FOP | PP | 272 - Kepler's Law

2. $$K = \frac{r^3}{T^2}$$

$$r^3 = kT^2$$

$$r = \sqrt[3]{kT^2}$$

$$r' = \sqrt[3]{k(2T)^2}$$

$$r' = \sqrt[3]{4kT^2}$$

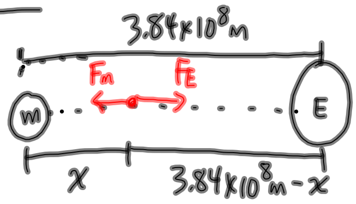
$$r' = \sqrt[3]{4}\sqrt{kT^2}$$

$$r' = \sqrt[3]{4}\; r$$

$$\boxed{r' \doteq 1.6\, r}$$

3. $$K_{earth} = \frac{(3.8 \times 10^8 m)^3}{(2.36 \times 10^6 s)^2}$$

PP | 580



$m_{moon} = 7.36 \times 10^{22} kg$

$m_{earth} = 5.98 \times 10^{24} kg$

$$F_{g_{moon}} = \frac{G m_{moon} m_{object}}{x^2}$$

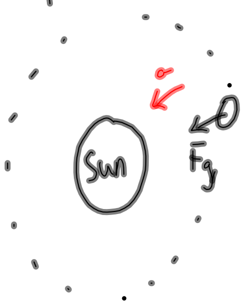
$$F_{g_{earth}} = \frac{G m_{earth} m_{object}}{(3.84 \times 10^8 m - x)^2}$$

$$\frac{\cancel{G} m_{moon} \cancel{m_{object}}}{x^2} = \frac{\cancel{G} m_{earth} \cancel{m_{object}}}{(3.84 \times 10^8 m - x)^2}$$

$$\frac{7.36 \times 10^{22}}{x^2} = \frac{5.98 \times 10^{24}}{(3.84 \times 10^8 - x)^2}$$

Newton's Hypothesis:

The F_g between a planet and the sun provides the centripetal force:



$F_{net} = ma$

$$F_c = \frac{mv^2}{r} = \frac{4\pi^2 r m}{T^2} = 4\pi^2 r m f^2$$

the orbiting mass

$$F_g = \frac{G m_1 m_2}{r^2}$$

central mass

mp|585 - Find the mass of the Sun given the earth's orbital radius and period.

$r = 1.49\times10^{11}\,m$ $\qquad$ $T = 365.25$ days

$\times 24 \times 3600\,s$

$= 31557600\ s$

$$F_g = F_c$$

$$\frac{G m_{sun} \cancel{m_{earth}}}{r^2} = \frac{4\pi^2 r \cancel{m_{earth}}}{T^2}$$

$$G m_{sun} T^2 = 4\pi^2 r^3$$

$$m_{sun} = \frac{4\pi^2 r^3}{G T^2}$$

Kepler's constant for sun

$$m_{sun} = \frac{4\pi^2 (1.49\times10^{11}\,m)^3}{\left(6.67\times10^{-11}\,\frac{N\cdot m^2}{kg^2}\right)(31557600\,s)^2}$$

$$\boxed{m_{sun} = 1.97\times10^{30}\,kg}$$

- PP|586
- Assignment: p597|22-33 (Thurs)