

Conservative Forces - Work - Energy

work-energy

$$W = \Delta K$$

work done ON object BY an external force equals the object's change in kinetic energy

conservative

non-conservative

$$W_c + W_{nc} = \Delta K$$

where $W_c = \int_1^2 \vec{F}_c \cdot d\vec{r}$

work done BY a conservative force ON the object

$$= - \int_{r_1}^{r_2} \frac{GM_E m}{r^2} dr$$

$$= -GM_E m \left[-\frac{1}{r} \right]_{r_1}^{r_2} = GM_E m \left(\frac{1}{r_2} - \frac{1}{r_1} \right)$$

move W_{nc} to the RHS

$$W_{nc} = \Delta K - W_c \Rightarrow \Delta U = -W_c = -GM_E m \left(\frac{1}{r_2} - \frac{1}{r_1} \right)$$
$$= \Delta K + \Delta U$$

$$U_2 - U_1 = \left(\frac{-GM_E m}{r_2} \right) - \left(\frac{-GM_E m}{r_1} \right)$$

$$\Rightarrow \boxed{U(r) = -\frac{GM_E m}{r}}$$