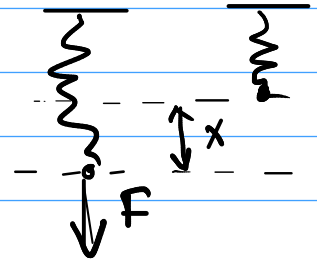
Spring



$$\boxed{-kx = F_x}$$

k ← spring constant

$$W_s = \int_{\vec{r}_1}^{\vec{r}_f} \vec{F}\, d\vec{r} = \int_{x_1=0}^{x_f} F_x\, dx =$$

$$= \int_0^{x_f} -kx\, dx = -k\frac{x^2}{2}\Big|_0^{x_f} = -\left(k\frac{x_f^2}{2} - k\frac{0^2}{2}\right)$$

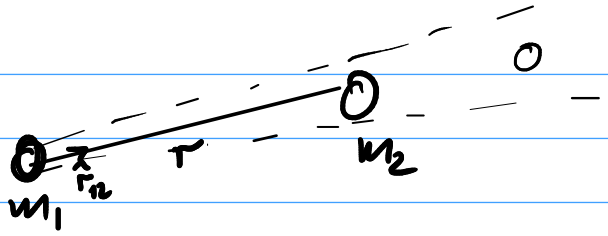
$k\frac{x_f^2}{2}$ ← U_f ; $k\frac{0^2}{2}$ ← U_i

$$= U_f - U_i$$

$$\boxed{U(x) = \frac{kx^2}{2}}$$

Gravitation

$$\vec{F_g} = m\vec{g}$$



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

G: universal constant of gravity

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

$$\vec{F}_{12} = G \frac{m_1 \cdot m_2}{|r_{12}|^2} \hat{r}_{12}$$

$\vec{F}_{12}$: on 1 by 2nd; $\hat{r}_{12}$: from 1st to 2nd

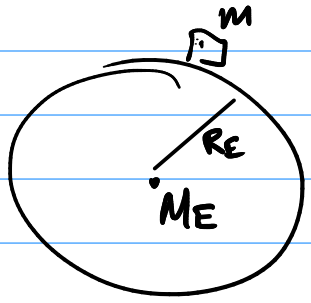
$$\vec{F}_{21} = G \frac{m_2 m_1}{|r_{21}|^2} \hat{r}_{21} = G \frac{m_1 m_2}{|r_{12}|^2} (-\hat{r}_{12})$$

$$F_{m_1 m_2} = G \frac{m_{m_1} \cdot m_{m_2}}{r^2} = 6.67 \cdot 10^{-11} \cdot \frac{70kg \; 70g}{1m^2}$$

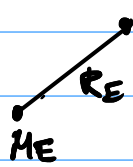
$$= \underbrace{6.67}_{7} \cdot 10^{-11} \cdot \underbrace{49}_{50} \cdot 10^2 = 350 \cdot 10^{-11} \cdot 10^2 =$$

$$= 3.5 \cdot 10^{-11} \cdot 10^4 =$$

$$= 3.5 \cdot 10^{-7} \, N$$



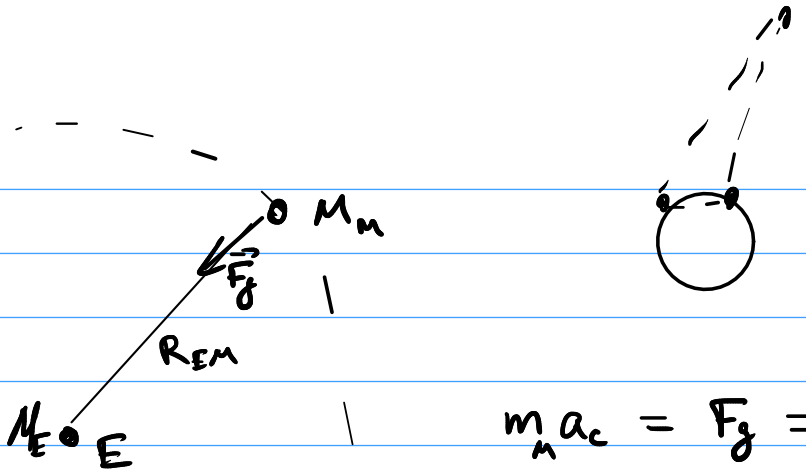
$\Longleftrightarrow$



$$\Rightarrow F_g = G \frac{M_E \cdot m}{R_E^2} = mg$$

$$M_E = \frac{g \cdot R_E^2}{G} = \frac{9.8 \cdot (6.4 \cdot 10^6 m)^2}{6.67 \cdot 10^{-11}} =$$

$$= 6 \cdot 10^{24} \, kg$$



$$m_m a_c = F_g = G \frac{M_E \cdot M_m}{R_{EM}^2}$$

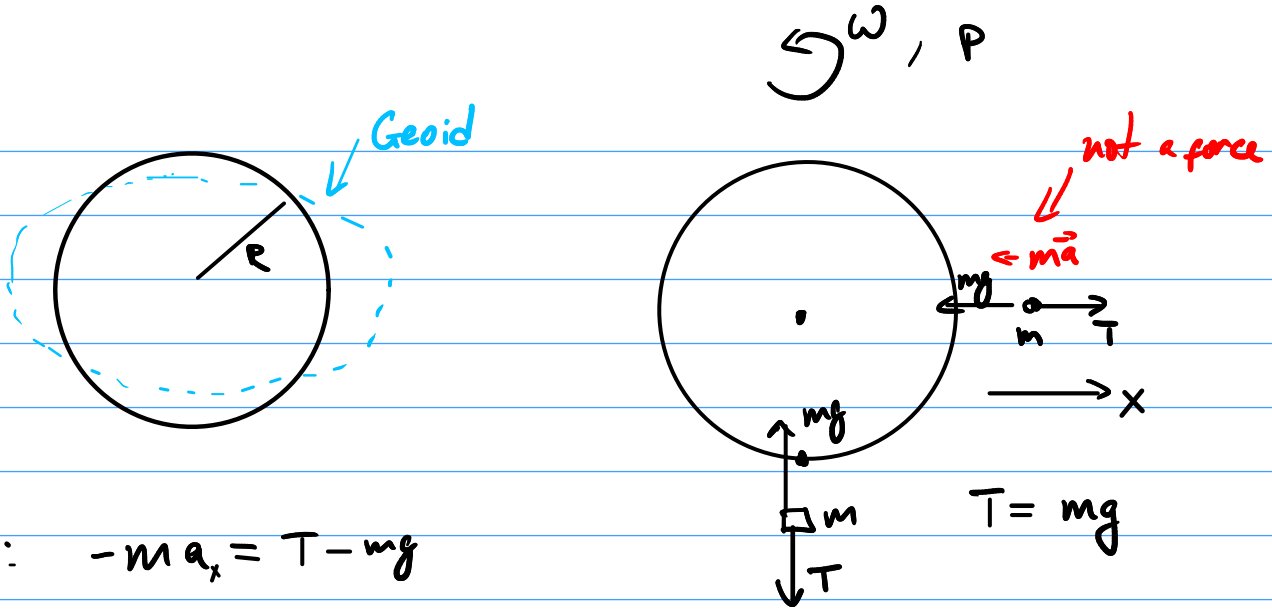
$$v_m = \frac{2\pi R_{EM}}{(27.3\,d)} \quad \leftarrow P$$

$$\frac{v_m^2}{R_{EM}} = a_c = G \frac{M_E}{R_{EM}^2}$$

$$\left(\frac{2\pi R_{EM}}{P}\right)^2 \frac{1}{R_{EM}} = G \frac{M_E}{R_{EM}^2}$$

$$M_E = \frac{(2\pi)^2}{P^2} R_{EM}^3 \frac{1}{G} = 6 \cdot 10^{24}\ kg$$

$$R_{EM} = 384 \cdot 10^6\ m$$



x: $-ma_x = T - mg$

$T = mg - ma_x$

$a_x = \frac{v^2}{R_E} = \frac{\left(\frac{2\pi R_E}{P}\right)^2}{R_E}$

400 m/s