Constants

$R_E = 6.371 \times 10^6$ m

$G = 6.67 \times 10^{-11}\ N\ m^2 / kg^2$

$A.U. = 1.49 \times 10^{11}$ m

g (Earth) $= 9.8$ m/ sec^2

$c = 3 \times 10^8$ m/sec

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ N\ m^2 / coul^2$

$\frac{\mu_0}{2\pi} = 10^{-7}$ Tm/A

$h = 4.13 \times 10^{-15}$ eV sec

$\sigma = 5.67 \times 10^{-8}$ Watts/(m^2 ° K^4)

$1\ amu = 1.66 \times 10^{-27}$ kg

$k = 1.38 \times 10^{-23}$ Joules/ °K

Equations

$A = \pi r^2$ area of circle

$C = 2\pi r$ circumference of a circle

$V = \frac{4\pi}{3} r^3$ volume of a sphere

$\frac{1}{P} = \frac{1}{P_E} \pm \frac{1}{S}$ $\left\{ \begin{matrix} + \text{inferior planet} \\ - \text{superior planet} \end{matrix} \right\}$

$P^2 = a^3$ (P in years, a in A.U.)

$a = \frac{a_1 + a_2}{2}$

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

$v_z = -gt$

$z = h + v_0 t - \frac{1}{2} g t^2$

$a = \frac{v^2}{r}$ (Circular orbit)

$F = m\frac{v^2}{R}$ (Circular orbit)

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

$$K.E. = \frac{1}{2} m v^2$$

$$P.E. = -G\frac{mM}{R}$$

$$L = m r v_{\perp}$$

$$F = G\frac{mM}{R^2}$$

$$v_{cir} = \sqrt{\frac{GM}{R}}$$

$$v_{esc} = \sqrt{2}\, v_{cir}$$

$$P^2 = Ka^3$$

$$K = 4\pi^2/[G(m_1 + m_2)]$$

$$E = \frac{1}{2} mv^2 - \frac{GmM}{R}$$

$$E = -GmM/(2a)$$

$$v^2 = GM[\frac{2}{R} - \frac{1}{a}]$$

$$\Delta F = 2G\frac{mM}{R^3}\Delta R$$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{R^2}$$

$$E = \frac{F}{q} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R^2}$$

$$F = qv B \sin\theta$$

$$I = \Delta q/\Delta t$$

$$B = \frac{\mu_0}{2\pi}\frac{I}{R}$$

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

$$\lambda = c/f$$

$$F\,(\text{flux}) = P/A$$

$$F\,(\text{flux}) = (1/\mu_0) EB$$

$$F\,(\text{flux}) = \sqrt{\varepsilon_0/\mu_0}\, E^2$$

$$F\ (\text{flux}) = \frac{P}{4\pi R^2}$$

$$\Delta f = f\ \frac{v}{c}$$

$$\theta_{min} = \frac{\lambda}{d}\ \text{radians}$$

$$\theta_{min} = 2.1 \times 10^5\ (\frac{\lambda}{d})\ \text{arcsec}$$

} single slit

$$\theta_{min} = 1.22\ (\frac{\lambda}{d})\ \text{radians}$$

$$\theta_{min} = 2.5 \times 10^5\ (\frac{\lambda}{d})\ \text{arcsec}$$

} circular single aperture

$$E = hf$$

$$p = cE$$

$$\Delta E = hc/\lambda$$

$$E\ (\text{flux}) = \sigma T^4$$

$$\lambda_m = 0.29/T\ \text{cm}\ (T \text{ in } ^\circ K)$$

$$n = c/v$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\frac{1}{f} = (n-1)\ (\frac{1}{R_1} + \frac{1}{R_2})\ \text{lens}$$

$$f = \frac{R}{2}\ \text{spherical mirror}$$

$$\text{Magnification} = \frac{\theta_I}{\theta_0} = \frac{f_0}{f_E}$$

$$v_{th} = \sqrt{\frac{3kT}{m}}$$

$$p = NkT$$

$$p = \frac{F}{A}$$

$$\frac{dp}{dz} = -\rho_m g$$

$$p = p_0 e^{-z/H}$$

$$H = \frac{k\,T}{mg}$$

$$v_{th} \le \frac{1}{6}\, v_{esc} \qquad \left(\begin{array}{c}\text{condition for}\\ \text{a bound}\\ \text{atmosphere}\end{array}\right)$$

$$T = \left(\frac{1-a}{1-a_E}\right)^{1/4} \frac{T_E}{\sqrt{R}}$$

$$T = \frac{1}{\sqrt{R}}\, T_E, \quad R \text{ in A.U.} \qquad \left(\begin{array}{c}\text{valid if } a << 1 \text{ and } a_E << 1\\ \text{of if } a = a_E\end{array}\right)$$

$$\Delta E = (\Delta m)\, c^2$$

$$\frac{dN}{dt} = -kN$$

$$N = N_0\, e^{-kT}$$