INFORMATION

$\mathbf{a}\cdot\mathbf{b} = ab\cos\theta$

$\mathbf{a}\times\mathbf{b} = ab\sin\theta\;\hat{\mathbf{c}} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$

$\mathbf{v} \equiv \frac{\mathrm{d}\mathbf{r}}{dt} \quad \mathbf{a} \equiv \frac{\mathrm{d}\mathbf{v}}{dt} \quad \mathbf{v} = \int \mathbf{a}\,\mathrm{d}t \quad \mathbf{r} = \int \mathbf{v}\,\mathrm{d}t$

$v = u + at \qquad \mathbf{a} = -g\mathbf{j}$
$x = ut + \frac{1}{2}at^2 \qquad \mathbf{v} = \mathbf{u} - gt\mathbf{j}$
$v^2 = u^2 + 2ax \qquad \mathbf{r} = \mathbf{u}t - \frac{1}{2}gt^2\mathbf{j}$

$s = r\theta \qquad v = r\omega \qquad a = \omega^2 r = \frac{v^2}{r}$

$\omega_f = \omega_i + \alpha t$
$\theta = \omega_i t + \frac{1}{2}\alpha t^2$
$\omega_f^2 = \omega_i^2 + 2\alpha\theta$

$\mathbf{p} \equiv m\mathbf{v}$

$N1:\quad$ if $\sum \mathbf{F} = 0$ then $\delta\mathbf{p} = \mathbf{0}$
$N2:\quad \sum \mathbf{F} = m\mathbf{a}$
$N3:\quad \mathbf{F_{AB}} = -\mathbf{F_{BA}}$

$W = mg \qquad F_r = \mu R$

$\boldsymbol{\tau} \equiv \mathbf{r}\times\mathbf{F}$

$\sum \mathbf{F_x} = \mathbf{0} \qquad \sum \mathbf{F_y} = \mathbf{0} \qquad \sum \boldsymbol{\tau}_P = \mathbf{0}$

$W \equiv \int_{\mathbf{r_1}}^{\mathbf{r_2}} \mathbf{F}\,\mathrm{d}\mathbf{r} \qquad W = \mathbf{F}\cdot\mathbf{s}$

$\mathrm{KE} = \frac{1}{2}mv^2 \qquad PE = mgh$

$P \equiv \frac{\mathrm{d}W}{\mathrm{d}t} = \mathbf{F}\cdot\mathbf{v}$

$F = kx \qquad PE = \frac{1}{2}kx^2$

$\frac{dv}{v_e} = -\frac{dm}{m} \qquad v_f - v_i = v_e \ln(\frac{m_i}{m_f})$

$F = |v_e \frac{dm}{dt}|$

$F = k\frac{q_1 q_2}{r^2} \quad k = \frac{1}{4\pi\epsilon_0} \approx 9\times 10^9\,\mathrm{Nm^2C^{-2}}$

$\epsilon_0 = 8.854\times 10^{-12}\,\mathrm{N^{-1}m^{-2}C^2}$

$\mathbf{E} \equiv \lim_{\delta q\to 0}\left(\frac{\delta\mathbf{F}}{\delta q}\right) \qquad \mathbf{E} = k\frac{q}{r^2}\hat{\mathbf{r}}$

$V \equiv \frac{W}{q} \qquad E = -\frac{\mathrm{d}V}{\mathrm{d}x} \qquad V = k\frac{q}{r}$

$\Phi = \oint \mathbf{E}\cdot\mathrm{d}\mathbf{A} = \frac{\sum q}{\epsilon_0}$

$C \equiv \frac{q}{V} \qquad C = \frac{A\epsilon}{d}$

$E = \frac{1}{2}\frac{q^2}{C} = \frac{1}{2}qV = \frac{1}{2}CV^2$

$C = C_1 + C_2 \qquad \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$

$R = R_1 + R_2 \qquad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$V = IR \qquad V = E - IR$

$P = VI = \frac{V^2}{R} = I^2 R$
$K1:\quad \sum I_n = 0$
$K2:\quad \sum(IR's) = \sum(EMF's)$

$\mathbf{F} = q\,\mathbf{v}\times\mathbf{B} \qquad \mathrm{d}\mathbf{F} = i\,\mathrm{d}\mathbf{l}\times\mathbf{B}$

$\mathbf{F} = i\,\mathbf{l}\times\mathbf{B} \qquad \boldsymbol{\tau} = ni\,\mathbf{A}\times\mathbf{B}$

$v = \frac{E}{B} \qquad r = \frac{m}{q}\frac{E}{BB_0} \qquad r = \frac{mv}{qB}$

$T = \frac{2\pi m}{Bq} \qquad \mathrm{KE_{max}} = \frac{R^2B^2q^2}{2m}$

$\mathrm{d}\mathbf{B} = \frac{\mu_0}{4\pi}i\frac{\mathrm{d}\mathbf{l}\times\hat{\mathbf{r}}}{r^2}$

$\oint \mathbf{B}\cdot\mathrm{d}\mathbf{s} = \mu_0\sum I \qquad \mu_0 = 4\pi\times 10^{-7}\,\mathrm{NA^{-2}}$

$\phi = \int_{area}\mathbf{B}\cdot\mathrm{d}\mathbf{A} \qquad \phi = \mathbf{B}\cdot\mathbf{A}$

$\epsilon = -N\frac{\mathrm{d}\phi}{\mathrm{d}t} \qquad \epsilon = NAB\omega\sin(\omega t)$

$f = \frac{1}{T} \qquad k \equiv \frac{2\pi}{\lambda}$
$\omega \equiv 2\pi f \qquad v = f\lambda$

$y = f(x \mp vt)$
$y = a\sin k(x - vt) = a\sin(kx - \omega t)$
$= a\sin 2\pi(\frac{x}{\lambda} - \frac{t}{T})$

$P = \frac{1}{2}\mu v\omega^2 a^2 \qquad v = \sqrt{\frac{T}{\mu}}$

$s = s_m \sin(kx - \omega t)$

$\Delta p = \Delta p_m \cos(kx - \omega t)$

$I = \frac{1}{2}\rho v \omega^2 s_m^2$

$n(\mathrm{db's}) \equiv 10\log\frac{I_1}{I_2} = 10\log\frac{I}{I_0}$

where $I_0 = 10^{-12}\,\mathrm{W\,m^{-2}}$

$f_r = f_s\left(\frac{v \pm v_r}{v \mp v_s}\right)$

where $v \equiv$ speed of sound $= 340\ \mathrm{m\,s^{-1}}$

$y = y_1 + y_2$

$y = [2a\sin(kx)]\cos(\omega t)$

$\underline{N} : x = m(\frac{\lambda}{2})$ $\quad \underline{AN} : x = (m + \frac{1}{2})(\frac{\lambda}{2})$

$(m = 0, 1, 2, 3, 4, ...)$

$y = [2a\cos(\frac{\omega_1 - \omega_2}{2})t]\sin(\frac{\omega_1 + \omega_2}{2})t$

$f_B = |f_1 - f_2|$

$y = [2a\cos(\frac{k\Delta}{2})]\sin(kx - \omega t + \frac{k\Delta}{2})$

$\Delta = d\sin\theta$

$\underline{Max} : \Delta = m\lambda$ $\quad \underline{Min} : \Delta = (m + \frac{1}{2})\lambda$

$I = I_0\cos^2(\frac{k\Delta}{2})$

$E = hf \qquad c = f\lambda$

$\mathrm{KE_{max}} = eV_0 = hf - \phi$

$\mathbf{L} \equiv \mathbf{r} \times \mathbf{p} = \mathbf{r} \times m\mathbf{v}$

$L = rmv = n(\frac{h}{2\pi})$

$\delta E = hf = E_i - E_f$

$r_n = n^2(\frac{h^2}{4\pi^2 mke^2}) = n^2 a_0$

$E_n = -\frac{ke^2}{2a_0}(\frac{1}{n^2}) = -\frac{13.6}{n^2}\ eV$

$\frac{1}{\lambda} = \frac{ke^2}{2a_0}(\frac{1}{n_f^2} - \frac{1}{n_i^2}) = R_H(\frac{1}{n_f^2} - \frac{1}{n_i^2})$

$(n = 1, 2, 3....)$ $(k \equiv \frac{1}{4\pi\varepsilon_0})$

$E^2 = p^2c^2 + (m_0c^2)^2$

$E = m_0c^2 \qquad E = pc$

$\lambda = \frac{h}{p}$ $\ (p = m_0 v\ (nonrelativistic))$

$\Delta x \Delta p_x \geq \frac{h}{\pi} \qquad \Delta E \Delta t \geq \frac{h}{\pi}$

$\frac{\mathrm{d}N}{\mathrm{d}t} = -\lambda N \qquad N = N_0\,\mathrm{e}^{-\lambda t}$

$R \equiv |\frac{dN}{dt}| \qquad T_{\frac{1}{2}} = \frac{\ln 2}{\lambda} = \frac{0.693}{\lambda}$

MATH:

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

y	dy/dx	$\int y dx$
x^n	$nx^{(n-1)}$	$\frac{1}{n+1}x^{n+1}$
e^{kx}	ke^{kx}	$\frac{1}{k}e^{kx}$
$\sin(kx)$	$k\cos(kx)$	$-\frac{1}{k}\cos kx$
$\cos(kx)$	$-k\sin(kx)$	$\frac{1}{k}\sin kx$

where $k = constant$

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

CONSTANTS:

g = acceleration due to gravity = 10 $\mathrm{ms^{-2}}$
1 u = 1.660×10^{-27} kg = 931.50 MeV
1 eV = 1.602×10^{-19} J
1 Ci = 3.7×10^{10} Bq
$c = 3.00 \times 10^8\ \mathrm{ms^{-1}}$
$h = 6.626 \times 10^{-34}$ Js
$e \equiv$ electron charge = 1.602×10^{-19} C
$R_H = 1.09737 \times 10^7\ \mathrm{m^{-1}}$
$\mathrm{a_0}$ = Bohr radius = 0.0529 nm

particle	mass(u)	mass(kg)
e	$5.485\,799\,031 \times 10^{-4}$	$9.109\,390 \times 10^{-31}$
p	1.007 276 470	$1.672\,623 \times 10^{-27}$
n	1.008 664 904	$1.674\,928 \times 10^{-27}$