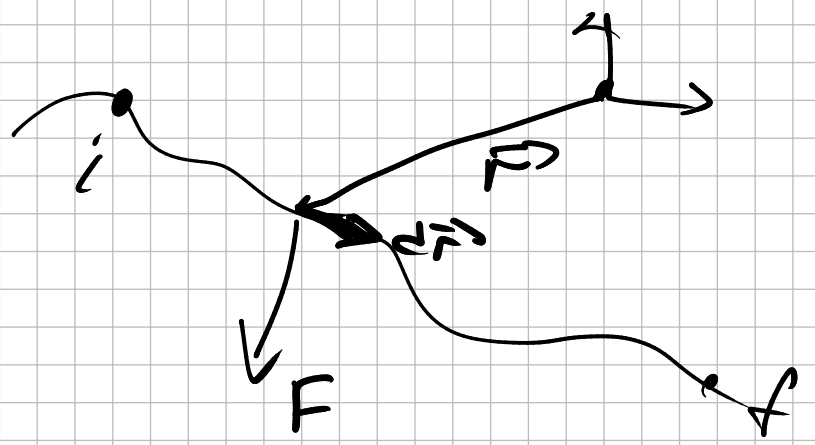
Work

$$W_F = \int_i^f \vec{F} \cdot d\vec{r}$$



$$W_{net} = K_f - K_i$$

$$K = \frac{mv^2}{2}$$

Forces which are conservative

$$W_{cons} = -(U(\vec{F}_f) - U(\vec{F}_i))$$

↑ Potential energy

Fgrav is $U = mgy$

Energy conservation

$$W_{net} = W_{\text{conservative forces}} + W_{\text{non conserv.}} = K_f - K_i$$

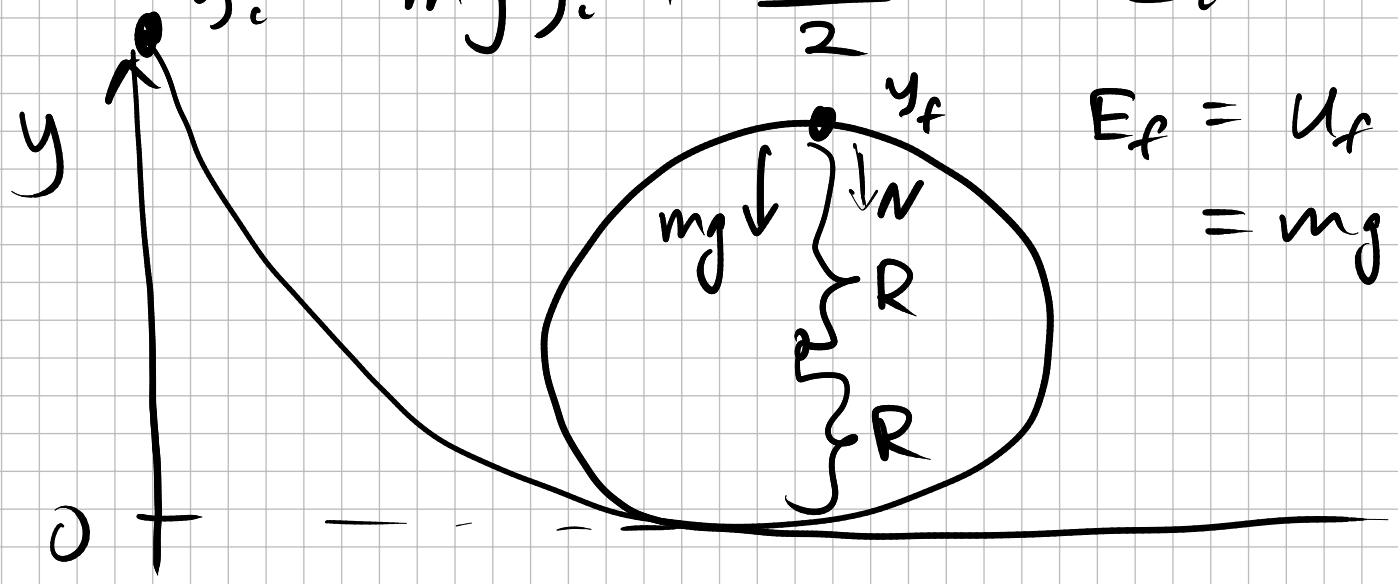
$$= -(U_f - U_i) + W_{\text{non cons}} = K_f - K_i$$

iff $W_{\text{non cons}} = 0$

$$\Rightarrow \quad -(U_f - U_i) = K_f - K_i$$

$$K_i + U_i = K_f + U_f$$

energy conservation



$$\underbrace{mgy_i}_{U_i} + \frac{mv_i^2}{2} = E_i = 0$$

$$E_f = U_f + K_f = mgy_f + \frac{mv_f^2}{2}$$

the slowest case $\Downarrow$ $N = 0$

$$a_c = \frac{v_f^2}{R} = \frac{F_{net}}{m} = \frac{mg + N}{m}$$

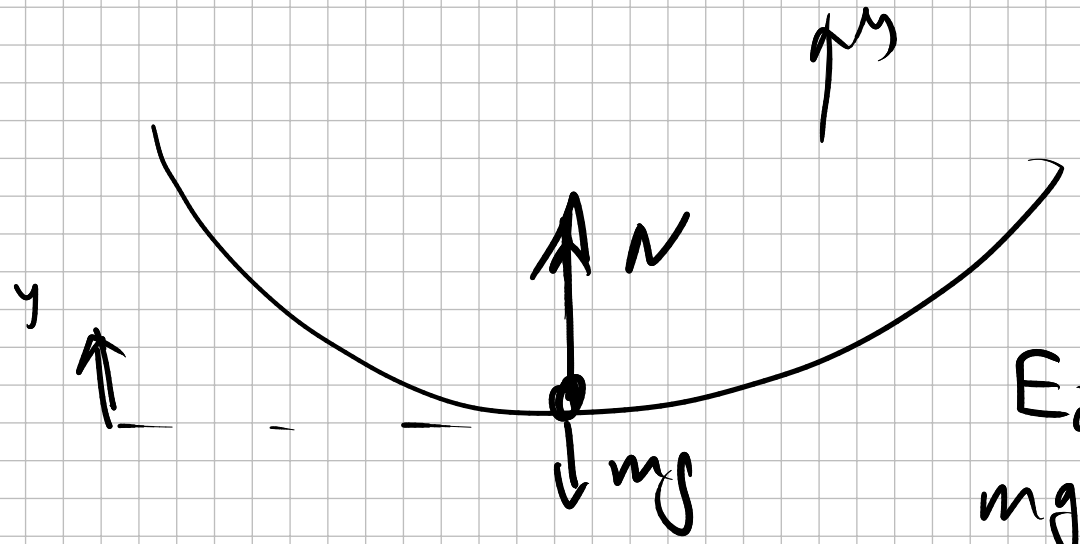
$$a_c = \frac{mg}{m} = g \Rightarrow v_f^2 = gR$$

$$E_i = E_f$$

$$\cancel{m}\cancel{g}y_i = \frac{m v_f^2}{2} + \cancel{m}\cancel{g} y_f =$$

$$= \frac{\cancel{m}\cancel{g}R}{2} + \cancel{m}\cancel{g} 2R$$

$$y_i = 2R + \frac{1}{2}R = \frac{5}{2}R$$



$$\vec{N} + m\vec{g} = m\vec{a}_c$$

$$N - mg = ma_c = m\frac{v^2}{R}$$

$$E_i = E_B$$

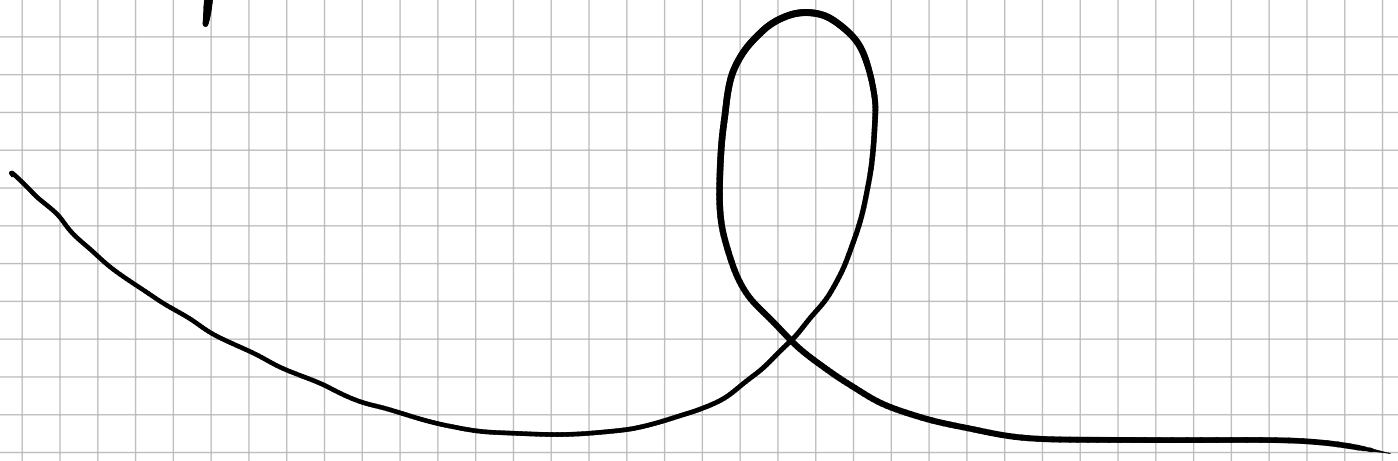
$$mgy_i = \frac{m v_B^2}{2} + mg0$$

$$v_B^2 = 2 \cdot g \cdot y_i = 2g \cdot \frac{5}{2} R = 5gR$$

$$N - mg = m \frac{v_B^2}{R} = m\, 5g \frac{R}{R}$$

$$N = mg(1+5) = 6mg$$

To save people



Power

$$P = \frac{dW}{dt} \qquad \left[\frac{J}{s} = W_{att}\right]$$

$$1\,hp = 735\,W$$

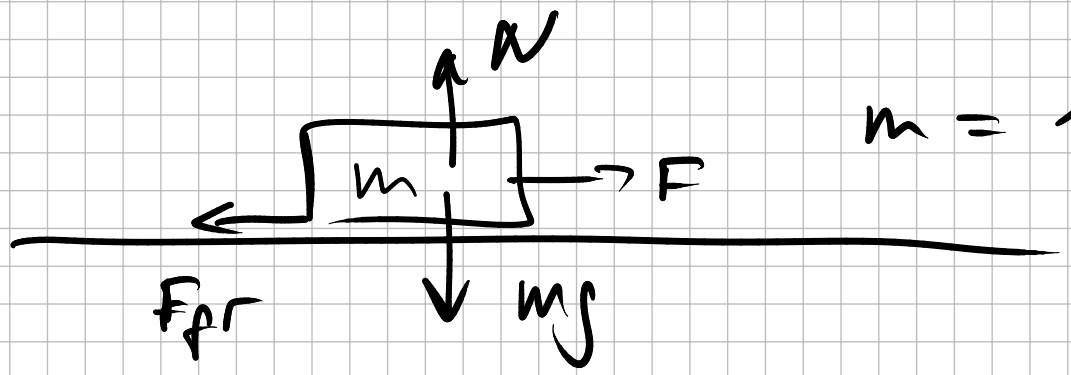
$$W = \int \vec{F} \cdot d\vec{r}$$

$$dW = \vec{F} \cdot d\vec{r}$$

$$P = \frac{dW}{dt} = \frac{\vec{F} \cdot d\vec{r}}{dt} = \vec{F} \cdot \frac{d\vec{r}}{dt} = \vec{F} \cdot \vec{v}$$

if force is constant

Car on a horizontal surface



$m = 1000\,kg$

$$F_{fr} + F_d = \mu N + \frac{1}{2}\rho v^2 C \cdot A$$

$$0.01 \cdot 1000 \cdot g$$

$$\approx 100\,N + \underbrace{\frac{1}{2} 1.2 \cdot \left(22 \tfrac{m}{s}\right)^2 \cdot 0.5 \cdot 4}$$

$$\approx 600\,N$$

$$F = 700\,N$$

$$P = F \cdot v = 700 \cdot 22 = \frac{15500\,W}{735\,W/hP}$$

$$\approx 20\,hP$$