Physics NYC Equation Sheet

Simple Harmonic Motion

$$F = -kx$$

$$x(t) = A\cos(\omega t + \phi)$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$\omega = \sqrt{\frac{g}{L}}$$

$$K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$$

$$U_g = mgh$$

$$U_e = \frac{1}{2}kx^2$$

$$E_{tot} = K + U = \frac{1}{2}kA^2$$

Waves and Sound

$$y(x,t) = A\sin(kx \pm \omega t + \phi)$$

$$k = \frac{2\pi}{\lambda}$$

$$v = f\lambda = \frac{\omega}{k}$$

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

$$\langle P \rangle = \frac{1}{2}\mu A^2 \omega^2 v$$

$$I = \frac{\langle P \rangle}{A}$$

$$y(x,t) = A_{\mathrm{SW}}\sin(kx)\cos(\omega t)$$

$$\beta = 10\log_{10}\left(\frac{I}{I_0}\right)$$

$$f_{beat} = |f_2 - f_1|$$

$$f_o = f_s\left(\frac{v \pm v_o}{v \mp v_s}\right)$$

Interference and Diffraction

$$\frac{phase\ diff}{2\pi} = \frac{path\ diff}{\lambda}$$

$$d\sin\theta = m\lambda$$

$$\phi = 2\pi\left(\frac{d\sin\theta}{\lambda}\right)$$

$$I_2 = I_1\cos^2\left(\frac{\phi}{2}\right)$$

$$a\sin\theta = m\lambda$$

$$\sigma = 2\pi\left(\frac{a\sin\theta}{\lambda}\right)$$

$$I_1 = I_{max}\left(\frac{\sin(\sigma/2)}{\sigma/2}\right)^2$$

$$\theta = 1.22\frac{\lambda}{D}$$

Quantum Physics

$$E = hf$$

$$p = \frac{E}{c}$$

$$K_{max} = eV_0 = hf - \phi$$

$$p = \frac{h}{\lambda}$$

$$\Delta\lambda = \frac{h}{m_e c}(1 - \cos\theta)$$

$$\Delta x \Delta p_x \geq \frac{h}{4\pi}$$

$$E_n = \frac{-Z^2 \cdot 13.6\ \mathrm{eV}}{n^2}$$

$$\psi_n(x) = \sqrt{\frac{2}{L}}\sin\left(\frac{n\pi x}{L}\right)$$

$$E_n = \frac{n^2 h^2}{8mL^2}$$

Relativity

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$\Delta t = \gamma \Delta\tau$$

$$L = \frac{L_0}{\gamma}$$

$$u_x = \frac{u'_x + v}{1 + \frac{v u'_x}{c^2}}$$

$$\vec{p} = \gamma m \vec{u}$$

$$E = \gamma mc^2$$

$$K_{rel} = (\gamma - 1)mc^2$$

$$E^2 = (pc)^2 + (mc^2)^2$$

Constants

Speed of sound in air (20°) = 343 m/s

Hearing Threshold: $I_0 = 1.0 \times 10^{-12}$ W/m^2

Audible range: 20 Hz to 20000 Hz

Visible spectrum: 400 nm to 700 nm

$c = 3.00 \times 10^8$ m/s

$e = 1.60 \times 10^{-19}$ C

1 eV = 1.60×10^{-19} J

$m_e = 9.11 \times 10^{-31}$ kg
$= 0.511$ MeV/c^2

$m_p = m_n = 1.67 \times 10^{-27}$ kg
$= 938$ MeV/c^2

$h = 6.63 \times 10^{-34}$ J $\cdot s = 4.14 \times 10^{-15}$ eV $\cdot s$

$g = 9.81$ m/s^2