Formula Sheet for Physics 1B03

Constants

$\rho_{air} = 1.29 kg/m^3$

$P_{atm} = 1.013 \times 10^5 Pa$

$g = 9.81 m/s^2$

Area

$A = \pi R^2, \quad A = 4\pi R^2, \quad A = 2\pi Rh$

Volume

$V = \frac{4}{3}\pi R^3, \quad V = \pi R^2 h$

Other

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Kinematics

$\vec{v}(t) = \vec{v}_0 + \vec{a}t$

$\vec{x}(t) = \vec{x}_o + \vec{v}_o t + \frac{1}{2}\vec{a}t^2$

$|\vec{v}_f|^2 = |\vec{v}_i|^2 + 2\vec{a} \cdot (\vec{x}_f - \vec{x}_i)$

Newton's Laws

$\sum \vec{F} = m\vec{a}$

$f_s \leq \mu_s F_N$

$f_k = \mu_k F_N$

$\vec{F}_s = -k\vec{x}$

Work and Energy

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

$U_g = mgh, \quad U_s = \frac{1}{2}kx^2$

$E = K + U_g + U_s$

$E_f = E_i + W$

$W = \int \vec{F} \cdot d\vec{x}$

$W = \vec{F} \cdot \vec{x}$, *constant force*

$P = \frac{dW}{dt}$

$P = \vec{F} \cdot \vec{v}$, *constant force*

Momentum

$\vec{p} = m\vec{v}$

$\vec{I} = \int \vec{F} dt = \Delta \vec{p}$

$\vec{I} = \vec{F}\Delta t$, *constant force*

$\sum \vec{p}_i = \sum \vec{p}_f$

$v_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) v_{1i} + \left(\frac{2m_2}{m_1 + m_2}\right) v_{2i}$

Simple Harmonic Motion

$a = -\omega^2 x$

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

$\omega^2 = \frac{k}{m}$

$\omega^2 = \frac{g}{l}$

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

$v(t) = -\omega A \sin(\omega t + \varphi)$

$a(t) = -\omega^2 A \cos(\omega t + \varphi)$

$E = \frac{1}{2}kA^2$

Travelling Waves

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

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

$v_\omega = \sqrt{\frac{T}{\mu}}$

$y(x,t) = A\sin(kx - \omega t + \varphi)$

Interference

$\delta = path\ difference$

$\delta = m\lambda, \quad (m + \frac{1}{2})\lambda, \quad m = 0, \pm 1, \pm 2...$

$\Delta\varphi = k\delta$

$\delta = d\sin\theta \approx d\frac{x}{L}$

$\delta = 2nt$

"low to high, phase shift of π"

$n = \frac{\lambda_0}{\lambda_n}$

Fluids

$m = \rho V$

$R = A_1 v_1 = A_2 v_2$

$F = PA$

$P = P_0 + \rho gh$

$F_B = \rho_l V_o g, \quad \rho_l V_l g$

$P_1 + \rho g h_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho v_2^2$