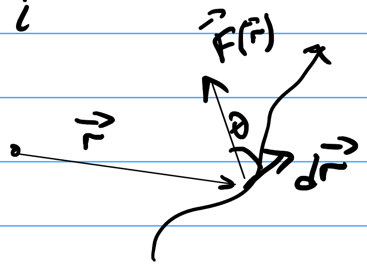
Work a force

$$\int_i^f \vec{F}\cdot d\vec{r} = \int_i^f \left(F_x dx + F_y dy + F_z dz \right)$$

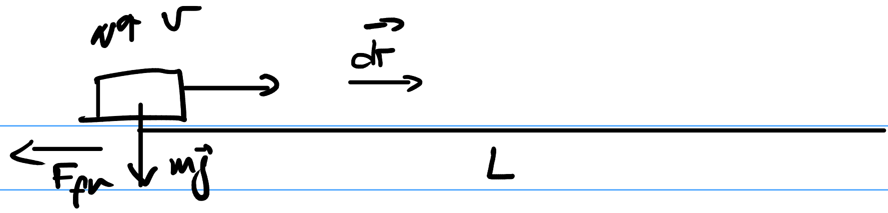


$$= \int_i^f F\cdot dr\cdot \cos\theta$$

$$\int_i^f \vec{F}_{net}\, d\vec{r} = \int_i^f m\vec{a}\, d\vec{r} = \int m \frac{d\vec{v}}{dt} d\vec{r} = \int m\, d\vec{v}\cdot\vec{v}$$

$$= \int m \underbrace{\vec{v}\, d\vec{v}}_{d\vec{v}^2} = m\frac{\vec{v}^2}{2}\Big|_i^f = \frac{m\vec{v}_f^2}{2} - \frac{m\vec{v}_i^2}{2}$$

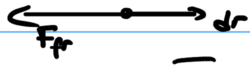
Kinetic energy



$\vec{N} + m\vec{g} = 0$

~~W_{fr}~~ $\quad W_N = \int \vec{F_N}\,\vec{dr} = \int F_N\, dr \cdot \cos\theta_{\widehat{N\,dr}} = 0$ (90°)

$W_{Net} = W_{fr} = \int F_{fr} \cdot dr \cdot \cos\theta_{\widehat{Fr.\,dr}} =$



$= \int F_{fr} \cdot dr \cdot \underbrace{\cos(180^\circ)}_{=-1}$

$= -F_{fr} \int_i^f dr = -F_{fr} \cdot L$

$= -\mu_k N \cdot L = -\mu_k m g L$

$v_i \longrightarrow v_f = 0 \qquad x: \; \overset{0}{v_{f_x}} = v_{i_x} + a_x t$

$v_{i_x} + \frac{F_{frx}}{m} t = v_i - \frac{\mu m g}{m} t$

$t = \frac{v_i}{\mu g}$

$x_f = x_i + v_{i_x} t + \frac{a_x t^2}{2} \Rightarrow L = x_f - x_i = v_{i_x} t + \frac{a_x t^2}{2}$

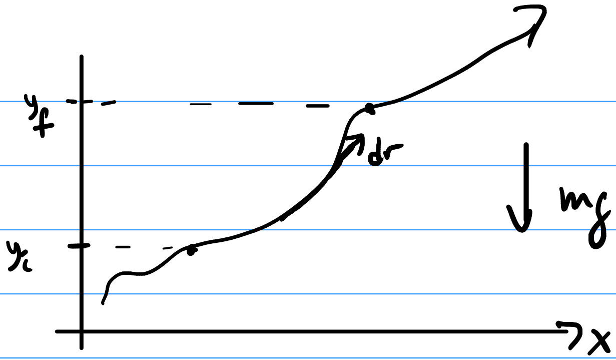
$L = v_i \cdot t - \frac{\mu g}{2} t^2 = \frac{v_i\, v_i}{\mu g} - \frac{\mu g}{2}\left(\frac{v_i^2}{\mu g}\right) = \frac{1}{2}\frac{v_i^2}{\mu g}$

$L\left(v_i = \frac{25\,mi}{h} \simeq \frac{11\,m}{s}\right) = \frac{1}{2}\frac{11^2}{\underset{\simeq 1}{\mu}\, 10} = 6\,m$

$L\left(v_i = \frac{50\,mi}{h} = 22\frac{m}{s}\right) = 6\,m \cdot 4 = 24\,m$

$W_{fr} = -\mu g \cdot L\, m = -\cancel{\mu g}\, m \cdot \left(\frac{1}{2}\frac{v_i^2}{\cancel{\mu g}}\right) = -\frac{1}{2} m v_i^2$

$W_{fr} = \frac{m \cancel{v_f^2}^{\,0}}{2} - \frac{m v_i^2}{2} = -\mu g L m$



$$W_g = \int_i^f \vec{F_g} \cdot \vec{dr} =$$

$$= \int_i^f \left(\cancel{F_x}\,dx + F_y\,dy + \cancel{F_z}\,dz \right)$$

$$= \int_i^f -mg\,dy =$$

$$= -mg(y_f - y_i)$$

$$= -\left(\underbrace{mg\,y_f}_{U_f} - \underbrace{mg\,y_i}_{U_i}\right)$$

potential energy