Newton's First Law of Motion

Newton’s First Law of Motion

Newton’s first law is often called the law of inertia.

Every object continues in its state of rest, or of motion in a straight line at a constant speed, unless it is compelled to change that state by forces exerted upon it.

Newton's First Law of Motion

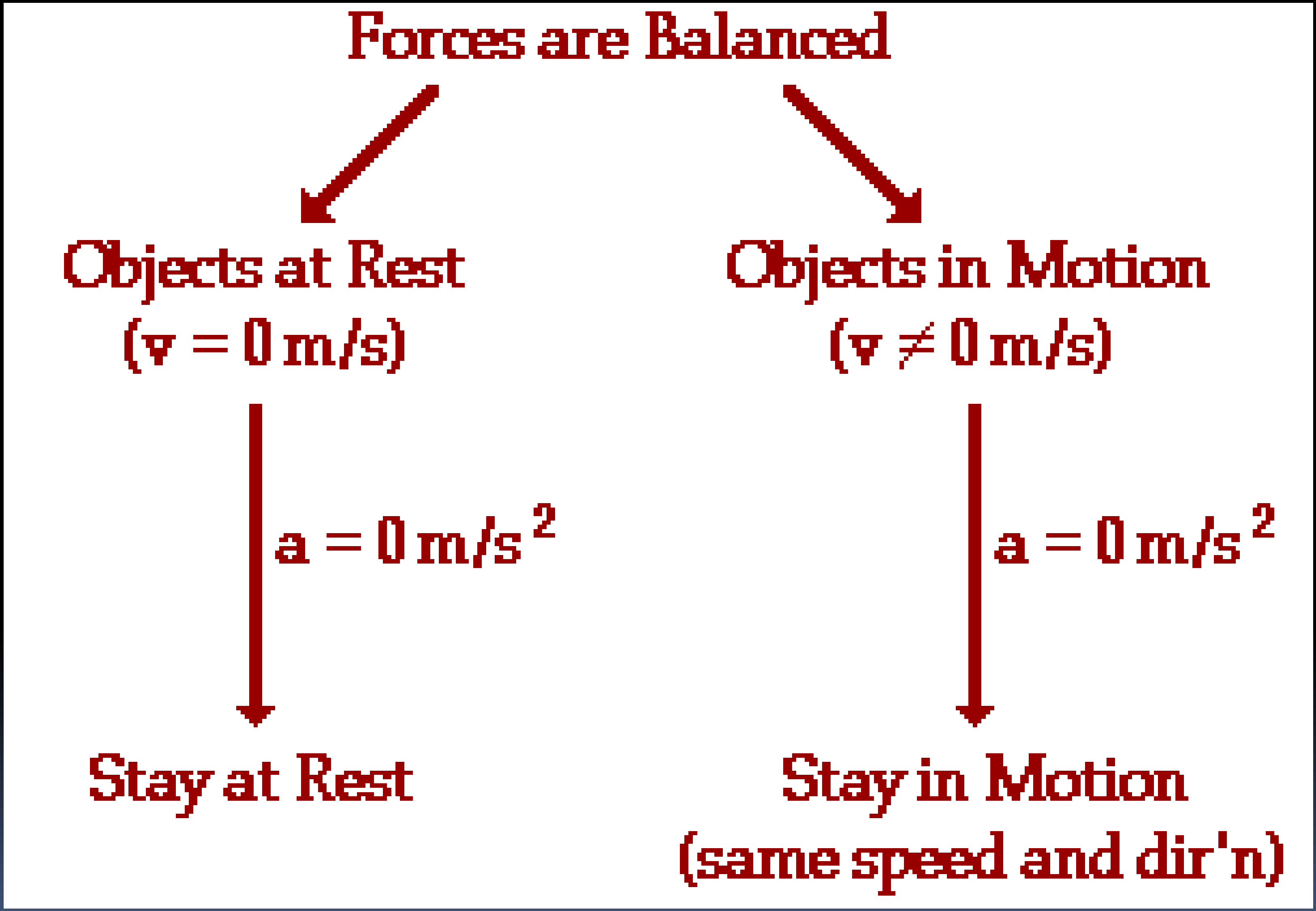
Mass is the measure of inertia of an object. In the SI system, mass is measured in **kilograms**.

Mass is not **weight**:

Mass is a **property** of an object. Weight is the **force** exerted on that object by gravity.

If you go to the moon, whose gravitational acceleration is about 1/6 *g*, you will weigh much less. Your mass, however, will be the same.

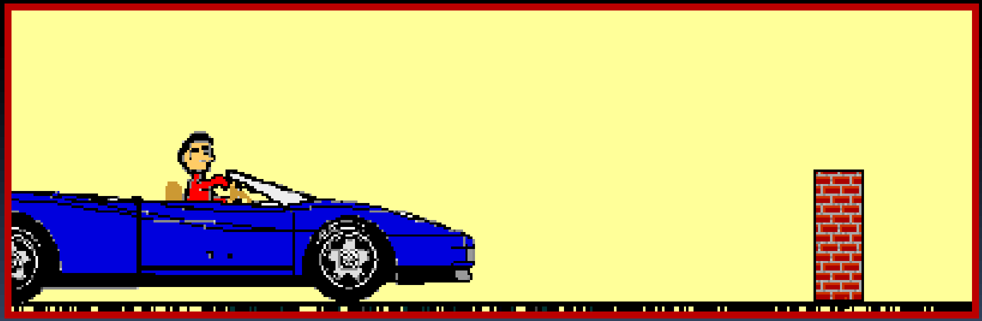
Newton’s First Law of Motion



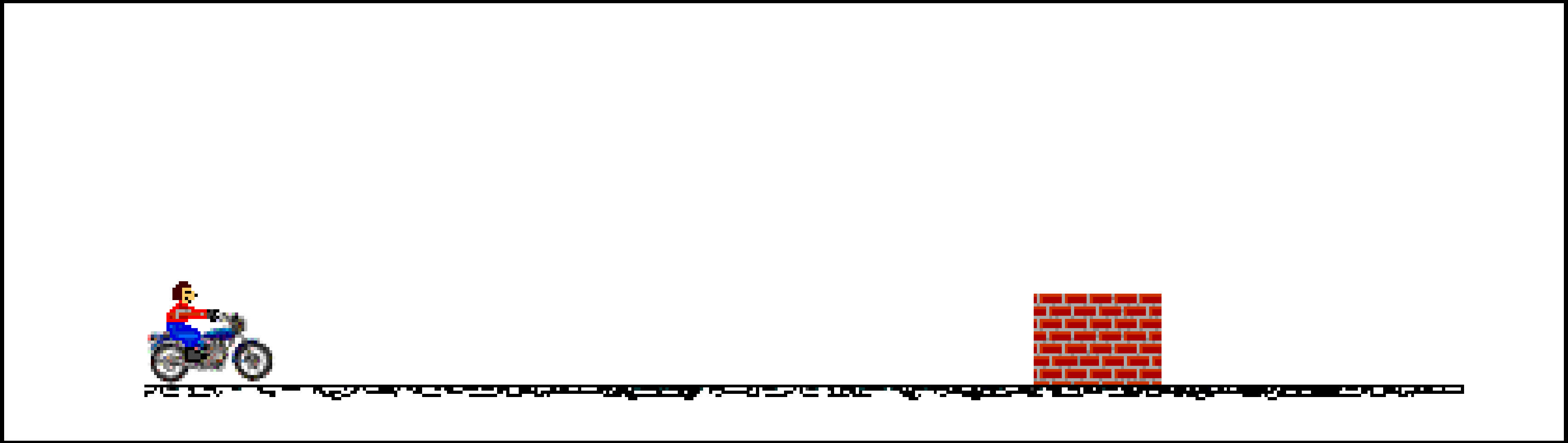
Newton's First Law of Motion

A person in motion tends to stay in motion with the same speed and in the same direction ... unless **acted upon by the unbalanced force** of a seat belt.

The seat belt provides the unbalanced force which brings you from a state of motion to a state of rest.



Newton’s First Law of Motion



Newton’s First Law of Motion

EXAMPLES

•blood rushes from your head to your feet when riding on a descending elevator which suddenly stops.

•the head of a hammer can be tightened onto the wooden handle by banging the bottom of the handle against a hard surface.

Newton's First Law of Motion

EXAMPLES

- to dislodge ketchup from the bottom of a ketchup bottle, the bottle is often turned upside down, thrust downward at a high speed and then abruptly halted.

- headrests are placed in cars to prevent whiplash injuries during rear-end collisions.

Newton's 1^{st} law movie

Forces

Force: a push or pull on an object

Forces can be divided into two categories:

- Contact Forces
- Forces resulting from action-at-a-distance

Forces

Contact Forces

Applied Force

Normal Force

Frictional Force

Air Resistance Force

Tensional Force

Spring Force

Action-at-a-Distance Forces

Gravitational Force

Electrical Force

Magnetic Force

Forces

An **applied force** is a force which is applied to an object by another object or by a person.

$$F_{app}$$

Forces

The force of gravity is the force with which the earth, moon, or other massive body attracts an object towards itself. By definition, this is the weight of the object.

$$F_{grav} = mg$$

Forces

The **normal force** is a contact force that is perpendicular to the surface of contact.

$$F_{norm}$$

Forces

The friction force is the force exerted by a surface as an object moves across it or makes an effort to move across it. The friction force opposes the motion of the object.

$$F_{fr}$$

Forces

Air resistance is a special type of frictional force which acts upon objects as they travel through the air.

$$F_{air}$$

Forces

Tension is the force which is transmitted through a string, rope, or wire when it is pulled tight by forces acting at each end.

$$F_{ten}$$

Forces

Tension is the force which is transmitted through a string, rope, or wire when it is pulled tight by forces acting at each end.

$$F_{tens}$$

Forces

The **spring force** is the force exerted by a compressed or stretched spring upon any object which is attached to it.

$$F_{spring}$$

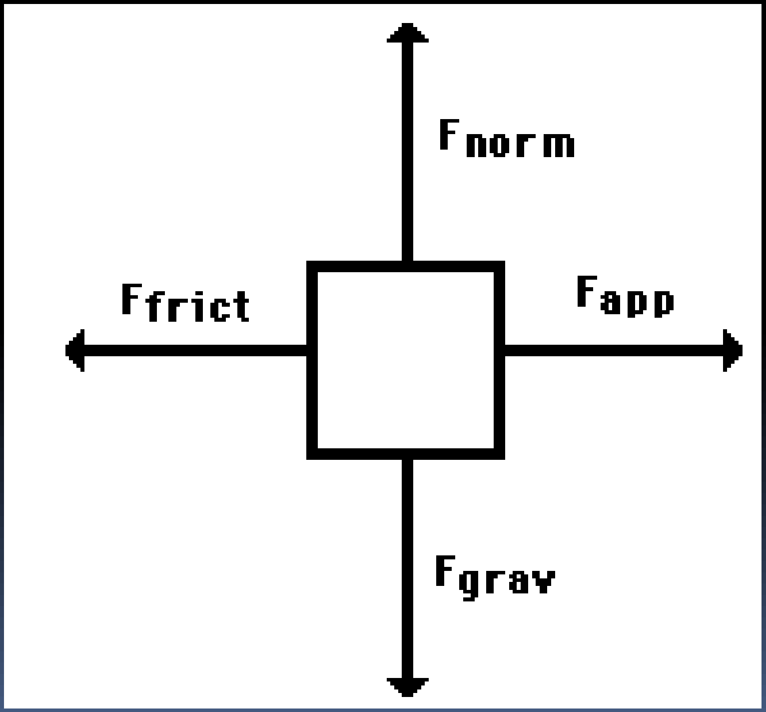
Forces

Force is a quantity which is measured using a standard metric unit known as the **Newton**

$$1\,\mathrm{Newton} = 1\frac{kgm}{s^2}$$

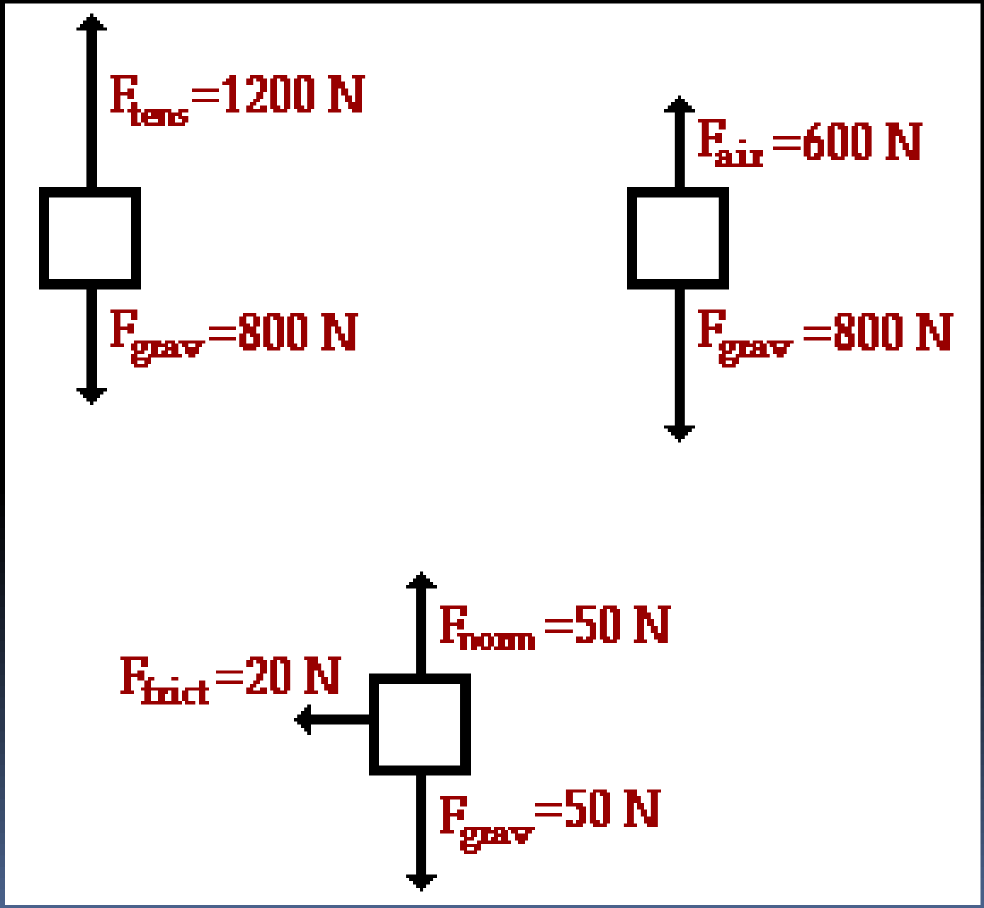
Drawing Free-Body Diagrams

Free-body diagrams (FBD) are diagrams used to show the relative magnitude and direction of all forces acting upon an object in a given situation.



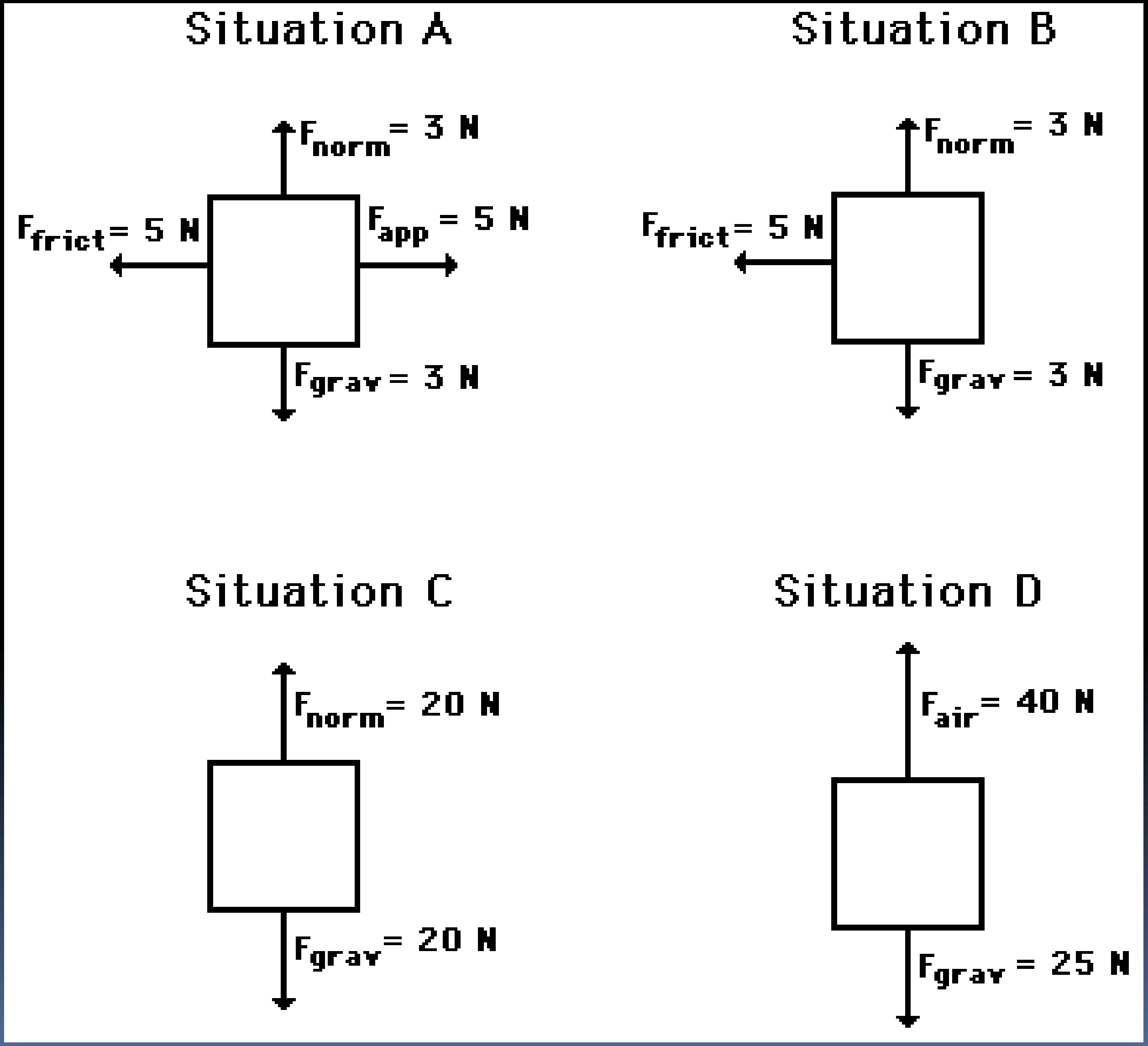
4.6 Net Force

Net Force **is the combination of all forces acting on an object.**



4.6 Net Force

What is the Net Force on these four objects?



4.6 Net Force

What are the unknown Forces if you know the Net Force on these four objects?