Kinematics: $v_x = \frac{dx}{dt}$ $a_x = \frac{dv_x}{dt}$ $v_{x_f} = v_{x_i} + a_x \Delta t$ $x_f = x_i + v_{x_i}\Delta t + \frac{1}{2}a_x \Delta t^2$
$v_{x_f}^2 = v_{x_i}^2 + 2a_x(x_f - x_i)$ $a_{rad} = \frac{v^2}{r}$ $T = \frac{2\pi r}{v}$ $f = 1/T$
$p = mv$ $K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$

Oscillations: $F = -kx$ $x = A\cos(2\pi f t + \phi)$ $\omega = 2\pi f = \frac{2\pi}{T}$ $f = \frac{1}{2\pi}\sqrt{k/m}$
$E = \frac{1}{2}kA^2$ $v_{\max} = 2\pi f A$ $a_{\max} = (2\pi f)^2 A$

Waves: $y(x,t) = A\cos\left(\frac{2\pi}{\lambda}x - \frac{2\pi}{T}t\right)$ $k = 2\pi/\lambda$ $v = \lambda f$ $v = \sqrt{\frac{F_T}{\mu}}$ $\mu = \frac{M}{L}$
$v = \sqrt{\frac{\gamma RT}{M}}$ $f_n = n\frac{v}{2L}$ $f_L = \left(\frac{v + v_L}{v + v_S}\right) f_S$ $f_{beat} = |f_2 - f_1|$ $I = \frac{P}{A}$

Interference: $\Delta r = m\lambda$ $d\sin\theta = m\lambda$ $d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$ $a\sin\theta = n\lambda$
$n = \frac{c}{v}$ $\lambda_n = \frac{\lambda}{n}$ $2nt = m\lambda$ $2nt = \left(m + \frac{1}{2}\right)\lambda$

Optics: $n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$

Electric Forces and Fields: $\vec{E} = k\sum_i \frac{q_i}{r_i^2}\hat{r}_i$ $k = \frac{1}{4\pi\epsilon_0}$ $\vec{F}_0 = q_0\vec{E}$
Infinite sheet: $E = \frac{\sigma}{2\epsilon_0}$

Electric Potential: $V = k\sum \frac{q_i}{r_i}$ $\Delta U = q_0 \Delta V$ $\Delta V = -E\Delta x$ $E_x = -\frac{dV}{dx}$

Capacitance: $Q = C(\Delta V)$ $C = \frac{\epsilon_0 A}{d}$ $\frac{1}{C_{series}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots$
$C_{parallel} = C_1 + C_2 + C_3 + \cdots$ $U = \frac{1}{2}Q(\Delta V)$ $u_e = \frac{1}{2}\epsilon_0 E^2$

Circuits: $I = \frac{dq}{dt}$ $\Delta V = IR$ $R = \frac{\rho L}{A}$ $P = I(\Delta V)$ $R_{series} = R_1 + R_2 + R_3 + \cdots$
$\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$ $\tau = RC$ $q = Q_0 e^{-t/\tau}$ $q = Q_0(1 - e^{-t/\tau})$

Magnetic Forces and Fields: $\vec{F} = q\vec{v}\times\vec{B}$ $\vec{F} = I\vec{L}\times\vec{B}$ $\vec{\mu} = NIA\hat{n}$ $\vec{\tau} = \vec{\mu}\times\vec{B}$
$\mu_0 I_{encl} = \oint \vec{B}\cdot d\vec{s}$ **Long solenoid:** $B = \mu_0 n I$ $n = N/L$
Long straight wire: $B = \frac{\mu_0 I}{2\pi r}$ **Center of current loop:** $B = \frac{\mu_0 I}{2r}$

Induction: $\Phi_B = NBA\cos\theta$ $\varepsilon = -\frac{d\Phi_B}{dt}$ $\varepsilon = vBL$ $\varepsilon = -L\frac{di}{dt}$ $U = \frac{1}{2}LI^2$
$u_m = \frac{B^2}{2\mu_0}$

Electromagnetic Waves: $\vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$ $v_{em} = c = 1/\sqrt{\epsilon_0\mu_0}$ $c = \lambda f$ $E_0 = cB_0$
$\vec{S} = \frac{1}{\mu_0}(\vec{E}\times\vec{B})$ $I = S_{ave} = \frac{1}{2}c\epsilon_0 E^2$

Modern Physics: $E = hf = \frac{hc}{\lambda}$ $\quad p = \frac{h}{\lambda}$ $\quad \Delta E = hf$

$r_n = n^2 a_0$ $\quad E_n = -\left(\frac{me^4}{8\epsilon_0^2 h^2}\right)\frac{1}{n^2} = -\frac{13.6\text{eV}}{n^2}$ $\quad (\Delta x)(\Delta p_x) \geq h/4\pi$ $\quad E = (\Delta m)c^2$

$N = N_0 e^{-t/\tau}$ $\quad T_{1/2} = \tau \ln 2$

Vectors: $A_x = A\cos\theta$ $\quad A_y = A\sin\theta$ $\quad A = \sqrt{A_x^2 + A_y^2}$ $\quad \tan\theta = \frac{A_y}{A_x}$

$\vec{A} \cdot \vec{B} = AB\cos\phi_{AB}$ $\quad \vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$ $\quad \vec{A} \times \vec{B} = \hat{n} AB \sin\phi_{AB}$

Math: $ax^2 + bx + c = 0$ $\quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $\quad (1+x)^n \approx 1 + nx$ for $x \ll 1$

$A = 4\pi r^2$ $\quad V = \frac{4}{3}\pi r^3$

Constants: $e = 1.602 \times 10^{-19}\,\text{C}$ $\quad \epsilon_0 = 8.854 \times 10^{-12}\,\text{C}^2/\text{Nm}^2$

$k = 1/4\pi\epsilon_0 = 8.988 \times 10^9\,\text{Nm}^2/\text{C}^2$ $\quad \mu_0 = 4\pi \times 10^{-7}\,\text{N/A}^2$ $\quad m_e = 9.109 \times 10^{-31}\,\text{kg}$

$c = 2.998 \times 10^8\,\text{m/s}$ $\quad h = 6.626 \times 10^{-34}\,\text{J}\cdot\text{s}$ $\quad hc = 1239.8\,\text{eV}\cdot\text{nm}$

$a_0 = 0.0529\,\text{nm}$ $\quad 1\text{u} = 931.5\,\text{MeV}/c^2 = 1.661 \times 10^{-27}\,\text{kg}$