MT #2 data sheet

Constants: seconds/year $= 3.15 \times 10^7$ $\hbar = 1.05 \times 10^{-34}$ J·s

$c = 3 \times 10^8$ m/s, $G = 6.67 \times 10^{-11}$ $N m^2/kg^2$, $u = 1.66 \times 10^{-27}$ kg

$$r_c \equiv \frac{\sum m_i r_i}{M} \qquad V_c = \frac{\sum m_i v_i}{M}$$

rotational motion, constant angular acceleration (careful with signs)

$\omega = \omega_0 + \alpha t$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$ $\qquad \omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

$\vec{\alpha} = \frac{d\vec{\omega}}{dt}$, $\quad I = \sum_i m_i r_i^2$, $\quad \vec{\tau} = \vec{r} \times \vec{F}$, $\quad |\vec{\tau}| = |\vec{r}||\vec{F}|\sin\theta$

$\sum \vec{\tau}_{ext} = I\vec{\alpha}$ $\qquad \vec{A} \times \vec{B} = (A_y B_z - A_z B_y)\hat{i} + (A_z B_x - A_x B_z)\hat{j} + (A_x B_y - A_y B_x)\hat{k}$

$\vec{L} = \vec{r} \times \vec{p}$ $\qquad x_{cg} = x_c$ if gravitational field is uniform

Simple Harmonic Motion:

$x = A\cos(\omega t + \delta)$

$T = \frac{2\pi}{\omega}$ $\qquad V = \frac{dx}{dt}$, $\quad a = \frac{dV}{dt}$

derivatives

$\frac{d}{dt}\sin[f(t)] = \cos[f(t)]\frac{df(t)}{dt}$

$\frac{d}{dt}\cos[f(t)] = -\sin[f(t)]\frac{df(t)}{dt}$

Newton's Law of Gravity: $F = G\frac{m_1 m_2}{r^2}$

$T^2 = K a^3$, $\quad K = \left(\frac{4\pi^2}{GM}\right)$ (a: semi-major axis)

$V_{esc} = \sqrt{\frac{2GM}{R}}$, $\quad \Delta U = -GMm\left(\frac{1}{r_f} - \frac{1}{r_i}\right)$

$r = r_0 A^{1/3}$ $\quad (r_0 = 1.2 \times 10^{-15}$ m), $\quad E = \Delta m c^2$, $\quad N = N_0 e^{-\lambda t}$

$Q = [M_{initial} - M_{final}]c^2$

rate $= \left|\frac{dN}{dt}\right| =:$ Activity $= \lambda N_0 e^{-\lambda t} = R_0 e^{-\lambda t}$

$\Delta t \Delta E \geq \hbar$

$\frac{V}{c} = \frac{(z+1)^2 - 1}{(z+1)^2 + 1}$, $\quad z = \frac{\lambda - \lambda_0}{\lambda_0}$

$V = H_0 d$, $\quad H_0 = 50$ km/s/Mpc

1 Mpc $= 2.93 \times 10^{22}$ m