Force

1st law: When an object has a velocity, it will continue to have that velocity unless a force changes it.

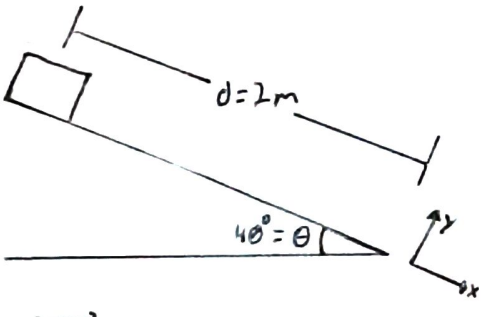
2nd law: $\vec{F_{net}} = m\vec{a}$ in units of Newtons(N) which equals $kg\frac{m}{s^2}$

3rd law: When you apply a force to an object, it applys an equal force back in the opposite direction called the normal force.

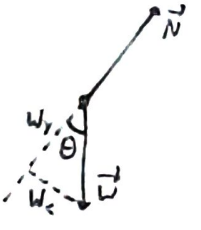
Steps for solving force problems:

1. Define a coordinate system
   - Prefer an axis in the same direction as acceleration.
2. Create a Free body diagram
3. $\vec{F_{net}} = m\vec{a}$

Ex: What is the final velocity (V_f) for a block on a frictionless ramp?



Free body diagram: Treat block as a point mass.



$\vec{F_{net}} = m\vec{a}$

$\vec{N} + \vec{W} = m\vec{a}$ → Convert vectors to scalars.

$N\hat{y} + W\sin\theta\,\hat{x} + W\cos\theta(-\hat{y}) = ma\hat{x} + 0\hat{y}$

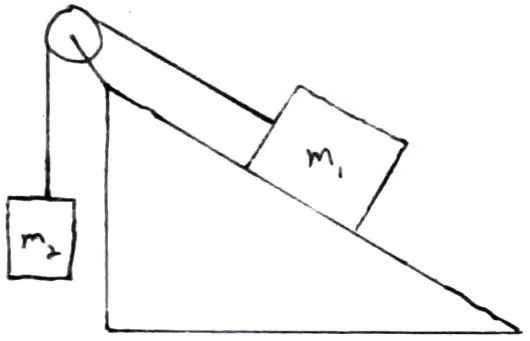
↓ Group $\hat{x}$s and $\hat{y}$s

$\hat{x}$: $W\sin\theta = ma \Rightarrow mg\sin\theta = ma \Rightarrow a = g\sin\theta = 6.3\frac{m}{s^2}$

$\hat{y}$: $N - W\cos\theta = 0 \Rightarrow N = W\cos\theta$

$V_f^2 = V_i^2 + 2a\Delta x \quad V_i = 0 \quad \Delta x = d \quad V_f = ?$

$V_f = \sqrt{2(6.3)(2)} = 5.02\frac{m}{s}$

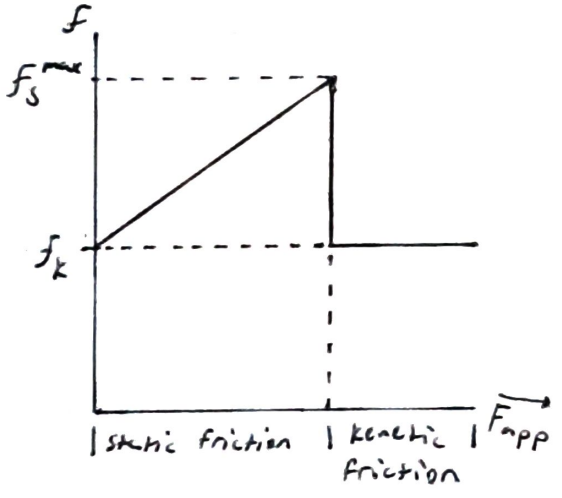


- Assume massless pulley
- $a, v,$ and x are the same for m_1 and m_2
- Assume a direction of motion.
- Use 2 free body diagrams and solve for tension (T) and acceleration (a).
  - Force in the rope

Friction is opposite to the direction of motion.

f_s = Static friction. Friction force when $V = 0$.

f_k = Kenetic friction. Friction force when $V > 0$.



$$f_s^{max} = \mu_s N$$

$$f_k = \mu_k N$$

Friction is proportional to the Normal force.