Newtonian Mechanics

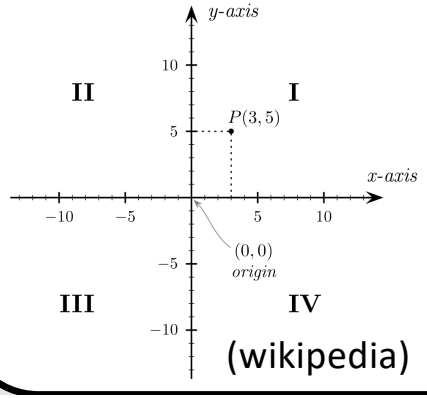
Newtonian Mechanics

- Published in *Principia*, 1687
- Include three laws of motion
  - Inertia
  - F=ma
  - action/reaction
- Point mass in a Cartesian coordinate system

Standing on the Shoulder of a Giants

- René Descartes (1596-1650) paved the way to the Newtonian mechanics
- Introduced Cartesian coordinate system

Cogito, ergo sum!



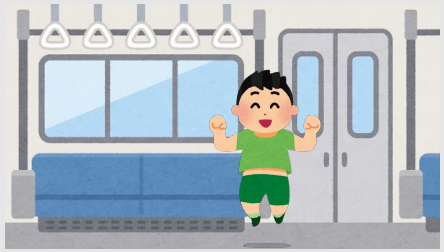
(wikipedia)

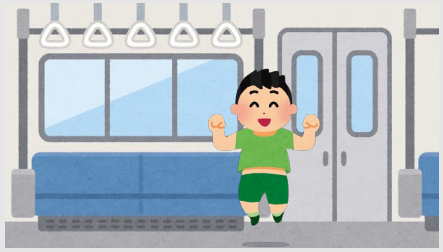
Decartes connected algebra and geometry

Newton's First Law

- An object will remain at rest or in uniform motion in a straight line unless acted upon by a force

No force, no move!





Newton's Second Law ($m\vec{a} = \vec{F}$)

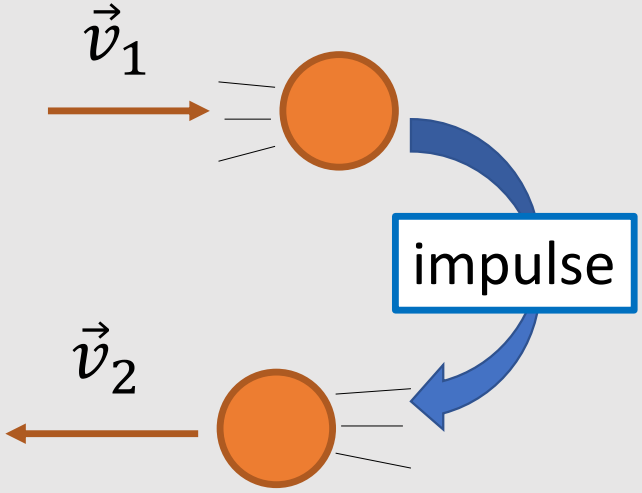
- The rate of change of momentum of a body is directly proportional to the force applied to the body

$$m\vec{a} = \vec{f}$$

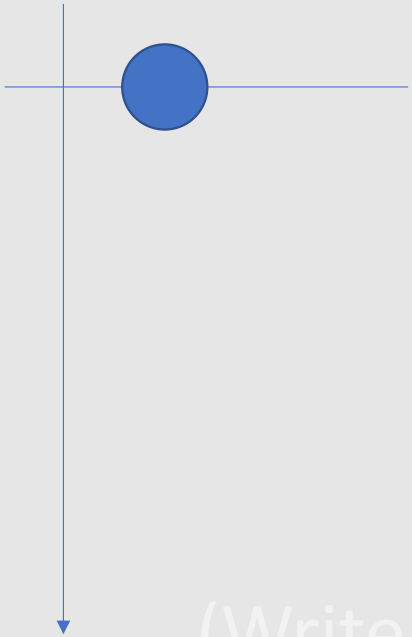
integration

$$m(\vec{v}_2 - \vec{v}_1) = \int \vec{f}\,dt$$

impulse



Position of a Falling Ball

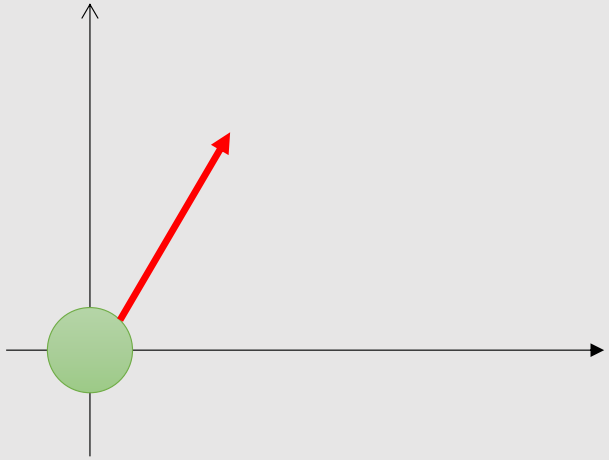


(Write equation here)

Projectile Motion

- Quadratic equation descrives trajectory

Write equation here

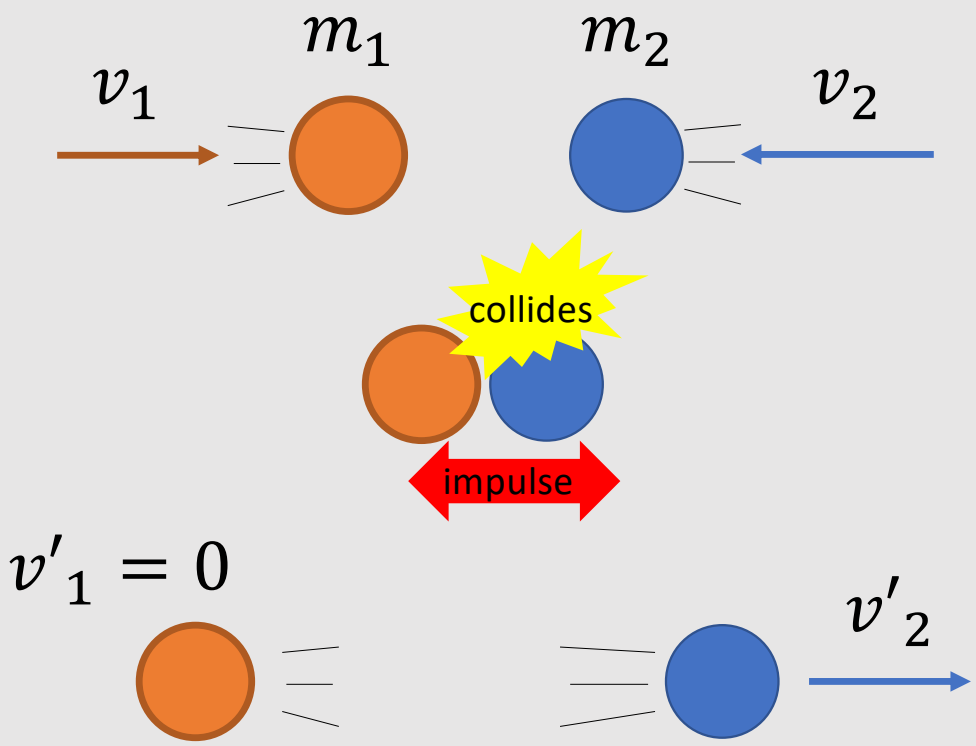


Newton’s Third Law (Action / Reaction)

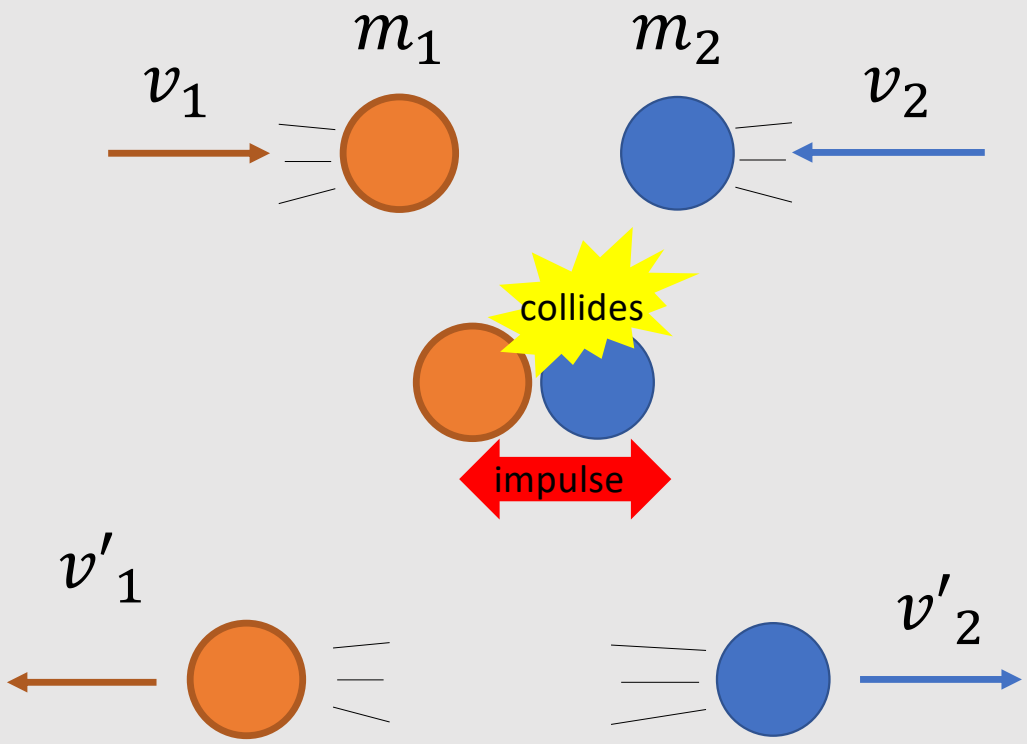
- For every action, there is an equal and opposite reaction

Colliding Balls

- What is the velocity after collision? Let's assume that $v_1' = 0$ after collision. Take impulse as unknown variable



Coefficient of Restitution



$$e = \frac{|v_1 - v_0|}{|v'_1 - v'_0|}$$

Collision in 2D