Formula Sheet
Physics 203: Fundamentals of Physics III
Sound

velocity $v = \lambda f$ angular frequency $\omega = 2\pi f$ wave number $k = \frac{2\pi}{\lambda}$

$y(x,t) = A\sin(kx - \omega t) = A\sin k(x - vt)$ wave to the right, + x

wave equation $\frac{\delta^2 y(x,t)}{\delta t^2} = v^2 \frac{\delta^2 y(x,t)}{\delta x^2}$

$v = \sqrt{\frac{F}{\mu}}$ transverse wave on a string $v = \sqrt{\frac{B}{\rho}}$ longitudinal wave in a fluid

$v = \sqrt{\frac{Y}{\rho}}$ longitudinal wave in a solid rod

$v = \sqrt{\frac{\gamma RT}{M}}$ speed of sound in an ideal gas

$P_{average} = \frac{1}{2}\sqrt{\mu F}\omega^2 A^2$ average power in a wave

$y(x,t) = A\sin kx\cos\omega t$ standing wave on a string

$f_n = nf_1 = n\frac{v}{2L}$ $(n = 1,2,3,\cdots)$ nodes or antinodes at both ends

$f_n = nf_1 = n\frac{v}{4L}$ $(n = 1,3,5,\cdots)$ node – antinode at the ends

$p_{max} = BkA$ $I = \frac{p_{max}^2}{2\sqrt{\rho B}}$ $\beta = (10\,dB)\log\frac{I}{I_o}$ where $I_o = 10^{-12}\ W/m^2$ in decibels

$f_L = \frac{|\vec{v} - \vec{v}_L|}{|\vec{v} - \vec{v}_S|} f_S$ Doppler Shift, + velocities in direction source to listener

when $v > v_{sound} \Rightarrow$ shock wave front $\sin\alpha = \frac{v}{v_S}$ = mach number