Physics 5B: Sound Waves and Decibel

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- Sound Waves are longitidual pressure waves. Sound waves travel through a medium, like air or water, etc.

  In air, the speed of sound $343\frac{m}{s}$

  $v=\sqrt{\frac{B}{\varrho}}$ $\quad B\colon \Delta P=B\frac{\Delta V}{V_0}$

  For an Ideal gas:

  $\mathrm{PV}=\mathrm{NKT}$ $\quad P=\frac{\mathrm{NKT}}{V}$

  $\mathrm{dP}=\frac{-\mathrm{NKT}}{v^2}\mathrm{dv}=\frac{\varrho}{m}\frac{\mathrm{dv}}{v}\Rightarrow B=\frac{\varrho}{m}\mathrm{KT}$

  $v=\sqrt{\frac{B}{\varrho}}=\sqrt{\frac{\mathrm{KT}}{\mathrm{nl}}}$

- Sound: Pitch is frequency: f=20-20,000 Hz

- Loundess: Intensity wave. energy hitting ear drum

- $\lambda=\frac{v}{f}=\frac{343m/s}{262/s}=1.31m$

  During a thunder storm, you can calculate how far away lighting is using $\lambda=\mathrm{vt}$

- $B=\frac{P}{\boldsymbol{\Delta}v/v_0}$

- D(x,t): logitudial displace of gas:

$$D(x,t)=\mathrm{Asin}(\mathrm{kx}-\omega t)\Rightarrow \mathrm{Asin}(k(x-\mathrm{vt}))$$

  $v=\omega k^{-1}$ $\quad \boldsymbol{\Delta}P=-B\frac{s\boldsymbol{\Delta}D}{s\boldsymbol{\Delta}x}$

  $\boldsymbol{\Delta}P=-B\frac{\mathrm{dD}}{\mathrm{dx}}$ $\quad \boldsymbol{\Lambda}P=-\mathrm{BAkcos}(\mathrm{kx}-\omega t)$

  $m=\frac{d^2D}{\mathrm{dt}^2}$

  Wave Equation:

$$\frac{d^2f}{\mathrm{dt}^2}-v^2\frac{d^2f}{\mathrm{dt}^2}=0$$

- $P=4\pi\mathrm{Ixr}^2$

- $I_0=10^{-12}W/n^2$

  $B=10\log_{10}(I/I_0)$