Kinematics

$$v = v_0 + at$$

$$\Delta x = v_0 t + 1/2 a t^2$$

$$\Delta x = v_f t - 1/2 a t^2$$

$$v^2 = v_0^2 + 2a\Delta x$$

$$\Delta x = \frac{v_0 + v}{2} t$$

Dynamics

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

$$f_k = \mu_k N \quad f_s \leq \mu_s N$$

$$a_c = a_r = \frac{v^2}{r} = \omega^2 r$$

$$v_{\min} = \sqrt{gR}$$

$$F_g = G\frac{Mm}{r^2}$$

$$g = \frac{GM}{r^2}$$

$$U = -\frac{GMm}{r}$$

$$T = \frac{2\pi r}{v}$$

$$v_a r_a = v_p r_p$$

$$T^2/R^3 = \text{constant}$$

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

$$\vec{j} = \vec{F}\ t$$

$$\vec{j} = \Delta\vec{p}$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$KE = 1/2\ mv^2$$

$$GPE = mgh$$

$$EPE = 1/2\ k\Delta x^2$$

$$\vec{F_T} = -k\Delta\vec{x}$$

$$W = F\ d\ \cos\theta = F_{\parallel}\ d = F\ d_{\parallel}$$

$$W_{\text{net}} = \Delta KE$$

$$W_{\text{net, non-conservative}} = \Delta E$$
$$= \Delta(KE + GPE + EPE)$$

$$P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t} = Fv\cos\theta$$

$$f = \frac{1}{T}$$

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

$$v_t \equiv r\omega \quad a_t \equiv r\alpha$$

$$v_{center} = r\omega \quad a_{center} = r\alpha \quad [r.w.s.]$$

$$\tau = rF\sin\theta = r_{\perp}F = rF_{\perp}$$

$$I_d = I_{cm} + md^2$$

$$\Sigma\vec{\tau} = I\vec{\alpha}$$

$$KE_{\text{total}} \equiv \frac{1}{2}mv_{cm}^2 + \frac{1}{2}I_{cm}\omega^2$$

$$L_{\text{point}} = r\ mv\ \sin\theta$$

$$L_{\text{fixed\_pivot}} = I\ \omega$$

$$L_{\text{total}} = L_o + L_s = r_{cm}\ mv_{cm}\ \sin\theta + I_{cm}\ \omega$$

$$\tau_{\text{net}} t = \Delta L$$

$$T = 2\pi\sqrt{\frac{m}{k}} \quad T = 2\pi\sqrt{\frac{L}{g}}$$

$$\rho = \frac{m}{V}$$

$$p = \frac{F}{A} \quad p = \rho g h$$

$$F_{buoy} = \rho_{\text{fluid}} V_{\text{submerged}} g$$

$$\rho_1 v_1 A_1 = \rho_2 v_2 A_2$$

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

Thermaldynamics

$$l = l_0(1 + \alpha\Delta T)$$

$$V = V_0(1 + \beta\Delta T)$$

$$N = nN_A \quad R = N_A k_B$$

$$pV = nRT = Nk_B T$$

$$\overline{KE_{cm}} = \overline{KE_t} = 3/2\ k_B\ T$$

$$\Delta E = Q + W_{\text{on system}}$$

$$W = -p\Delta V$$

$$Q = mc\Delta T \quad Q = mL$$

$$\Delta S = \frac{Q}{T}$$

$$Q = \frac{kA\Delta T\ t}{\Delta x}$$

$$Q = \epsilon\sigma T^4 A\ t$$

$$\Delta S_{\text{isolated}} \geq 0$$

$$e = \frac{W}{Q_H} \leq \frac{T_H - T_L}{T_H}$$

$$cop = \frac{Q_L}{W} \leq \frac{T_L}{T_H - T_L}$$

Wave, Sound, Optics

$$v = f\lambda \quad v = \sqrt{\frac{T}{m/L}}$$

$$\lambda_n = \frac{2L}{n}$$

$$I \propto \frac{1}{r^2}$$

$$dB = 10\ \log_{10}\frac{I}{I_0}$$

$$f_{obs} = f_{src}\frac{v_{snd} \pm v_{obs}}{v_{snd} \mp v_{src}}$$

$$n = \frac{c}{v}$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\frac{1}{f} = \frac{1}{d_{obj}} + \frac{1}{d_{img}}$$

$$m = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

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

$$\theta \approx \frac{\lambda}{D}$$

$$I = I_0\cos^2(\theta)$$

Electromagnetism

$$F_e = \frac{kQq}{r^2}$$

$$E = \frac{kQ}{r^2}$$

$$V = \frac{kQ}{r}$$

$$PE_e = \frac{kQq}{r}$$

$$\vec{F} = q\vec{E}$$

$$\Delta V = \frac{W}{q} \quad W = \Delta U = q\Delta V$$

$$\Delta V = -Ed\cos\theta = -E_{\parallel}d = -Ed_{\parallel}$$

$$R = \frac{\rho l}{A}$$

$$R_{eq} = R_1 + R_2 + R_3...$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}...$$

$$\Delta V = IR$$

$$P = I\Delta V = I^2 R = \frac{\Delta V^2}{R}$$

$$C = \frac{\epsilon A}{d}$$

$$Q = CV$$

$$PE_e = \frac{1}{2}CV^2 = \frac{1}{2}QV = \frac{1}{2}\frac{Q^2}{C}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}...$$

$$C_{eq} = C_1 + C_2 + C_3...$$

$$I = I_0 e^{-\frac{t}{\tau}} \quad \tau = R\ C$$

$$F = qvB\sin\theta = qvB_{\perp}$$

$$F = ILB\sin\theta = ILB_{\perp}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 nI$$

$$\mathcal{E} = -\frac{\Delta\phi}{\Delta t} = -N\frac{\Delta(BA)}{\Delta t}$$

$$\mathcal{E} = vlB$$

$$\phi = LI \quad U = \frac{1}{2}LI^2$$

$$I = I_0 e^{-\frac{t}{\tau}} \quad \tau = \frac{L}{R}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} \quad \frac{I_s}{I_p} = \frac{N_p}{N_s}$$

Modern Physics

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

$$t = \gamma\ t_0 \quad l = \frac{l_0}{\gamma}$$

$$p = \gamma m_0 v$$

$$E = \gamma m_0 c^2 = mc^2$$

$$E = hf$$

$$hf = KE_e + W_0$$

$$\lambda = \frac{h}{m\ v}$$

$$f = \frac{E}{h} = \frac{\sqrt{p^2c^2 + m_0^2 c^4}}{h}$$

$$\Delta E \cdot \Delta t \geq \frac{h}{4\pi}$$

$$\Delta m v_x \cdot \Delta x \geq \frac{h}{4\pi}$$

$$\Delta m v_y \cdot \Delta y \geq \frac{h}{4\pi}$$

$$\Delta m v_z \cdot \Delta z \geq \frac{h}{4\pi}$$

$$T = e^{-2\sqrt{\frac{2m(U_0 - E)}{\hbar^2}}L}$$

$$N = N_0 e^{-kt} = N_0 e^{-t/\tau} \quad t_{\frac{1}{2}} = \frac{\ln 2}{k}$$

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

$$E_n - E_m = hf_{m->n}$$