Inertial Frames of Reference

Examples of frames of reference:

- When you measure velocities relative to stationary objects, the corresponding frame of reference is Earth.
- You may also measure velocities relative to a moving object; the corresponding frames of reference might be a car or an airplane.

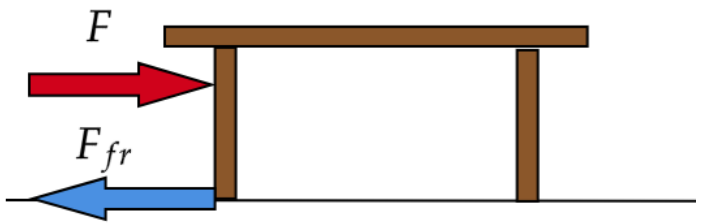
Inertial frames of reference:

- All have zero acceleration (when measured relative to some fixed inertial frame).
- Objects remain at rest or in uniform motion relative to the frame until acted upon by external forces.
- In other words, Newton's first law of motion holds in all inertial frames of reference.

Friction Forces

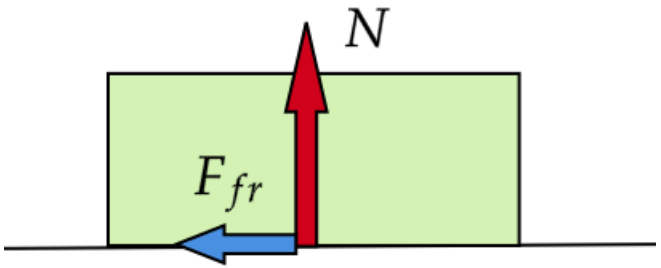
Static friction:

$$\vec{F}_{fr} = -\vec{F}$$



Kinetic friction:

$$F_{fr} = \mu \cdot N$$



The direction of the kinetic friction force is always opposite to the relative velocity of the bodies in contact (e.g. the table and the floor).

Homework 10

Problem 1.
Give three examples of inertial frames of reference and three examples of non-inertial frames of reference. Explain how Newton's first law does not hold in your examples of non-inertial frames of reference.

Problem 2.
You push a table with force $50\ N$ to the right, but it does not move. What is the magnitude and direction of the friction force acting on the table? Is it static or kinetic friction?

Problem 3.
Amazon develops a new robot to help organize boxes at the sorting center. The robot should drag boxes with constant velocity on the horizontal floor. What force should the robot apply to a $10\ kg$ box if the friction coefficient between the box and the floor is $\mu = 0.5$?

Problem 4.
A $1\ kg$ block lies on the floor of an elevator. When must we apply a larger force to move the block horizontally with constant velocity: when the elevator is at rest or accelerating upwards?