Gravitational Energy

$\Delta U_G = -W_G$

$\vec{F}_G = -\frac{Gm_1m_2}{r^2}\hat{r}$

$W_G = \int \vec{F}_G \cdot d\vec{r}$

$W_G = \int \frac{-Gm_1m_2}{r^2}\hat{r} \cdot dr\,\hat{r}$

$W_G = \int -\frac{Gm_1m_2}{r^2}\ dr$

$W_G = -Gm_1m_2 \int \frac{dr}{r^2}\ dx$

$W_G = -Gm_1m_2 \left(\frac{-1}{r}\right)$

$W_G = Gm_1m_2 \left(\frac{1}{r}\right)$

$\Delta U_G = \frac{-Gm_1m_2}{r}$

Important

$U_G = \frac{-Gm_1m_2}{r} + U_0$

U_0 is like + C

U_0 is 0 at $r = \infty$

Earth going around sun:

$E_{tot} = KE + U_G$

$E_{tot} = \frac{1}{2}m_Ev^2 + \frac{-Gm_sm_E}{R}$

$\sum \vec{F} = F_G = ma_c$

$\frac{Gm_sm_E}{R^2} = m_E\frac{v^2}{R}$

$$v^2 = \frac{Gm_s}{R}$$

$$E_{tot} = \frac{1}{2}m_E\left[\frac{Gm_s}{R}\right] - \frac{Gm_sm_E}{R}$$

$$E_{tot} = -\frac{1}{2}\frac{Gm_Em_s}{R}$$

$$E_A = \frac{1}{2}m_o{v_{esc}}^2 - \frac{Gm_Em_o}{R_E} = 0$$

$$E_B = 0 + 0$$

$$c = v_{esc} = \sqrt{\frac{2Gm_E}{R_E}}$$