Astronomy 11 Fall 1998
Steven T. Myers

Equations and Constants for Midterm #1
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Constants

$c = 2.998 \times 10^5$ km/s

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

$\mathrm{m_p} = 1.67 \times 10^{-27}\,\mathrm{kg}$

$\mathrm{m_e} = 9.11 \times 10^{-31}\,\mathrm{kg}$

$M_\odot = 2 \times 10^{30}$ kg

$R_\odot = 6.96 \times 10^5$ km

$M_\oplus = 5.98 \times 10^{24}$ kg

$R_\oplus = 6378$ km

$g_\oplus = 9.807\ \mathrm{m/s^2}$

$1\,AU = 1.496 \times 10^8\,km$

$1\,\mathrm{radian} = 206265''$

1 year $= 3.156 \times 10^7$ seconds $= 365.26$ days

Mechanics

$$\vec{v} = d\vec{r}/dt \qquad \vec{a} = d\vec{v}/dt$$

$$\vec{p} = m\vec{v} \qquad \vec{L} = \vec{r} \times \vec{p}$$

$$F_{cen} = \frac{mv^2}{r} \qquad F = \frac{Gm_1 m_2}{r^2}$$

$$E = \frac{1}{2}\mu v^2 - \frac{GM\mu}{r} \qquad \frac{1}{S} = \frac{1}{P_{in}} - \frac{1}{P_{out}}$$

$$v_{circ} = \frac{2\pi a}{P} \qquad \mu = \frac{m_1 m_2}{m_1 + m_2}$$

$$M = m_1 + m_2 \qquad GM\,P^2 = 4\pi^2\,a^3$$

$$M\vec{R} = m_1\vec{r}_1 + m_2\vec{r}_2 = 0 \qquad M\vec{V} = m_1\vec{v}_1 + m_2\vec{v}_2 = 0$$

$$\vec{r} = \vec{r}_2 - \vec{r}_1 \qquad \vec{v} = \vec{v}_2 - \vec{v}_1$$

$$\vec{r}_1 = -\frac{\mu}{m_1}\vec{r} \qquad \vec{r}_2 = \frac{\mu}{m_2}\vec{r}$$

$$m_1 r_1 = m_2 r_2 \qquad m_1 v_1 = m_2 v_2$$

$$r_p = a(1-e) \qquad r_a = a(1+e)$$

$$H = r v_\theta \qquad L_{orb} = \mu v_p r_p = \mu v_a r_a$$

$$\frac{E}{\mu} = -\frac{GM}{2a} \qquad H^2 = GMa(1-e^2)$$

$$v_{circ}^2 = \frac{GM}{r} \qquad v_{esc}^2 = \frac{2GM}{r}$$

$$v_\theta^2 = \frac{GMa}{r^2}(1-e^2) \qquad v^2 = GM\left[\frac{2}{r} - \frac{1}{a}\right]$$

$$\vec{F} \cdot d\vec{r} = F_r dr + F_\theta r d\theta \qquad d\vec{r}/dt = (dr/dt, r d\theta/dt)$$