Constants:

$$g \approx 9.81\,\mathrm{m/s^2}$$
$$N_A = 6.022 \times 10^{23}\text{ things/mol}$$
$$k_e \equiv 1/4\pi\epsilon_o = 8.98755 \times 10^9\,\mathrm{N \cdot m^2 \cdot C^{-2}}$$
$$\epsilon_o = 8.85 \times 10^{-12}\,\mathrm{C^2/N \cdot m^2}$$
$$\mu_0 \equiv 4\pi \times 10^{-7}\,\mathrm{T \cdot m/A}$$
$$e = 1.60218 \times 10^{-19}\,\mathrm{C}$$
$$h = 6.6261 \times 10^{-34}\,\mathrm{J \cdot s} = 4.1357 \times 10^{-15}\,\mathrm{eV \cdot s}$$
$$\hbar = \frac{h}{2\pi}$$
$$k_B = 1.38065 \times 10^{-23}\,\mathrm{J \cdot K^{-1}} = 8.6173 \times 10^{-5}\,\mathrm{eV \cdot K^{-1}}$$
$$c = \frac{1}{\sqrt{\mu_0\epsilon_0}} = 2.99792 \times 10^8\,\mathrm{m/s}$$
$$hc = 1240\,\mathrm{eV \cdot nm}$$
$$m_e = 9.10938 \times 10^{-31}\,\mathrm{kg} \qquad m_ec^2 = 510.998\,\mathrm{keV}$$
$$m_p = 1.67262 \times 10^{-27}\,\mathrm{kg} \qquad m_pc^2 = 938.272\,\mathrm{MeV}$$

Quadratic formula:

$$0 = ax^2 + bx^2 + c \Longrightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Basic Equations:

$$\vec{\mathbf{E}} = \sigma/\epsilon_0 \text{ capacitor}$$
$$C = \epsilon_0 A/d$$
$$\vec{\mathbf{F}}_{\text{net}} = m\vec{\mathbf{a}} \text{ Newton's Second Law}$$
$$\vec{\mathbf{F}}_{\text{centr}} = -\frac{mv^2}{r}\hat{\mathbf{r}} \text{ Centripetal}$$
$$K_{\text{classical}} = \frac{1}{2}mv^2$$
$$0 = ax^2 + bx^2 + c \Longrightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

E & M

$$\vec{\mathbf{F}}_{12} = k_e\frac{q_1q_2}{r_{12}^2}\,\hat{\mathbf{r}}_{12} = q_2\vec{\mathbf{E}}_1 \qquad \vec{\mathbf{r}}_{12} = \vec{\mathbf{r}}_1 - \vec{\mathbf{r}}_2$$
$$\vec{\mathbf{E}}_1 = \vec{\mathbf{F}}_{12}/q_2 = k_e\frac{q_1}{r_{12}^2}\,\hat{\mathbf{r}}_{12}$$
$$\vec{\mathbf{F}}_B = q\vec{\mathbf{v}} \times \vec{\mathbf{B}}$$
$$U_{12} = k_e\frac{q_1q_2}{r_{12}} \quad \text{potential E, 2 charges}$$

Oscillators & waves

$$E = \frac{1}{2}kA^2 = \frac{1}{2}\omega^2mA^2 = 2\pi^2mf^2A^2$$
$$\omega = 2\pi f = \sqrt{k/m}$$
$$c = \lambda f$$

Approximations, $x \ll 1$

$$(1+x)^n \approx 1 + nx + \frac{1}{2}n\,(n+1)\,x^2 \qquad e^x \approx 1 + x + \frac{1}{2}x$$
$$\sin x \approx x - \frac{1}{6}x^3 \qquad \cos x \approx 1 - \frac{1}{2}x^2$$

Radiation

$$P_{\text{rad}} = \frac{q^2a^2}{6\pi\epsilon_oc^3} \qquad \text{total emitted power, } E \text{ and } B \text{ fields}$$

Relativity

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$
$$\Delta t'_{\text{moving}} = \gamma\Delta t_{\text{stationary}} = \gamma\Delta t_p$$
$$L'_{\text{moving}} = \frac{L_{\text{stationary}}}{\gamma} = \frac{L_p}{\gamma}$$
$$x' = \gamma\,(x - vt) \qquad x = \gamma\left(x' + vt'\right)$$
$$t' = \gamma\left(t - \frac{vx}{c^2}\right) \qquad t = \gamma\left(t' + \frac{vx'}{c^2}\right)$$
$$v_{\text{obj}} = \frac{v + v'_{\text{obj}}}{1 + \frac{vv'_{\text{obj}}}{c^2}} \qquad v'_{\text{obj}} = \frac{v_{\text{obj}} - v}{1 - \frac{vv_{\text{obj}}}{c^2}}$$
$$\text{KE} = (\gamma - 1)mc^2 = \sqrt{m^2c^4 + c^2p^2} - mc^2$$
$$E_{\text{rest}} = mc^2$$
$$p = \gamma mv$$
$$E^2 = p^2c^2 + m^2c^4 = \left(\gamma mc^2\right)^2$$

Calculus of possible utility:

$$\int \frac{1}{x}dx = \ln x + c$$
$$\int udv = uv - \int vdu$$

Vectors:

$$|\vec{\mathbf{F}}| = \sqrt{F_x^2 + F_y^2} \quad \text{magn} \qquad \theta = \tan^{-1}\left[\frac{F_y}{F_x}\right] \quad \text{dir}$$