$$E=E'$$

$$W=F∆d$$

$$F∆d=E\_{k}+E\_{g}$$

$$E\_{k}=\frac{1}{2}mv^{2}$$

$$E\_{g}=mgh$$

$$m\_{w}g∙∆d=\frac{1}{2}m\_{b}v^{2}+m\_{b}gh$$

$$v\_{o}=\sqrt{\frac{2m\_{w}g∙∆d}{m\_{b}}-gh}$$

$$v\_{o}=\sqrt{\frac{2\left(\frac{40.0}{2.2}kg\right)\left(9.81m/s\right)∙(1.09728m-0.0762m)}{(0.057kg)}-\left(9.8\frac{m}{s^{2}}\right)(2.7432m)}$$

$$v\_{o}= 79.7301 m/s$$

$$v\_{o}= 79.7 m/s$$

$$E\_{k}= m\_{w}g∙∆d-m\_{b}gh$$

$$E\_{k}= \left(\frac{40.0}{2.2}kg\right)\left(9.81m/s\right)∙(1.09728m-0.0762m)-(0.057kg)\left(9.8\frac{m}{s^{2}}\right)(2.7432m)$$

$$E\_{k}=180.5911 J$$

$$E\_{k}=181 J$$

$$\vec{p}=m\_{b}\vec{v}$$

$$\vec{p}=(0.057kg)(79.7301 m/s)$$

$$\vec{p}=4.5446157 kgm/s$$

$$\vec{p}=4.54 kgm/s$$

$$m\_{w}g∙∆d=\frac{1}{2}m\_{b}v\_{f}^{2}$$

$$v\_{f}=\sqrt{\frac{2m\_{w}g∙∆d}{m\_{b}}}$$

$$v\_{f}=\sqrt{\frac{2\left(\frac{40.0}{2.2}kg\right)\left(9.81m/s^{2}\right)∙(1.09728m-0.0762m)}{(0.057kg)}}$$

$$v\_{f}=79.9394m/s$$

$$v\_{f}=79.9m/s$$

$$v\_{f}^{2}=v\_{i}^{2}+2g∆d\_{y}$$

$$v\_{f}=0$$

$$∆d\_{y}=\frac{-v\_{i}^{2}}{2g}$$

$$∆d\_{y}=\frac{-(79.7sin45 m/s)^{2}}{2(-\frac{9.8m}{s^{2}})}$$

$$∆d\_{y}=162.04431122 m$$

$$∆d\_{y}=162 m$$

Maximum Range Calculation:

$$v\_{o}=\sqrt{\frac{2m\_{w}g∙∆d}{m\_{b}}-gh}$$

$$v\_{o}=126.2887$$

$$v\_{f}=\sqrt{\frac{2m\_{w}g∙∆d}{m\_{b}}}$$

$$v\_{f}= 126.3952$$

$$\frac{v\_{f}\sin(45)-v\_{o}\sin(45)}{g}=∆t$$

$$∆t=18.2321 s $$

$$∆d\_{x}=v\_{o}\cos(45)\left(∆t\right)$$

$$∆d\_{x}=1628.119167 m$$

$$∆d\_{x}=1.63 x10^{3} m$$

$$Effieciency=\frac{∆d\_{x actual}}{∆d\_{x theoretical}}$$

$$Efficiency= \frac{70 m}{1.63 x10^{3} m}$$

$$Efficiency=0.043$$