m}{s}} (392\,Hz)$

$f_L = 375\,Hz$

b) $f_L = \frac{344\frac{m}{s} + 15\frac{m}{s}}{344\frac{m}{s} + 35\frac{m}{s}} (392\,Hz)$

$f_L = 371\,Hz$

c) $f_{beat} = f_1 - f_2 = 375\,Hz - 3.71\,Hz$

$f_{beat} = 4\,Hz$

16.45) $v_{wave} = 0.33\frac{m}{s}$

a) $\lambda_f = 0.16m$

$f_{duck} = 1\,Hz$

$\lambda_{front} = \frac{v - v_s}{f_s}$

$0.16m = \frac{0.33\frac{m}{s} - v_{duck}}{1\,Hz}$

$v_{duck} = 0.17\frac{m}{s}$

b) $\lambda_{back} = \frac{v + v_s}{f_s}$

$\lambda_{back} = \frac{0.33\frac{m}{s} + 0.17\frac{m}{s}}{1\,Hz}$

$\lambda_{back} = 0.5m$

16.51) a) Higher pitch -> towards you

Lower pitch -> away from you

Towards

b) $f_{car} = \frac{v \pm v_p}{v \pm v_{car}} (f_p)$

$f_{p2} = \frac{v \pm v_{car}}{v \pm v_p} (f_{car})$

$f_{car} = \frac{v}{v + v_{car}} f_p$

$f_{p2} = \frac{v + v_{car}}{v} f_{car}$

$f_{p2} = \frac{v + v_{car}}{v} \cdot \frac{v}{v - v_{car}} f_p$

$f_{p2} = \frac{v + v_{car}}{v - v_{car}} f_p$

$1260\,Hz = \frac{344 + v_{car}}{344 - v_{car}} (1230\,Hz)$

$1.02(344 - v_{car}) = 344 + v_{car}$

$2.02 v_{car} = 8.39\frac{m}{s}$

$v_{car} = 4.15\frac{m}{s}$

c) $f_{car} = \frac{v+v_p}{v-v_{car}} f_p$

$f_{car} = \frac{344+24}{344-4.14}(1200Hz)$

$f_{car} = 1364.33Hz$

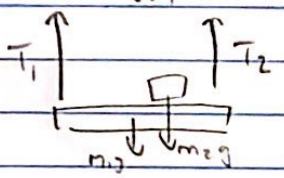
$f_{p2} = \frac{v+v_{car}}{v-v_p}(f_{car})$

$f_{p2} = \frac{344+7.14}{344-24}(1364.33)$

$\boxed{f_{p2} = 1484.3Hz}$

16.58) $f = \frac{v}{2L}$

$v = \sqrt{\frac{T}{\mu}}$



$T_1 + T_2 - m_1g - m_2g = 0$

$\sum \tau = 0$

$T_1 r_1 + m_2 g r_2 - T_2 r_3 = 0$

$m_1g = 165N$, $m_2g = 185N$

$T_1 = 350N - T_2$

$(350N - T_2)(\frac{1}{2}) + 185N(\frac{1}{4}) - T_2(\frac{1}{2}) = 0$

$175N - \frac{1}{2}T_2 + 46.25N - \frac{1}{2}T_2 = 0$

$-T_2 = -221.25N$

$T_2 = 221.25N$

$T_1 = 350N - 221.25N = 128.75N$

$\mu = \frac{0.0055}{0.75}$

$\mu = 0.00733 \frac{kg}{m}$

$v_1 = \sqrt{\frac{128.75}{0.00733}} = 132.5 \frac{m}{s}$

$v_2 = \sqrt{\frac{221.25N}{0.00733}} = 173.74 \frac{m}{s}$

$f_1 = \frac{v_1}{1.5\lambda_1} = 88.33Hz$

$f_2 = \frac{v_2}{1.5\lambda_2} = 115.82Hz$

$\boxed{f_{beat} = 27.49Hz}$

16.62) Flying toward wall -> f ↑

$f_{b2} = 1708Hz$

$f_{b2} = \frac{v+v_{wall}}{v-v_b}(f_{wall})$

$f_{wall} = \frac{v+v_b}{v+v_{wall}}(f_b)$

$f_{b2} = \frac{v}{v-v_b}(f_{wall})$

$f_{wall} = \frac{v+v_b}{v} f_b$

$f_{b2} = \frac{v}{v-v_b}(\frac{v+v_b}{v}) f_b$

$f_{b2} = \frac{v+v_b}{v-v_b}(f_b)$

$1708Hz = \frac{344+v_b}{344-v_b}(1700Hz)$

$1.0047 = (344+v_b)/(344-v_b)$

$345.62 - 1.0047v_b = 344 + v_b$

$1.619 = 2.0047v_b$

$\boxed{v_b = 0.808 \frac{m}{s}}$