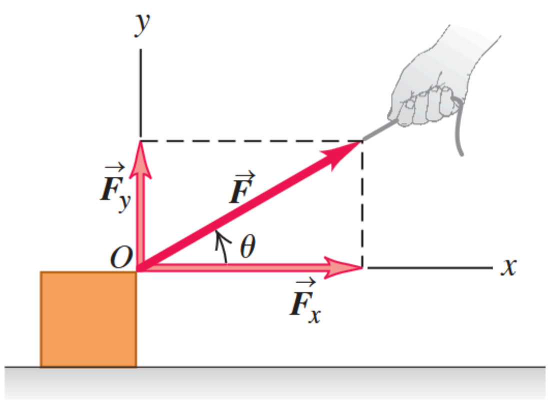
4. Newton's Laws

Always remember to set the coordinates of the system correctly.

Draw free body diagrams. Set the axis's in the direction of the system's acceleration.

Superposition of Forces

Component Vectors:



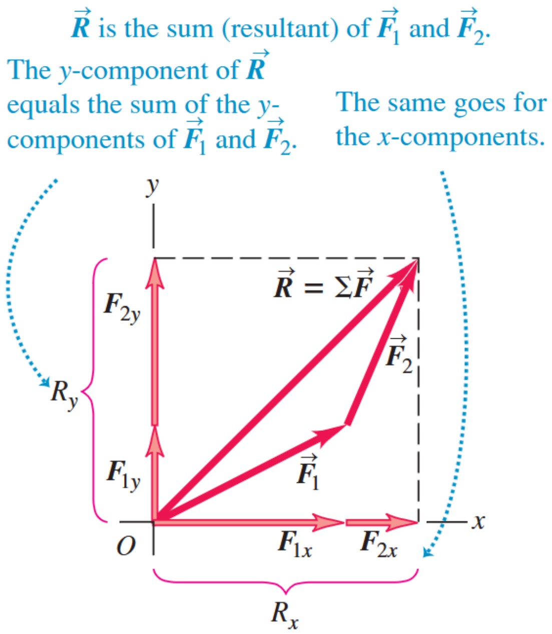
$$F_x = F\cos\theta \qquad F_y = F\sin\theta$$

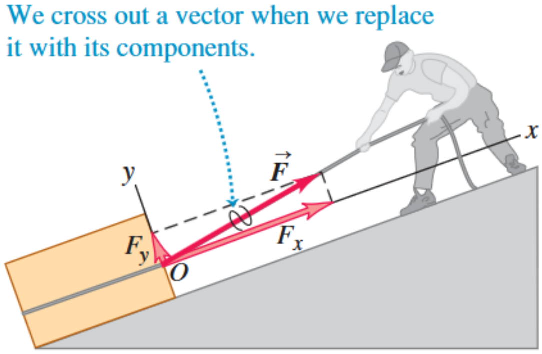
Resultant Force:

$$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \ldots$$

$$R = \sqrt{R_x^2 + R_y^2}$$

$$R_x = \sum F_x \qquad R_y = \sum F_y$$





4.6 F_x and F_y are the components of $\vec{F}$ parallel and perpendicular to the sloping surface of the inclined plane.

Newton's First Law

Newton's first law of motion: A body acted on by **no net force** movies with constant velocity (which may be zero) and zero acceleration.

$$\sum \vec{F} = 0 \qquad \text{body in equilibrium}$$

Free-body diagram

Normal force

- A **contact force** that prevents objects from going through a surface. Hence, it is always **perpendicular to the surface** in contact.
- If there is two or more contacts, the normal force is divided with each surface.

$$n = w_{\perp} = mg\cos\theta$$

Tension force

- A force transmitted through a flexible medium (rope, string) that acts **along the string**.

$$T = w_{||} = mg\sin\theta$$

Newton's Second Law

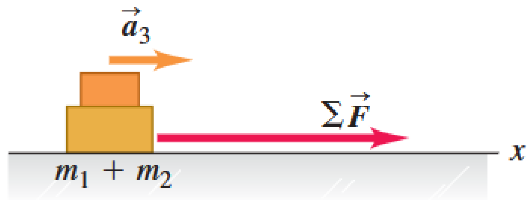
a net force acting on a body causes the body to accelerate in the same direction as the net force

the magnitude of the acceleration is directly proportional to the magnitude of the net force acting on the body

$$\sum \vec{F} = m\vec{a}$$

One newton N is the amount of net force that gives an acceleration of 1 meter per second squared to a body of with a mass of 1 kilogram.

(c) When the two objects are fastened together, the same method shows that their composite mass is the sum of their individual masses.



$$\sum F_x = ma_x \qquad \sum F_y = ma_y \qquad \sum F_z = ma_z$$

Newton’s Third Law

when two bodies interact, the forces they exert on each other are always equal in magnitude and opposite in direction

$$\overrightarrow{F}_{A \text{ on } B} = -\overrightarrow{F}_{B \text{ on } A}$$