

Chapter 5: Forces and Newton's Laws of Motion

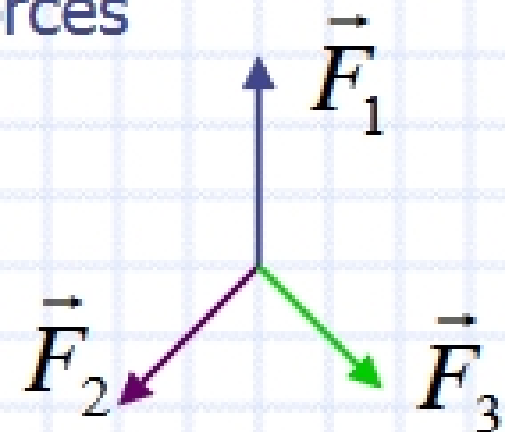
- Previously, we have studied kinematics, which
 - describes the motion of an object (x, v, a)
 - does not explain the cause of the motion
- Now, we begin the study of the second part of mechanics – ***dynamics***
 - which does address the cause of motion
 - that cause is a ***force***, a push or pull
- Force, \vec{F} , is a vector, has magnitude and direction
- How forces affect the motion of an object is described by Newton's Laws of Motion (Newtonian Mechanics)
- Objects are treated as point particles; in Chapter 10 we will consider the shape of an object in more detail

Newton's First Law of Motion

- An object at rest will remain at rest
- An object moving at a constant velocity will continue to move at the constant velocity, unless acted upon by a net force
- What does it mean?
 - tendency for an object's motion not to change
- Net force = the sum of all applied forces

$$\sum_i \vec{F}_i = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$$

- No effect on the motion



□ According to the 1st law, zero velocity (at rest) is equivalent to constant velocity

□ An object with a constant velocity does not require a force to maintain its velocity

- forces act to change motion, not to sustain the motion (e.g., the speed of the Voyagers)
- *seems* contrary to everyday experience

□ **Inertia** – tendency for an object to remain at rest, or to remain in motion with a constant velocity

- all objects have inertia

□ **Mass** – a quantitative measure of inertia (a scalar)

- use symbol m - unit is kg (SI) or slug (British)
- more mass, means more inertia
- *not* equivalent to weight (a force)