Derivation of PE

How much energy is "stored" in some thing heigh $h + y_i$?

$\rightarrow$ How much $E$ will Gravity transfer?

$\rightarrow$ How much work will Gravity do?

$$W = F_{\text{g}} \Delta y$$

Energy transfer $= F_{\text{g}} \Delta y$

with this force $F_{\text{g}} = -mg$

$$= -mg \Delta y$$

Clever trickery:

Height: $h = y_i - y_f = -(y_f - y_i) = -\Delta y$

$\Delta y = -h$

$W = -mg (-h)$

$W = mgh$

$PE = mgh$ (height)
Cons. of Energy: No Dissipation

\[ \text{ME}_t = \text{ME}_i \]

\[ \text{PE}_f + \text{KE}_f = \text{KE}_i + \text{PE}_i \]

\[ mgh_f + \frac{1}{2}mv_f^2 = \frac{1}{2}mv_i^2 + mgh_i \]
Bike on a Hill

\[ W_{NC} = ME_t - ME_i \]

\[ 0 = ME_t - ME_i \]

\[ ME_i = ME_t \]

\[ KE_i + PE_i = KE_f + PE_f \quad \text{on 2nd eq. sheet} \]

\[ KE = \frac{1}{2} mV_{net}^2 \text{\ net velocity} \]

\[ PE = mg \cdot h \]

\[ \frac{1}{2} mV_i^2 + mg h_i = \frac{1}{2} mV_f^2 + mg h_f \]

\[ \frac{1}{2} V_i^2 + g h_i = \frac{1}{2} V_f^2 + g h_f \]

Knew:

\[ V_i = 2.0 \text{ m/s} \]

\[ h_i = 50 \text{ m} \]

\[ h_f = 30 \text{ m} \]

\[ \Delta y = -20 \text{ m} \]

\[ V_f = ? \]

\[ \frac{1}{2} (2)^2 + (9.8)(50) = \frac{1}{2} (V_f^2) + (9.8)(80) \]

\[ 2 + 490 = \frac{1}{2} V_f^2 + 294 \]

\[ 492 - 294 = \frac{1}{2} V_f^2 \]

\[ (2)(198) = V_f^2 \]

\[ V_f = \sqrt{396} \]

\[ V_f = 19.9 \text{ m/s} \]
Power

Light bulb: 60W.
60 J per second