Forces and the Second Law

Newton's Second Law of Motion

- The acceleration of an object is equal to the force applied to it divided by its mass.
- An object moving at constant speed requires no force (zero acceleration)
- Forces cause acceleration; masses resist acceleration.
- F=ma

Newton's Second Law of Motion

- What force is needed to speed a 2500 kg car from rest to 20.0 m/s in 5.0 seconds?

$$F = ma$$

$$a = \frac{20.0 - 0}{5.0} = \frac{20.0}{5.0} = 4.0\frac{m}{s^2}$$

$$F = (2500)(4.0)$$

$$F = 10000N$$

Newton's Second Law of Motion

- Weight is the gravitational force on a mass.
- If a person weighs 450 N, what is the mass? Gravity accelerates objects at 10 m/s^2.

$$F = ma$$

$$450 = m(10)$$

$$\frac{450}{10} = m = 45kg$$

Newton's Second Law of Motion

- 4.448 N = 1 pound; so a 150 lb adult has a weight of 667.2 N
- The sum of all the forces acting on an object is the net force on the object.
  - A net force not equal to zero means the object is accelerating
  - A net force of zero means the object is not accelerating, but not necessarily at rest either.