FOP|272

2. $T_p = 2T_E$

$R_p = ??$

For new planet: $\frac{R^3}{T^2} = 3.35\times10^{18} \frac{m^3}{s^2}$

$$\frac{R^3}{(2(365.25d))^2} = 3.35\times10^{18} \frac{m^3}{s^2}$$

$365.25d \downarrow$ change to seconds.

Solve for R and compare to the Earth's orbital radius.

A better way:

$$\frac{R_p^3}{T_p^2} = \frac{R_E^3}{T_E^2}$$

$$\frac{R_p^3}{(2T_E)^2} = \frac{R_E^3}{T_E^2}$$

$$R_p^3 = \frac{4\cancel{T_E^2} R_E^3}{\cancel{T_E^2}}$$

$$R_p^3 = 4R_E^3$$

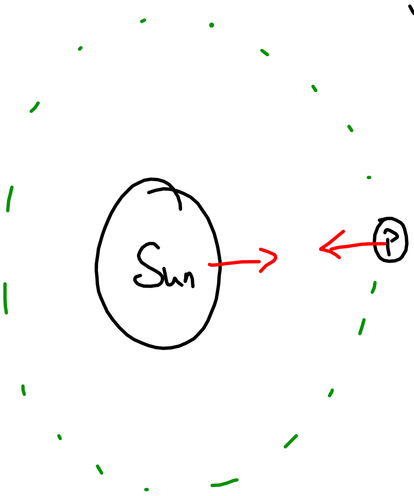
$$R_p = \sqrt{4R_E^3}$$

$$R_p = \sqrt[3]{4}\, R_E^3$$

$$R_p = 1.6\, R_E$$

Newton's Hypothesis

Newton proposed that the "circular" motion of the planets was due to the force of gravity on the planet.



$$F_g = F_c$$

$$a_c = \frac{4\pi^2 r}{T^2}$$

$$\frac{G m_s m_p}{r^2} = m_p a_c$$

$$\frac{G m_s \cancel{m_p}}{r^2} = \frac{\cancel{m_p}\, 4\pi^2 r}{T^2}$$

$$G m_s T^2 = 4\pi^2 r^3$$

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

You can use Kepler's constant to find the mass of the central body, in this case the mass of the sun.

MP|585

$m_{sun} = ?$

$r_{earth's\ orbit} = 1.49 \times 10^{11}\,m$

$T_{earth} = 365.25\,d$

31556736 s

$$F_g = F_c$$

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

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

$$m_{sun} = \frac{4\pi^2 (1.49 \times 10^{11}\,m)^3}{\left(6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2}\right)(31556736\,s)^2}$$

$$m_{sun} = 1.97 \times 10^{30}\,kg$$

TO DO

1. Planetary Motion
2. PP|586