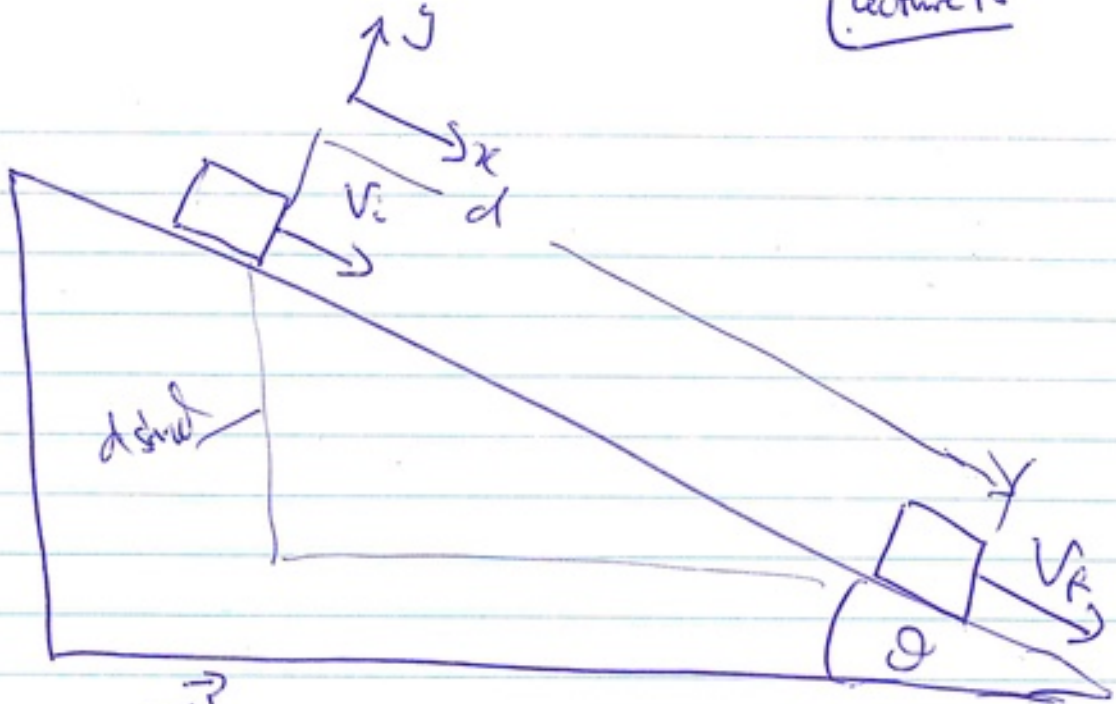
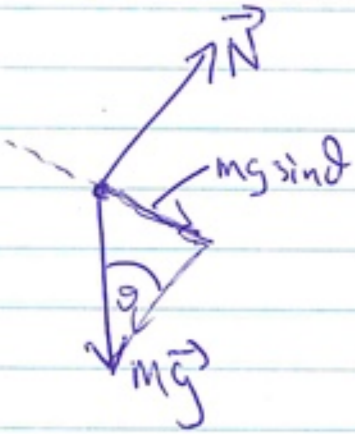
Ramp





$W_N = 0$ Normal force does no work.

$F_x = mg\sin\theta$ force causing acceleration

$$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = W_g = F_x d$$

$$= mg(d\sin\theta)$$

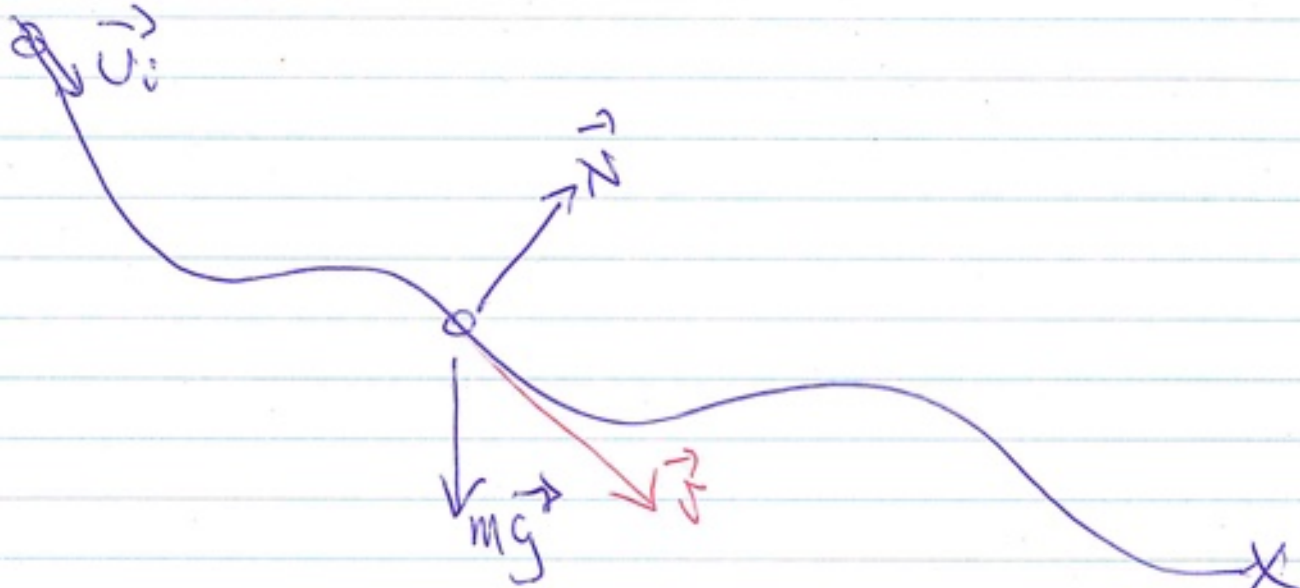
$$= -mg\Delta y$$

$$\Delta y = -d\sin\theta$$

Same as for a free projectile! Ramp plays no role.

Consider a bead on a wire

(no friction)



- $\vec{N}$ always $\perp$ wire, ie the path ($\vec{v}$ points along wire).
- $\vec{F}_g = m\vec{g}$ does work.

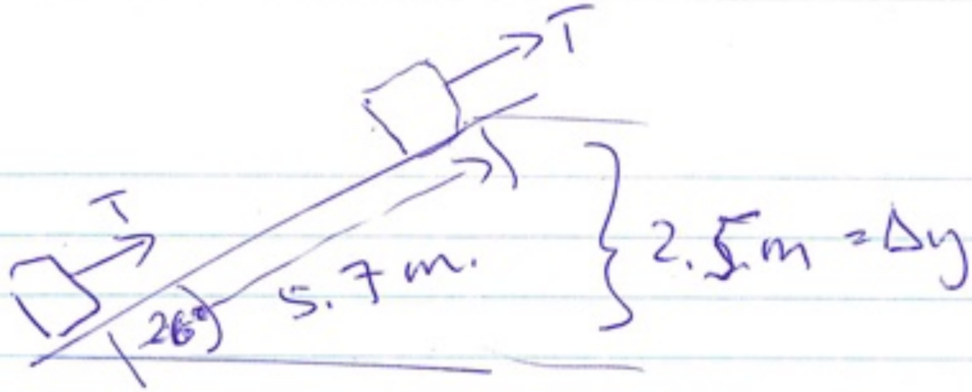
$= -mg\hat{j}$

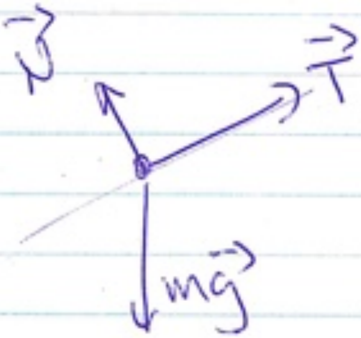
$\Delta\vec{d}$ for segment along wire:

$$\Delta\vec{d} = \Delta x\,\hat{i} + \Delta y\,\hat{j}$$

$$\boxed{\begin{aligned} W_g &= -mg\,\Delta y \\ &= \tfrac{1}{2}mv^2 - \tfrac{1}{2}mv_i^2 \end{aligned}}$$

true for any shape of wire





$W_g = -mg\,\Delta y$

$\Delta y = 5.7\,m \times \sin 26^\circ = 2.5$

$W_g = -15\,kg \times 9.8\,\frac{m}{s^2} \times 2.5\,m$

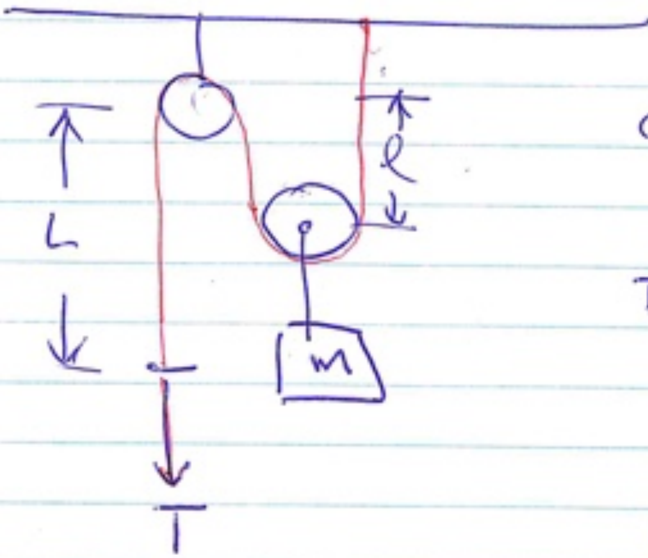
$= -370\,J$

$\Delta K = 0 = W_{total}$.

$W_T = +370\,J$

regardless of whether T is constant in magnitude or direction.

Atwood machine



cord is massless, inextensible.

If cord is pulled down a distance d.

$\Rightarrow m$ rises by $\frac{d}{2}$

Proof: $2l + L = \text{constant}$

If $L \to L' = L + d$.

$$2l' + L' = \text{constant}$$

$$= 2l + L$$

$$2l' + \cancel{L} + d = 2l + \cancel{L}$$

$$\therefore 2l' \to 2l - d.$$

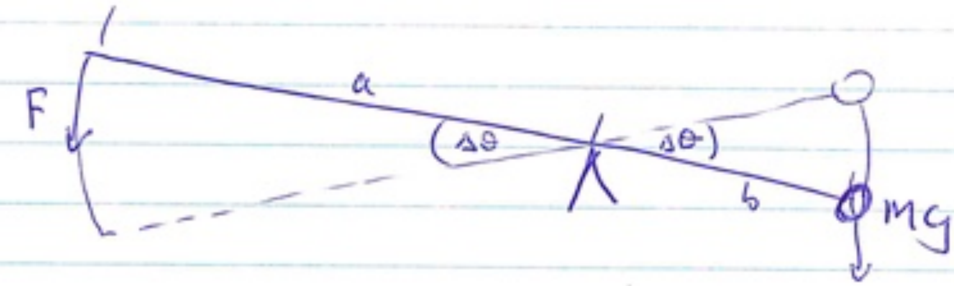
$$\therefore l' = l - \frac{d}{2}.$$

Work done (if v = constant)

$= 0 \quad W = Td + (-mg)\frac{d}{2} = 0$

$$\therefore T = \frac{mg}{2}$$

Lever



$$W_{total} = F(a\Delta\theta) - mg(b\Delta\theta) = 0$$

$$\therefore \quad F = mg\left(\frac{b}{a}\right)$$

mechanical advantage