Formula sheet

$\Phi_e = Q_{enc}/\varepsilon_o$ Area of spherical shell = $4\pi r^2$, $g = 9.8\ ms^{-2}$

$k = \frac{1}{4\pi\varepsilon_o} = 8.99x10^9\ Nm^2/C^2$ $\varepsilon_o = 8.85x10^{-12}\ C^2/Nm^2$ $e = 1.6x10^{-19}\ C$

$F = \frac{Qq}{4\pi\varepsilon_0 r^2}$; $E = \frac{Q}{4\pi\varepsilon_0 r^2}$; $\oint_S \vec{E}.d\vec{s} = \frac{Q_{enc}}{\varepsilon_0}$; $\varphi_B = \oint_S \vec{B}.d\vec{s}$;

$\oint \vec{B}.d\vec{l} = \mu_0 I_{enc}$; $\vec{F} = q\vec{v}\times\vec{B}$; $d\vec{F} = Id\vec{l}\times\vec{B}$; $L = N\frac{\varphi_B}{I}$

$m_e = 9.11x10^{-31}\ kg$ $m_p = 1.67x10^{-27}\ kg$ $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$ (quadratic eqn roots)

$B = \mu_o I/2\pi r$ (long conductor) $B = \mu_o nI$ (solenoid) $B = \mu_o I/2r$ (centre of circular loop)

$E = \lambda/\varepsilon_o 2\pi r$ (long line of charge) $U = CV^2/2 = Q^2/2C$, $U = LI^2/2$

$Q = C\Delta V$ $C_\kappa = \kappa C$ parallel plate capacitor $C = \varepsilon_o A/d$ $\Delta V = -\int_a^b \vec{E}.d\vec{l}$

$\Phi_e = Q_{enc}/\varepsilon_o$ Area of spherical shell = $4\pi r^2$, $\mu_o = 4\pi x10^{-7}$, $\mu = IA$. (magnetic dipole-moment)

$E = \frac{\rho_l}{2\pi\varepsilon_0 r}$	field due to an infinite line
$E = \frac{\rho_s}{2\varepsilon_0}$	field due to an infinite plane
$\vec{B} = \frac{\mu_0}{4\pi r^2} q\vec{v}\times\hat{r}$	Biot-Savart Law
$e = \oint \vec{E}.d\vec{l} = -\frac{d}{dt}\oint_S \vec{B}.d\vec{s}$	Induced emf
$e = -\frac{d\lambda}{dt} = -N\frac{d\varphi_B}{dt}$	Induced emf

Integrals

$$\int x\,dx = \frac{1}{2}x^2$$

$$\int x^2\,dx = \frac{1}{3}x^3$$

$$\int \frac{1}{x^2}\,dx = -\frac{1}{x}$$

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} \qquad n \neq -1$$

$$\int \frac{dx}{x} = \ln x$$

$$\int \frac{dx}{a+x} = \ln(a+x)$$

$$\int \frac{x\,dx}{a+x} = x - a\ln(a+x)$$

$$\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \ln\left(x + \sqrt{x^2 \pm a^2}\right)$$

$$\int \frac{x\,dx}{\sqrt{x^2 \pm a^2}} = \sqrt{x^2 \pm a^2}$$

$$\int \frac{dx}{x^2 + a^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)$$

$$\int \frac{dx}{(x^2+a^2)^2} = \frac{1}{2a^3}\tan^{-1}\left(\frac{x}{a}\right) + \frac{x}{2a^2(x^2+a^2)}$$

$$\int \frac{dx}{(x^2 \pm a^2)^{3/2}} = \frac{\pm x}{a^2\sqrt{x^2 \pm a^2}}$$

$$\int \frac{x\,dx}{(x^2 \pm a^2)^{3/2}} = -\frac{1}{\sqrt{x^2 \pm a^2}}$$

$$\int e^{ax}\,dx = \frac{1}{a}e^{ax}$$

$$\int xe^{ax}\,dx = \frac{1}{a^2}e^{ax}(ax - 1)$$

$$\int \sin(ax)\,dx = -\frac{1}{a}\cos(ax)$$

$$\int \cos(ax)\,dx = \frac{1}{a}\sin(ax)$$

$$\int \sin^2(ax)\,dx = \frac{x}{2} - \frac{\sin(2ax)}{4a}$$

$$\int \cos^2(ax)\,dx = \frac{x}{2} + \frac{\sin(2ax)}{4a}$$

$$\int_0^\infty x^n e^{-ax}\,dx = \frac{n!}{a^{n+1}}$$

$$\int_0^\infty e^{-ax^2}\,dx = \frac{1}{2}\sqrt{\frac{\pi}{a}}$$