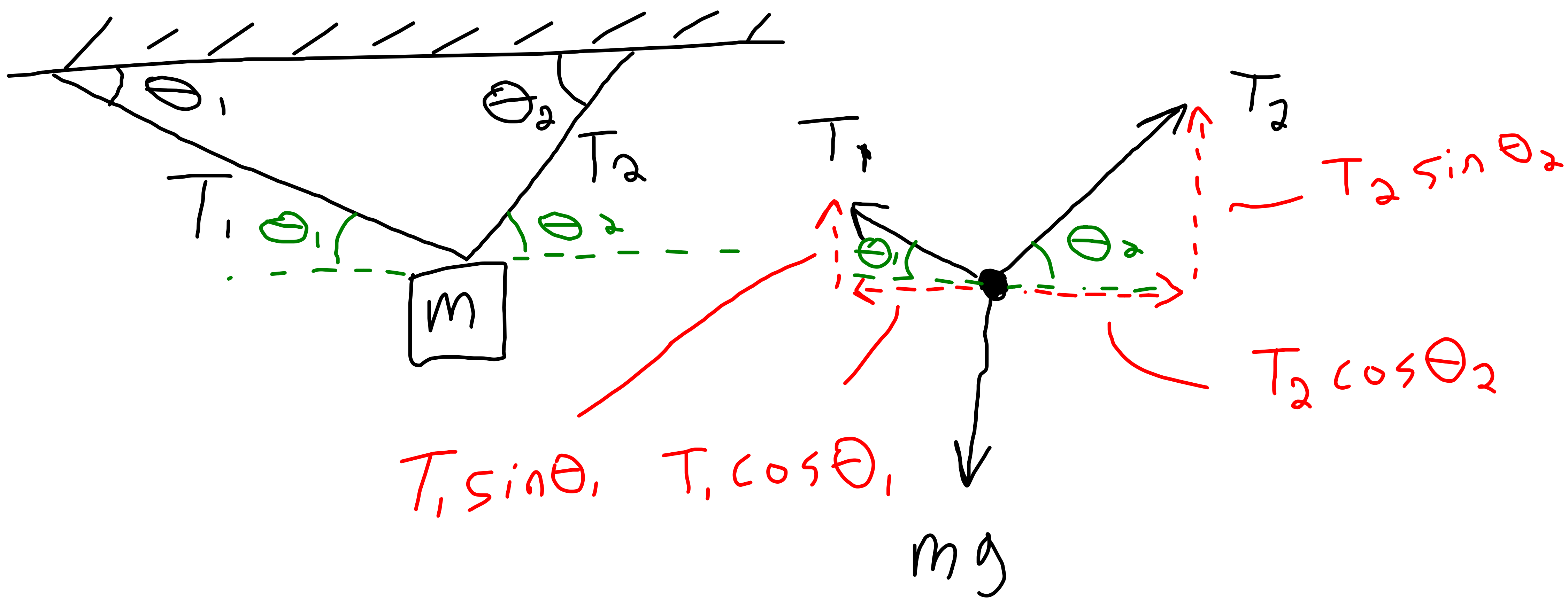
Cords - provide tension forces

- tension is the same at both ends of the cord (Newton's 3^{rd} law)



x-direction

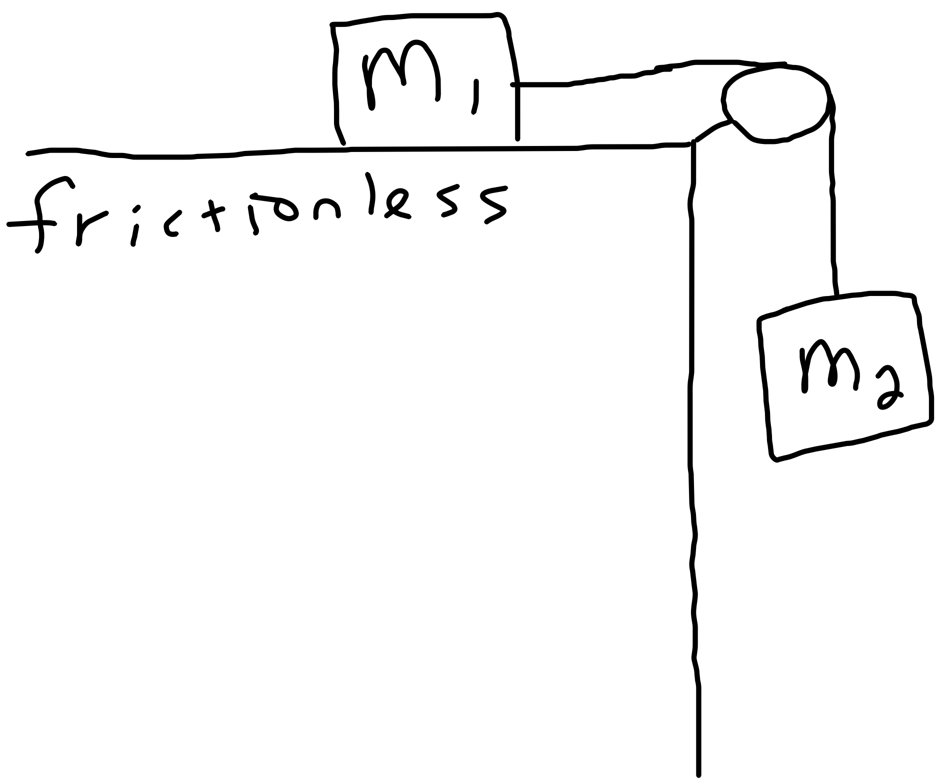
$$T_1 \cos\theta_1 = T_2 \cos\theta_2$$

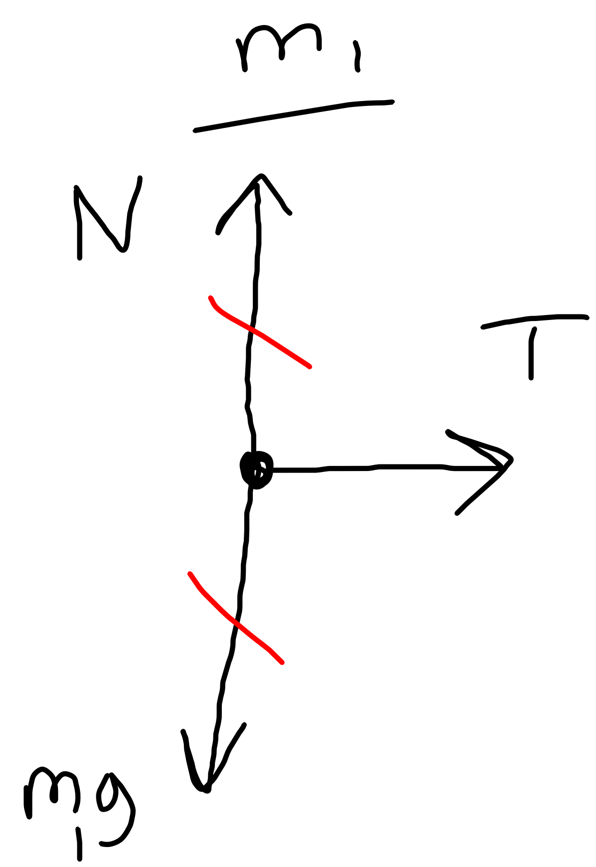
y-direction

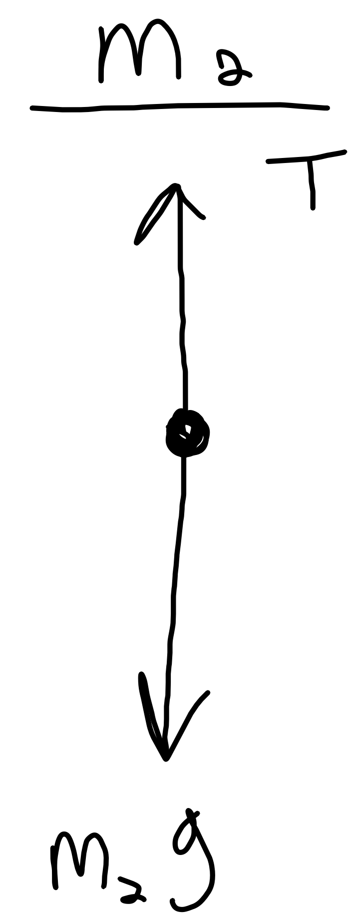
$$T_1 \sin\theta_1 + T_2 \sin\theta_2 = mg$$

<u>(Ideal) pulleys</u> – preserve the magnitude of tension but changes its direction.

2 F.B.D.s:







$N = m_1 g$

$$\boxed{T = m_1 a}$$

$$\boxed{m_2 g - T = m_2 a}$$

Chapter 5 - Energy

Analogy -

Bank account: \$800
cash: \$300

1 oz of gold (@ \$150/oz) : \$150

\$1250

⇒

Bank account: \$600
cash: \$200

how many oz of gold?

⇒ 3 oz (\$450)

\$1250

Similarly -

KE: 100 units
PE: 0 units

100 units

⇒

KE: 0 units
PE: 100 units

100 units

⇒

KE: 25 units
PE: 75 units

100 units

In the analogy, we had to do some simple calculations to convert oz of gold to \$ (\$ = (# of oz)*(\$150/oz)). Similarly, we have to do some calculations to convert mass, velocity, and height.

Experimental evidence reveals that:

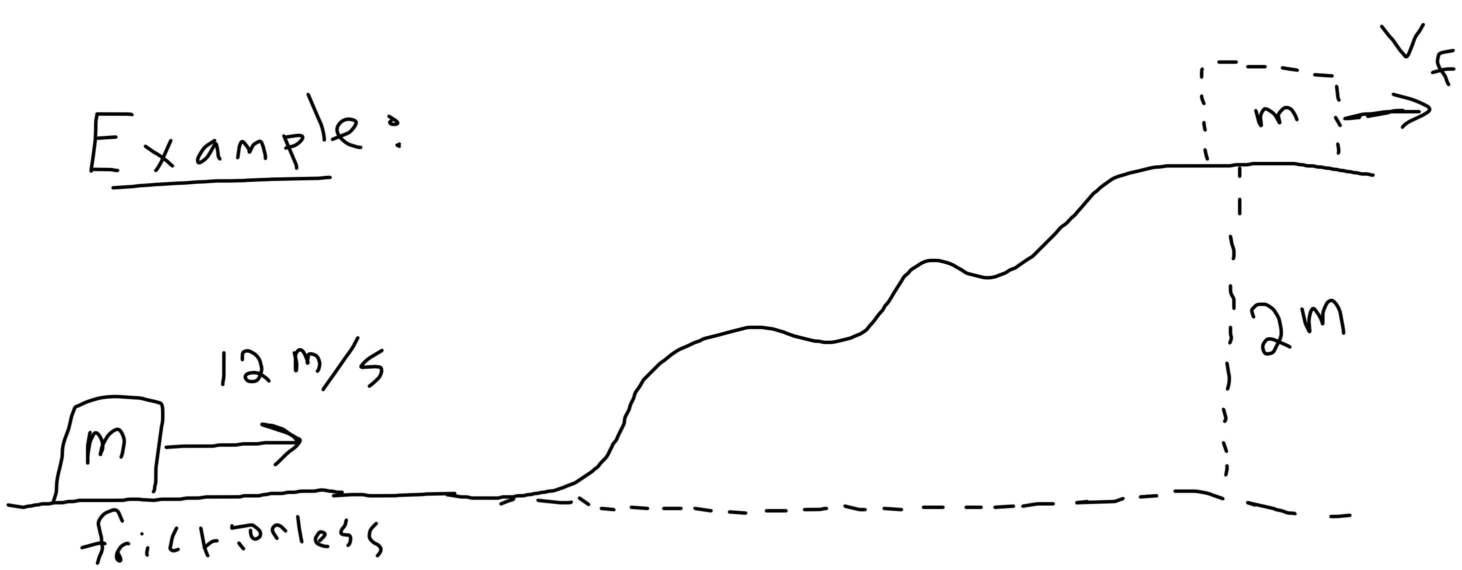
$$\boxed{\begin{aligned} KE &= \tfrac{1}{2}mv^2 \\ PE_g &= mgh \end{aligned}}$$

- KE — energy carried by a moving object
- PE_g — energy stored in an object lifted to some height h.

Units: Joules (J)

$$[J] = \frac{kg \cdot m^2}{s^2}$$

Example:



find v_f.

$KE: \frac{1}{2}m(12)^2 = 72m$

$PE: mg(0) = 0$

$72m$

$\Longrightarrow$

$KE: \frac{1}{2}mv_f^2$

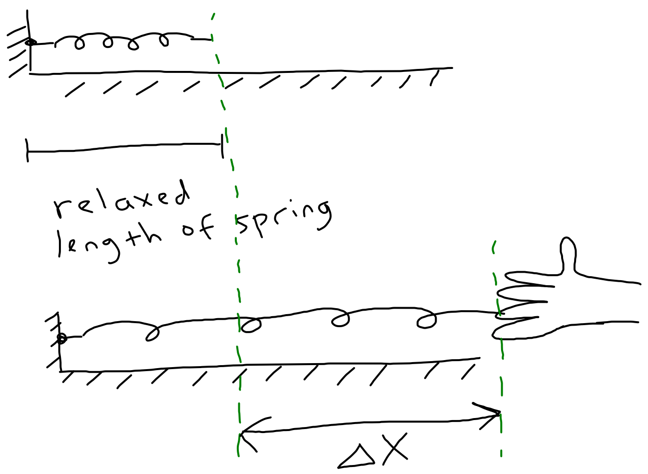
$PE: mgh = mg(2)$

$\frac{1}{2}\cancel{m}v_f^2 + 2\cancel{m}g = 72\cancel{m}$

$v_f = \sqrt{2(72 - 2(9.8))}$

$= \boxed{10.2 \text{ m/s}}$

Springs



$$P.E._{spring} = \frac{1}{2} K (\Delta X)^2$$

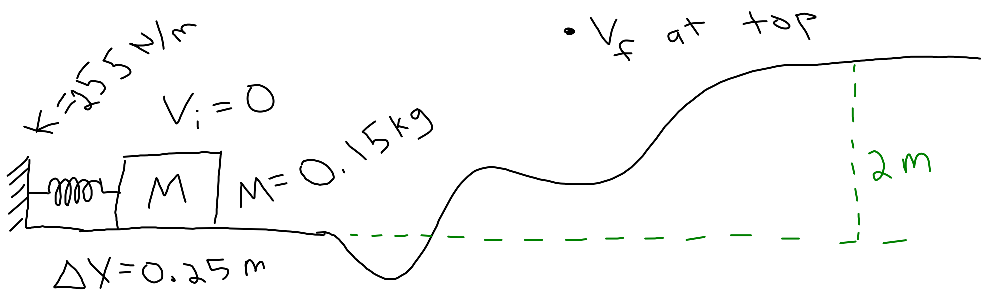
spring constant $[K] = \frac{N}{m} = \frac{kg}{s^2} = \frac{J}{m^2}$ *

- small for flimsy springs
- large for beefy springs

Example

find:

- V after uncompression but before ramp
- V_f at top



$KE: \frac{1}{2} M (0)^2 = 0$

$PE_g = Mg(0)$

$PE_s = \frac{1}{2}(255)(0.25)^2 = 1.72\,J$

$7.96\,J$

$\Rightarrow$

$KE: \frac{1}{2}(0.15)V^2$

$PE_g: Mg(0)$

$PE_s = \frac{1}{2}K(0)^2$

$0.075V^2 = 7.96$

$\boxed{V = 10.3 \frac{m}{s}}$

$\Downarrow$

$KE: \frac{1}{2}(0.15)V_f^2$

$PE_g: (0.15)(9.8)(2) = 2.94$

$PE_s: \frac{1}{2}K(0)^2 = 0$

$0.075V_f^2 + 2.94 = 7.96$

$V_f = \sqrt{\frac{5.02}{0.075}} = \boxed{8.18 \frac{m}{s}}$