

$$V_{esc} = \sqrt{\frac{2GM}{r}}$$

$$V_{orb} = \sqrt{\frac{GM}{r}} \quad \text{or} \quad \sqrt{rg} \quad \text{IF you know } g \text{ at that altitude}$$

$$F_g = \frac{GM_1M_2}{r^2}$$

$$g = \frac{GM}{r^2}$$

$$F_R = \frac{mv^2}{r}$$

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

$$\frac{T_1^2}{r_1^3} = \frac{T_2^2}{r_2^3}$$

(may use any units, such as  
T in years, r in AU.

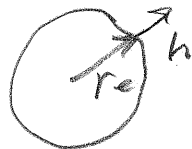
$$1 \text{ AU} = 1.496 \times 10^{11} \text{ m} = r_{es}$$

$$M_e = 5.98 \times 10^{24} \text{ kg}$$

$$1 \text{ year} = 3.15 \times 10^7 \text{ s}$$

$$r_e = 6.37 \times 10^6 \text{ m}$$

$$r_{es} = 1.496 \times 10^{11} \text{ m}$$



$$G = 6.67 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}$$

$$M_s = 1.991 \times 10^{30} \text{ kg}$$

$$r = r_e + h \quad \text{"h" is altitude above ground}$$

$$M_s = \frac{4\pi^2 r_{es}^3}{GT^2}$$

$$= \frac{4\pi^2 (1.5 \times 10^{11} \text{ m})^3}{6.67 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2} (3.15 \times 10^7 \text{ s})^2}$$

$$M_s = 2 \times 10^{30} \text{ kg}$$

How to find the mass of the sun!