Formula Sheet, Phys 101 (Revised Jan 31, 2015)

Fluids:

$$P = P_0 + \rho g h \qquad A_1 v_1 = A_2 v_2 \qquad P_{\text{gauge}} = P - P_0$$

$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant} \qquad F_B = m_f g = \rho_f g V \qquad \rho = \frac{m}{V}$$

Harmonic Motion:

$$F = -kx \qquad PE = \frac{1}{2}kx^2 \qquad KE = \frac{1}{2}mv^2$$

$$x(t) = A\cos(\omega t + \phi_0) \qquad v(t) = -A\omega \sin(\omega t + \phi_0) \qquad a(t) = -A\omega^2 \cos(\omega t + \phi_0) = -\omega^2 x(t)$$

$$\omega = 2\pi f = \frac{2\pi}{T} \quad \left(f = \frac{1}{T}\right) \qquad \omega = \sqrt{\frac{k}{m}} \quad \text{(spring)} \qquad \omega = \sqrt{\frac{g}{L}} \quad \text{(simple pendulum)}$$

$$E = \frac{1}{2}kA^2 = \frac{1}{2}mv_{\max}^2 \qquad x_{\max}(t) = Ae^{-bt/2m} \qquad x(t) = Ae^{-bt/2m}\cos(\omega_D t + \phi)$$

$$E(t) = E_0 e^{-bt/m} \qquad \omega_D = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$$

Travelling Waves:

$$k = \frac{2\pi}{\lambda} \qquad v = f\lambda = \frac{\omega}{k} \qquad v = \sqrt{\frac{T}{\mu}}$$

General equation for a travelling wave: $D(x,t) = D_M \sin(kx \mp \omega t + \phi_0)$

Sound:

$$I = \frac{P}{A} \qquad I = \frac{P}{4\pi r^2} \text{ (spherical wave)} \qquad \beta(\text{dB}) = 10\log_{10}\left(\frac{I}{I_0}\right)$$

$$f = f_0\left(\frac{1 \pm \frac{v_o}{v}}{1 \mp \frac{v_s}{v}}\right) = f_0\left(\frac{v \pm v_o}{v \mp v_s}\right) \qquad f_{beat} = |f_2 - f_1|$$

Interference & diffraction:

$$n = \frac{c}{v} \qquad \lambda_n = \frac{\lambda}{n}$$

Thin film interference: $\Delta\phi = 2\pi\frac{\Delta x}{\lambda} + \Delta\phi_0$

2-slit interference, with small angle approximation ($m = 0, \pm 1, \pm 2, \ldots$):

Bright fringes: $y_{\text{bright}} = m\frac{\lambda L}{d}$

Dark fringes: $y_{\text{dark}} = \left(m + \frac{1}{2}\right)\frac{\lambda L}{d}$

Single-slit diffraction minima with small angle approximation:

$$y_{\text{dark}} = p\frac{\lambda L}{a}, \quad \text{where} \quad p = \pm 1, \pm 2, \ldots$$

Circular aperture: $\theta_{\min} = 1.22\frac{\lambda}{D}$

Areas & volumes:

$$A(\text{circle}) = \pi r^2 \qquad A(\text{sphere}) = 4\pi r^2 \qquad V(\text{sphere}) = \frac{4}{3}\pi r^3$$

$$V(\text{cylinder}) = \pi r^2 h$$

Constants:

$P_0 = P_{\text{atmosphere}} = 1.013 \times 10^5 \text{Pa}$; $\rho_{\text{fresh water}} = 1.00 \times 10^3\ \text{kg/m}^3$;

$\rho_{\text{air}} = 1.29\ \text{kg/m}^3$; $\rho_{\text{mercury}} = 13.6 \times 10^3\ \text{kg/m}^3$; $g = 9.81\ \text{m/s}^2$

$I_0 = 10^{-12}\ \text{W/m}^2$; $v_{\text{sound}}(\text{in air}) = 343\ \text{m/s}$