SN2: Electricity & Magnetism
Data Sheet

Constants

Acceleration Due to Gravity Near Earth $|\vec{a}_g| = 9.81\ m/s^2$

Gravitational Constant ... $G = 6.67 \times 10^{-1}\ N \cdot m^2/kg^2$

Radius of Earth ..... $r_E = 6.37 \times 10^6\ m$

Mass of Earth..... $M_E = 5.97 \times 10^{24}\ kg$

Elementary charge..... $e = 1.60 \times 10^{-19} C$

Coulomb's Law Constant $k = \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9 N \cdot m^2/C^2$

Electron Volt..... $1\ eV = 1.60 \times 10^{-19} J$

Atomic Mass Unit..... $u = 1.66 \times 10^{-27}\ kg$

Permittivity of free space .... $\varepsilon_0 = 8.85 \times 10^{-12}\ \frac{C^2}{\mathrm{N \cdot m^2}}$

Permeability of free space .... $\mu_0 = 4\pi \cdot 10^{-7}\ \frac{\mathrm{N}}{\mathrm{A^2}} or \frac{\mathrm{Wb}}{\mathrm{A \cdot m}}$

Avogadro's Number..... $N_A = 6.022 \times 10^{23}\ atoms/mol$

Prefixes Used with SI Units

Prefix	Symbol	Exponential Value
atto	a	10^{-18}
femto	f	10^{-15}
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
deka	da	10^{1}
hecto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Particles

	Charge	Mass
Alpha Particle	$+2e$	$6.65 \times 10^{-27}\ kg$
Electron	$-1e$	$9.11 \times 10^{-31}\ kg$
Proton	$+1e$	$1.67 \times 10^{-27}\ kg$
Neutron	0	$1.67 \times 10^{-27}\ kg$

Kinematics & Dynamics

$$x = x_o + v_o t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$$v^2 = {v_o}^2 + 2a(x - x_o)$$

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

$$\vec{F} = \frac{G m_1 m_2}{r_{12}^2} \hat{r}_{12}$$

Momentum & Energy

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

$$K_1 + U_1 + W_{nc} = K_2 + U_2$$

$$\vec{F} \Delta t = m \Delta \vec{v}$$

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

$$P = \frac{W}{t} = \vec{F} \cdot \vec{v}$$

Useful Equations

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

$$\frac{d(t^n)}{dt} = nt^{n-1}$$

$$\frac{d}{dt} \sin(\omega t) = \omega \cos(\omega t)$$

$$\frac{d}{dt} \cos(\omega t) = -\omega \sin(\omega t)$$

$$\ln(e^{ab}) = ab$$

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Equation Sheet

Electricity

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

$$\vec{E}_p = \frac{kQ}{r^2}\hat{r}_p$$

$$U(r) = k\frac{qQ}{r}$$

$$V = \frac{U}{q} = -\int_R^P \vec{E}\cdot d\vec{l}$$

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

$$\vec{E} = -\left(\frac{\partial V}{\partial x}\hat{\imath} + \frac{\partial V}{\partial y}\hat{\jmath} + \frac{\partial V}{\partial y}\hat{z}\right)$$

Circuits

$$I = \frac{dQ}{dt}$$

$$V = IR$$

$$R_{eq} = R_1 + R_2 + R_3 \ldots$$

$$R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots\right)^{-1}$$

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

$$C = \frac{Q}{V}$$

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

$$C_{eq} = C_1 + C_2 + C_3 \ldots$$

$$U_C = \frac{1}{2}V^2C = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}QV$$

$$\tau = RC$$

$$q(t) = Q\left(1 - e^{\frac{-t}{\tau}}\right)$$

$$q(t) = Qe^{\frac{-t}{\tau}}$$

$$I(t) = I_0e^{\frac{-t}{\tau}}$$

Magnetism

$$\vec{F} = q\vec{v}\times\vec{B}$$

$$\vec{F} = I\vec{l}\times\vec{B}$$

$$r = \frac{mv}{qB}$$

$$\vec{\mu} = NIA\hat{n}$$

$$\vec{\tau} = \vec{\mu}\times\vec{B}$$

$$\vec{B} = \frac{\mu_0}{4\pi}\int_{wire}\frac{Id\vec{l}\times\hat{r}}{r^2}$$

$$B_{\text{wire}} = \frac{\mu_0 I}{2\pi R}$$

$$B_{\text{coil}} = \frac{\mu_0 NI}{2R}$$

$$B_{\text{solenoid}} = \mu_0 nI$$

$$\Phi_m = \vec{B}\cdot\vec{A}$$

$$\mathcal{E} = -N\frac{d\Phi_m}{dt}$$