Equilibrium

- An object either at rest or moving with a constant velocity is said to be in *equilibrium*
- The net force acting on the object is zero (since the acceleration is zero)

$$\sum \vec{\mathbf{F}} = 0$$

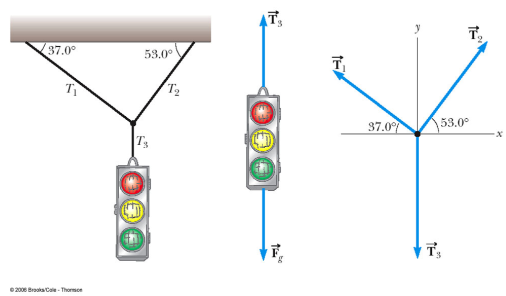
Equilibrium

- Easier to work with the equation in terms of its components:

$$\sum F_x = 0 \text{ and } \sum F_y = 0$$

A stoplight is held up by two cords, making a 53-degree and 37-degree angle with the support beam respectively. If the stoplight has a mass of 30 kg, what are the tensions in both cords?

Equilibrium Example – Free Body Diagrams



Forces of Friction

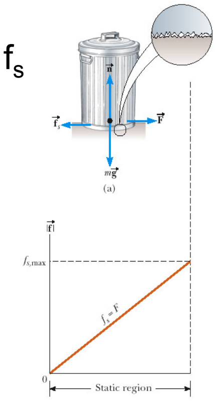
- When an object is in motion on a surface or through a viscous medium, there will be a resistance to the motion
  - This is due to the interactions between the object and its environment
- This resistance is called **friction**

More About Friction

- Friction is proportional to the normal force
- The force of static friction is generally greater than the force of kinetic friction
- The coefficient of friction (μ) depends on the surfaces in contact
- The direction of the frictional force is opposite the direction of motion
- The coefficients of friction are nearly independent of the area of contact

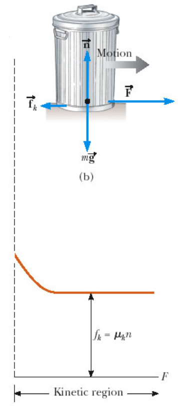
Static Friction, f_s

- Static friction acts to keep the object from moving
- If F increases, so does f_s
- If F decreases, so does f_s
- $f_s \le \mu$ N



Kinetic Friction, f_k

- The force of kinetic friction acts when the object is in motion
- $f_k = \mu$ N
  - Variations of the coefficient with speed will be ignored

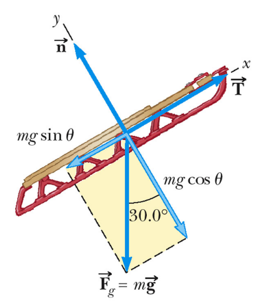


Newton's Laws Lecture-Tutorial Part 2

- Work with a partner or two
- Read directions and answer all questions carefully. Take time to understand it now!
- Come to a consensus answer you all agree on before moving on to the next question.
- If you get stuck, ask another group for help.
- If you get really stuck, raise your hand and I will come around

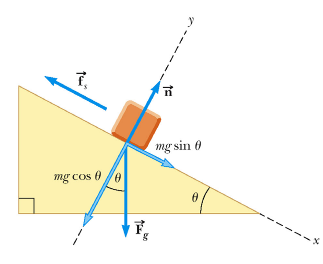
Inclined Planes

- Choose the coordinate system with x along the incline and y perpendicular to the incline
- Replace the force of gravity with its components



Block on a Ramp, Example

- Axes are rotated as usual on an incline
- The direction of impending motion would be down the plane
- Friction acts up the plane
  - Opposes the motion
- Apply Newton's Laws and solve equations



Friction/Inclined Plane Example

A 4000 kg truck is parked on a 15º slope. How big is the frictional force on the truck?