Note SMGROUP

2.4

$$E=\frac{1}{2}m_1|\vec{v}_1|^2+\frac{1}{2}m_2|\vec{v}_2|^2-G\frac{m_1m_2}{|\vec{r}_2-\vec{r}_1|}$$

$$\mu\equiv\frac{m_1m_2}{m_1+m_2},\quad \vec{r}_1=-\frac{\mu}{m_1}\vec{r},\quad \vec{r}_2=\frac{\mu}{m}\vec{r}$$

$$r=|\vec{r}_2-\vec{r}_1|$$

$$E=\frac{1}{2}\mu v^2-G\frac{M\mu}{r}\qquad M=m_1+m_2$$

2.5

$$\vec{L}=m_1\vec{r}_1\times\vec{v}_1+m_2\vec{r}_2\times\vec{v}_2$$

$$=m_1\left(+\frac{\mu}{m_1}\vec{r}\right)\times\left(+\frac{\mu}{m_1}\vec{v}\right)$$

$$+m_2\left(\frac{\mu}{m_2}\vec{r}\right)\times\left(\frac{\mu}{m_2}\vec{v}\right)$$

$$=\frac{\mu^2}{m_1}(\vec{r}\times\vec{p})+\frac{\mu^2}{m_2}(\vec{r}\times\vec{v})$$

$$=\mu^2(\vec{r}\times\vec{v})\left(\frac{1}{m_1}+\frac{1}{m_2}\right)$$

$$=\mu^2(\vec{r}\times\vec{v})\cdot\left(\frac{m_1+m_2}{m_1m_2}\right)$$

$$=\mu(\vec{r}\times\vec{v})$$

$$=\vec{L}$$

Note SMGROUP

2.6

· total orbital angular momentum

(a)

$$L=\mu\sqrt{GMa(1-e^2)}$$

or. $A=\frac{1}{2}\frac{L}{\mu}p$

$$\pi ab=\frac{1}{2}\cdot\frac{L}{\mu}p$$

$$\therefore L=\frac{2\pi ab\mu}{p}\qquad mvr$$

$$L^2=\frac{4\pi^2a^2b^2\mu^2}{p^2}=\frac{4\pi^2a^4(1-e^2)\mu^2}{p^2}$$

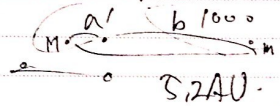
$a=5.2AU.\quad e=0.048\quad p=11.86yr$

$M_\odot=1.99\times10^{30}kg\quad M_J=317.83\times5.97\times10^{24}$

$=1.90\times10^{27}$

$L=2.72\times10^{28}\ kg\cdot AU^2/yr$

(b) Center of mass



$a+b=5.2A$

$100:1$

$m_Ma+m_b(5.2-a)$

$a+b=5.2$

$19+m$

$5.19\times$

(b) $P^2 = \frac{4\pi^2}{GM_\oplus} a^3$

$a^3 = \frac{P^2}{4\pi^2} GM_\oplus$

$= \frac{(86400\,sec)^2}{4\pi^2} \cdot (6.673\times10^{-11}\,N\cdot m^2\cdot kg^{-2})(5.973\times10^{24}\,kg)$

$24\,hr \times \frac{3600\,sec}{1\,hr} = 86400$

$a = 42240313.158\ m$

$= 42240\,km$

$= h + r_\oplus$

$\therefore h = (42240 - 6378)\,km$

$= 35862\,km.$

2.8

~~h = 610 km~~

$r = 6.378 \times 10^6\ m$

(a) $h = 610\ km = 610 \times \frac{1000\ m}{1\ km} = 6.10 \times 10^5\ m$

$= 610000\ m$

$R = r + h$

$= 63.78 \times 10^5\ m + 6.10 \times 10^5\ m$

$= 69.88 \times 10^5\ m$

$= 6.988 \times 10^6\ m$

$P^2 = \frac{4\pi^2}{G M_\oplus} R^3$: Kepler's third law.

$P^2 = \frac{4\pi^2}{(6.673 \times 10^{-11}\ N \cdot m^2 \cdot kg^{-2}) \cdot (5.9736 \times 10^{24}\ kg)} \cdot (6.988 \times 10^6\ m)^3$

$N = kg \cdot m / sec^2$

$= 3.3796 \times 10^7\ sec^2$

$P = 5813\ sec$