* Work $W = Fd\cos\theta$

  $W > 0$ is work done by the force on the system such that energy of the system increases

* Kinetic energy $KE = \frac{1}{2}mv^2$

  energy in the motion of an object of mass m

* Potential energy PE

  capacity of an object to do work based on its configuration (position in gravity, extension/compression of a spring)

  $$PE_g = mgy$$
  $$PE_{spring} = \frac{1}{2}k(\Delta L)^2 = \frac{1}{2}kx^2$$

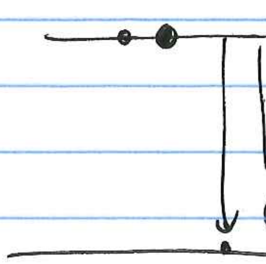
* Work/energy theorem:

  $$W_{net} = KE_f - KE_i = \Delta KE$$

<u>IF</u> there is potential energy

$$W_{net} = -(PE_f - PE_i) = -\Delta PE$$

→ conservation of energy: $\underline{KE_i + PE_i = KE_f + PE_f}$



$v_{f,1} = v_{f,2}$ → $KE_1 = \frac{1}{2}\underline{m_1}v_{f_1}^2 \;\Big|\; KE_2 = \frac{1}{2}\underline{m_2}v_{f_2}^2$

* Conservatifve forces / Non-conservative forces

↳ Work W_{net} only depends on initial and final state, doesn't depend on path taken

$$\hookrightarrow -(PE_f - PE_i) = W_{net}$$

Non-conservative forces : W_{net} depends on path
example : friction

$$W_{net} = \underset{\underset{-(PE_f - PE_i)}{\parallel}}{W_c} + \underline{W_{NC}} = (KE_f - KE_i)$$

$$-(PE_f - PE_i) + W_{NC} = KE_f - KE_i$$

$$OE_f + KE_f + PE_f = KE_i + PE_i + W_{NC} + OE_i \qquad W_{NC} = Fd\cos\theta$$

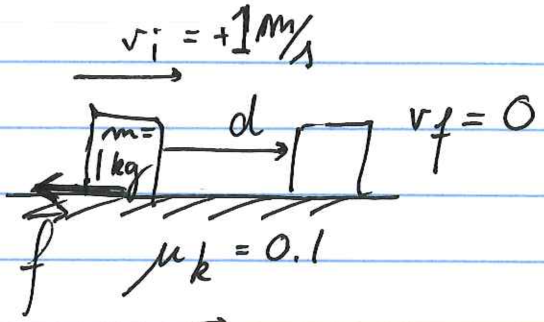
~~(generali~~
"generalized" conservation of energy

$$\Delta PE = PE_f - PE_i = mg\,(0.5\,m) = (5\,kg)(10\,m/s^2)(0.5\,m) = 25\,J$$

$$\Delta KE = 0 - 0 = 0$$

$$W_F = F \cdot \underset{\underset{1m}{\parallel}}{d} \cdot \underset{\underset{1}{\parallel}}{\cos\theta} = \underbrace{(1m)\,F = 25\,J}_{F = \frac{25J}{1m} = 25N}$$

$\theta = 0°$



How far does this object slide?

$\vec{N} \longrightarrow N = mg$ $\qquad f_k = -\mu_k N = -\mu_k mg$

$\vec{W} = m\vec{g} = -mg$

$$\underbrace{KE_f}_{\substack{= \\ 0 \\ v_f = 0}} + \underbrace{PE_f}_{\substack{= \\ 0}} = \underbrace{KE_i}_{\substack{= \\ \frac{1}{2}mv_i^2 \\ = \\ \frac{1}{2}(1kg)(1\,m/s)^2 = 0.5\,J}} + \underbrace{PE_i}_{\substack{= \\ 0}} + W_{nc}$$

$$W_{nc} = F \cdot d \cdot \cos\theta = \mu_k mg\, d \underbrace{\cos 180^\circ}_{-1}$$

$$= -\mu_k mg\, d$$

$$0 = \frac{1}{2}mv_i^2 - \mu_k mg\, d$$

$$\hookrightarrow d = \frac{1}{2}\frac{v_i^2}{\mu_k g} = \frac{(1\,m/s)^2}{2(0.1)(10\,m/s^2)} = \underline{0.5\,m}$$

$v_i = 40\,\text{m/s}$ (90 mph)

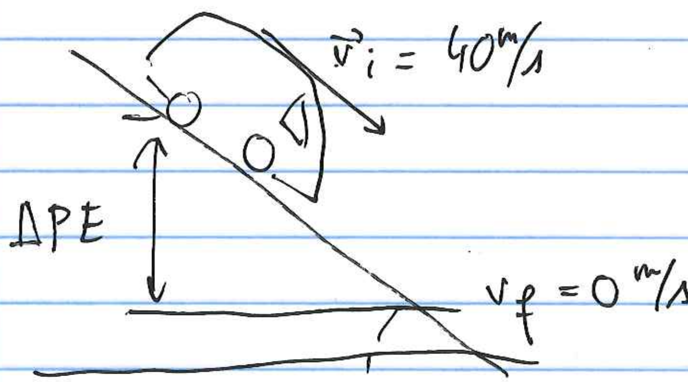
rubber/road : $\mu_k = 0.8$

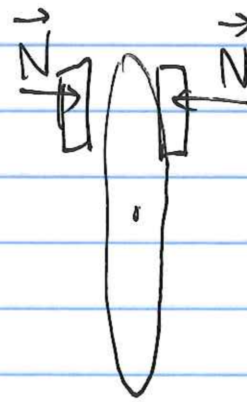
$$\underbrace{\frac{1}{2} m v_i^2}_{KE_i} + \underbrace{W_{nc}}_{-\mu_k m g d} = 0$$

$$\hookrightarrow \quad d = \frac{v_i^2}{2\mu_k g} = \frac{(40\,\text{m/s})^2}{2(0.8)(10\,\text{m/s}^2)} = \frac{1600\,\text{m}^2/\text{s}^2}{(1.6)(10\,\text{m/s}^2)}$$

$$= 100\,\text{m}$$

rubber/ice : $\mu_{k,ice} = 0.4 \rightarrow 200\,\text{m}$





$\mu_s > \mu_k$

rolling slipping

ABS

Power = rate at which work is done

$$P = \frac{W}{\Delta t}$$

$W = 10\,J \;:\; 1\,s = \Delta t$

$\rightarrow P = \frac{10\,J}{1\,s} = 10\,\frac{J}{s} = 10\,W$

$1\text{ Watt} = 1\,\frac{J}{s}$

$10\,s = \Delta t \rightarrow P = 1\,W$