Worksheet 3 Soln

(1) Loudness is dependent on amplitude

(2) Pitch is dependent on frequency, and so angular frequency

(3) $\sqrt{\frac{Pa}{kg/m^3}} = \sqrt{\frac{Nm}{kg}} = \sqrt{\frac{kg\,m^2}{s^2\,kg}} = \left[\frac{m}{s}\right]$

(4) $v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{1.42 \times 10^5}{1.23}} = 339.8 \left[\frac{m}{s}\right]$

(5) actually, it stays the same since Bulk modulus and density both scale linearly with pressure.

(6) Sound travels faster at higher temperature

(7) $v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{5 \times 10^7}{125}} = 632 \left[\frac{m}{s}\right]$

(8) GLS, but note that this is the transmission of a wave and not the particles themselves.

(9) $P = P_0 + P_{wave} = 10^5 + ABk \sin(kx - \omega t)$

$= 10^5 + 50 \sin(0.5x - 2155t)$ [Pa]

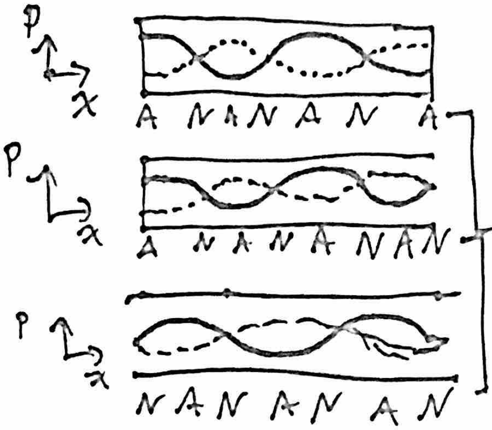
(10) Sin ranges in [-1, 1] $\Rightarrow 50(1 - -1) = 100$

(11) $I = p(x,t)\, v_y(x,t) = -B\, \partial_x y(x,t)\, \partial_t y(x,t) = BA^2 \omega k \sin^2(kx - \omega t)$

(12) $\langle I \rangle = \frac{BA^2 \omega k}{2} = \frac{10^5 \cdot (2 \times 10^{-4})^2 \cdot 60 \cdot 8.33}{2} = 1$ [W]

(13) $\beta = 10 \log_{10}(I/I_0) = 10 \log_{10}\left(1/10^{-12}\right) = 120$ [dB]

(14) The problem statement is unclear, so here are the pressure waves:



Pressure Nodes and Antinodes, displacement nodes & antinodes are the flip.

(15) $L = 0.3$ [m], $v = 344$ [m/s], $n = 2$ $\Big\}$ $f_2 = \frac{2v}{2L} = 1147$ [Hz]

(16) There is no second harmonic. There is a second overtone with $n=5$

$$f_5 = \frac{5v}{4L} = 1433 \text{ [Hz]}$$

(17) Yes, the waves interfere constructively: $\lambda = 0.25$m, so $\phi_L - \phi_R = 10 - 10 = 0 \rightarrow$ in phase

(18) Still yes, although the distance is now 2.69 m $\rightarrow \phi_L - \phi_R = 10.77 - 10.77 = 0$

(19) $f_{beats} = |f_1 - f_2| = 440.00 - 261.63 = 178.37 \rightarrow$ heard as a new tone

(20) $f_L = \frac{340 - 0}{340 - 6} 300 = 305.4$ [Hz] let the speed of sound be 340 $\frac{m}{s}$

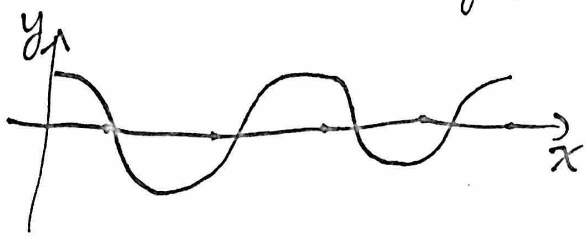
(21) $f_L = \frac{340 + 6}{340 + 0} 250 = 254.4$ [Hz]

(22) γ is dimensionless

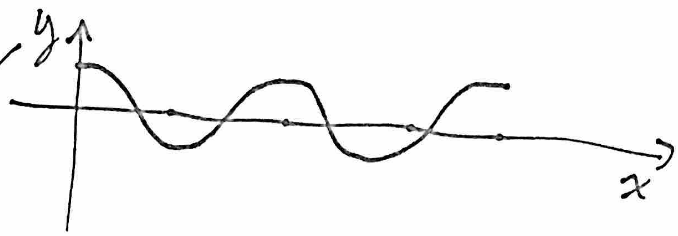
$$\sqrt{\frac{\gamma RT}{m}} = \sqrt{\frac{\frac{J}{mol\,K}\cdot K}{\frac{kg}{mol}}} = \sqrt{\frac{J}{kg}} = \frac{m}{s}$$

(23) Sound is faster in nitrogen, the lighter gas

(24)



(25)



Pressure, or displacement for a pressure wave