Newton's 1st Law

Objectives

- Define force.
- Define mass and inertia.
- Explain the meaning of Newton's 1st Law.

Newton's 1st Law of Motion

- An object at rest will remain at rest, and an object in motion will remain in motion, at constant velocity and in a straight line, unless acted upon by a net force.

- (Also known as the Law of Inertia.)

Force

- A force is a push or a pull on an object.
- Units of force are Newtons (N)
- $1N = \frac{1kg \cdot m}{s^2}$
- How much is a Newton?
  - A Newton is roughly equivalent to the weight of a medium-sized apple.

What is a Net Force?

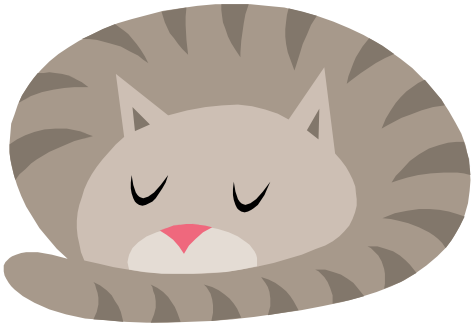
- A net force is the vector sum of all the forces acting on an object.
- If all forces are balanced, there is no net force.
- An unbalanced force is a net force.

What Does it Mean?

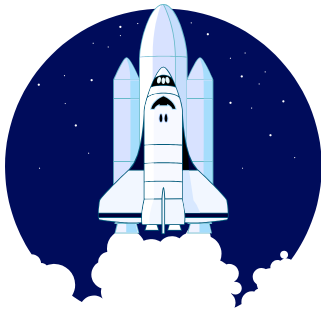
- An object will continue in its current state of motion unless an unbalanced force acts upon it.

Objects at Rest

- Will remain at rest unless an unbalanced force acts upon them.



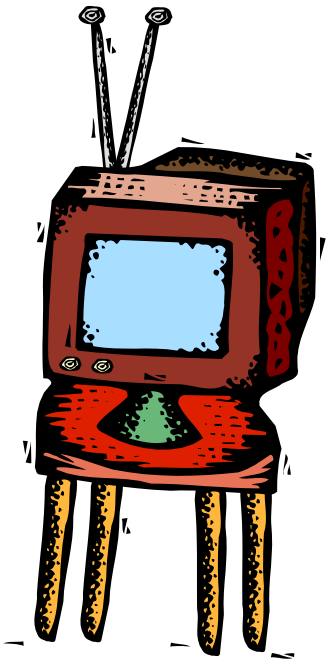
Objects in Motion



- Will remain in motion at constant velocity unless acted upon by a net force.
- Much less obvious.
- Hard to find a frictionless environment here on Earth.

Static Equilibrium

- Net force on an object is 0.
- We'll revisit this concept when we explore Newton's 2nd Law of motion.



Inertia

- Inertia is the tendency of an object to resist a change in velocity.
- Mass actually has two aspects
  - Inertial mass is how hard it is to change an object's velocity.
  - Gravitational mass is how strongly a gravitational field affects a mass
- For the purposes of basic introductory physics, mass and inertia are synonymous.

Sample Problem – Inertia

- Which object has the greatest inertia?

A. A falling leaf

B. A softball in flight

C. A seated high school student

D. A helium-filled party balloon

Which object has the greatest inertia?

A. A 5-kg mass moving at 10 m/s

B. A 10-kg mass moving at 1 m/s

C. A 15-kg mass moving at 10 m/s

D. A 20-kg mass moving at 1 m/s