

Newton's First Law - Inertia

An object at rest remains at rest, and an object in motion continues in motion with constant velocity (that is, constant speed in a straight line) unless the object experiences a net external force.



MCHS Honors Physics 2014-15

Inertia

- A common misconception is that an object on which no force is acting will always be at rest.
- This situation is not always the case. If an object is moving at a constant velocity, then there is no net force acting on it.
- In the 1630s, Galileo concluded correctly that it is an object's nature to *maintain its state of motion or rest*.
- Note that an object on which no force is acting is not necessarily at rest; the object could also be moving with a constant velocity.

Inertia

- This concept was further developed by Newton in 1687 and has come to be known as Newton's first law of motion:

An object at rest remains at rest, and an object in motion continues in motion with constant velocity (that is, constant speed in a straight line) unless the object experiences a net external force.



Inertia

- Inertia is the tendency of an object *not* to accelerate.
- Newton's first law is often referred to as the *law of inertia* because it states that in the absence of a net force, a body will preserve its state of motion.
- Newton's first law says that *when the net external force on an object is zero, the object's acceleration (or the change in the object's velocity) is zero.*

Net Force

- The sum of forces acting on an object is the net force
- Many forces act on a car in motion. All the external forces acting on the car, summed together using the methods for finding resultant vectors, is the **net external force**.
- A car traveling at a constant velocity has a **vector sum** of its external forces equal to zero.
- Net force is equal to the one force that would **produce the same effect** on the object that all of the external forces combined would.

Mass is a Measure of Inertia

- Imagine a golf ball and a bowling ball at rest side by side on the ground.
- Newton's first law states that both balls remain at rest as long as no net external force acts on them.
- Imagine supplying a net force by hitting each ball with a golf club.
- The inertia of an object is proportional to the object's mass. The greater the mass of a body, the less the body accelerates under an applied force.
- Mass, which is a measure of the amount of matter in an object, is also a measure of the inertia of an object.

Equilibrium

- Objects that are either at rest or moving with constant velocity (whether they are at rest or moving) are said to be in **equilibrium**.
- One condition that must be true for equilibrium: the net force (the vector sum) acting on a body in equilibrium must be **equal to zero**.



Equilibrium

- If there is a net force, a second force **equal and opposite** to this net force will put the body in equilibrium.


