Recognizing Forces

A force is a push or pull. It is measured in Newtons (N) where:

$1\ N = 1\ kg \cdot m/s^2$

Forces are classified as either:

1. Contact Forces – where one object exerts a force on another object when they touch each other.

$\vec{F}_f$ Force of Friction: exists between objects and always resists the sliding motion or attempted sliding motion

kinetic friction (sliding motion) static friction (attempted sliding motion) air resistance is a special type of friction

$\vec{F}_a$ Applied Force: a force due to one object coming into contact with another object, such that a push or pull results

$\vec{F}_T$ Tension: pulling force exerted by objects such as strings and ropes

$\vec{F}_N$ Normal Force: a support force that acts perpendicular to the surface between the objects in contact

eg. person leans on wall, wall pushes horizontally on person
textbook on desk, desk pushes upward

2. Non-contact Forces – where the two objects don't need contact to exert a force on each other (also called action at a distance forces)

$\vec{F}_g$ Force of Gravity: attractive force between large masses. On Earth, all objects experience the downward force of gravity which is equal to mass × acceleration due to gravity

$\vec{F}_g = m\vec{g}$ where $\vec{g} = 9.8\ m/s^2$ [down]

or $\vec{F}_g = -mg$ to indicate the force is in the negative y

* on a level surface, $F_N = -F_g$ *

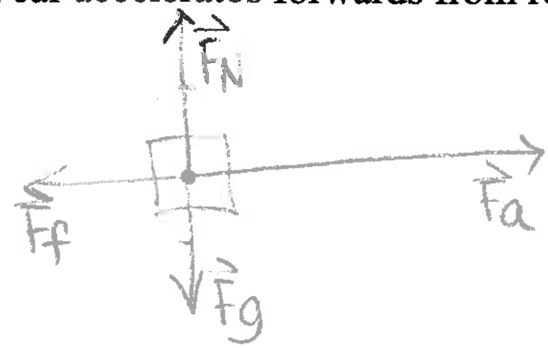
When solving force problems, it is necessary to visualize all the different forces acting on an object. To do this, we draw a Free Body Diagram where:

- Objects are represented by a box
- Arrows represent the approximate direction and magnitude of each force

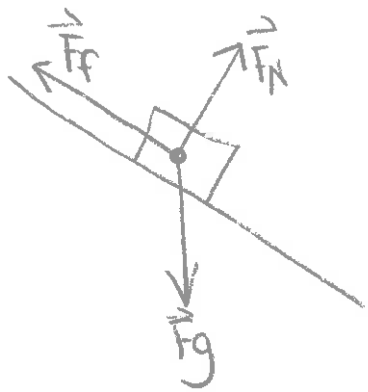
Examples:

1. A textbook sits motionless on a desk.

2. A car accelerates forwards from rest.



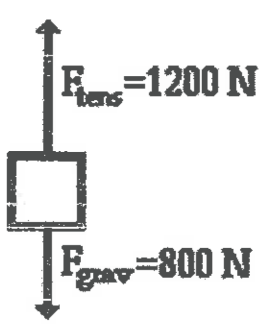
3. A block of wood slides down an incline.



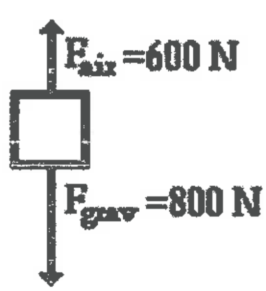
Once we identify all the forces acting on an object, we can calculate the net force ($\Sigma\vec{F}$), or the sum of all forces acting on an object.

$\Sigma\vec{F}$ = winners - losers

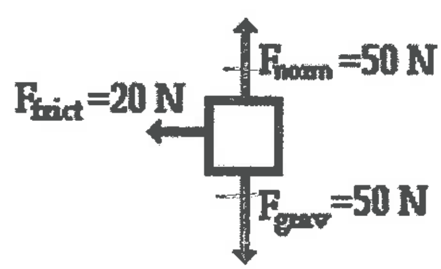
Examples:



$\Sigma\vec{F} = \vec{F}_T - \vec{F}_g$
$= 1200 - 800$
$= 400$ N [up]



$\Sigma\vec{F} = F_g - F_{air}$
$= 800 - 600$
$= 200$ N [down]



$\Sigma\vec{F} = \vec{F}_f$
$= 20$ N [left]

Why is the net force important??? Newton's First Law of Motion states that:

an object at rest stays at rest and an object in motion stays in motion... unless acted upon by a net force!

no change in speed or direction

This means that:

- A net force is NOT required for an object to maintain a constant velocity.
- If a net force exists, acceleration occurs.

(change in speed, direction or both