¿Y si el modelo no es lineal?

Muchas veces puede linealizarse la ecuación

$$y = a.x^3$$

Se grafica $y\ vs\ x^3$

$$\Delta(x_i{}^3) = \sqrt{\left(\frac{\partial(x^3)}{\partial x}\Delta x_i\right)^2}$$

$$y = a.b^x$$

$$\ln(y) = \ln(a.b^x)$$

$$\ln(y) = \ln(a) + x.ln(b)$$

Se grafica $\ln(\mathrm{y})\ vs\ x$

Δ (a) = ?????

Δ (b) = ?????

¿Qué se obtiene de CM????

$$y(x) = a.x^b$$

$$\ln(y) = \ln(a.x^b)$$

$$\ln(y) = \ln(a) + b.\ln(x)$$

→ Se grafica $\ln(y)$ vs $\ln(x)$

IMPULSO LINEAL. COLISIONES

CANTIDAD DE MOVIMIENTO $(\vec{P})$

Cantidad de movimiento que posee un cuerpo

- Magnitud asociada a los cuerpos en movimiento de traslación

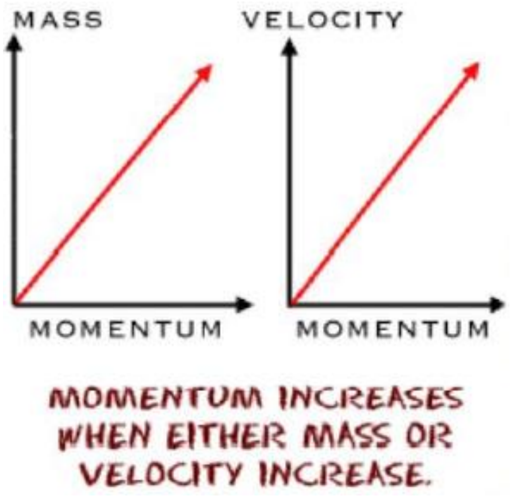
$$\vec{P} = m\vec{v}$$

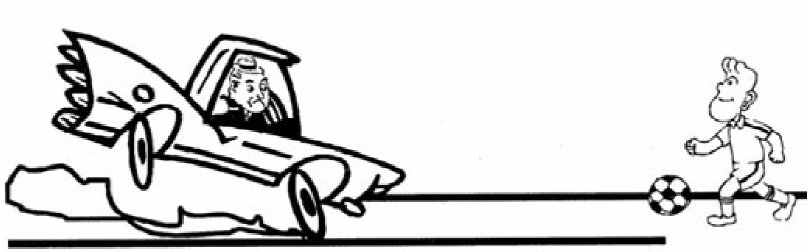
- m= masa [Kg]
- v= velocidad [m/s]
- P= cantidad de movimiento [Kgm/s]

- Magnitud vectorial, producto de un escalar por un vector
- El vector cantidad de movimiento tiene la misma dirección y sentido que el vector velocidad

Se conserva en un sistema aislado (en ausencia de fuerzas externas)

$$\vec{P} = m\vec{v}$$





$$\Delta\vec{P} = \vec{P}_f - \vec{P}_i$$

Es necesario que haya una **fuerza externa al automóvil** que haga **disminuir** su velocidad y, por consiguiente, **su cantidad de movimiento**

$$\frac{d\vec{P}}{dt} = m\frac{d\vec{v}}{dt} = m\vec{a}$$

$$\frac{d\vec{P}}{dt} = \sum \vec{F}^{ext}$$

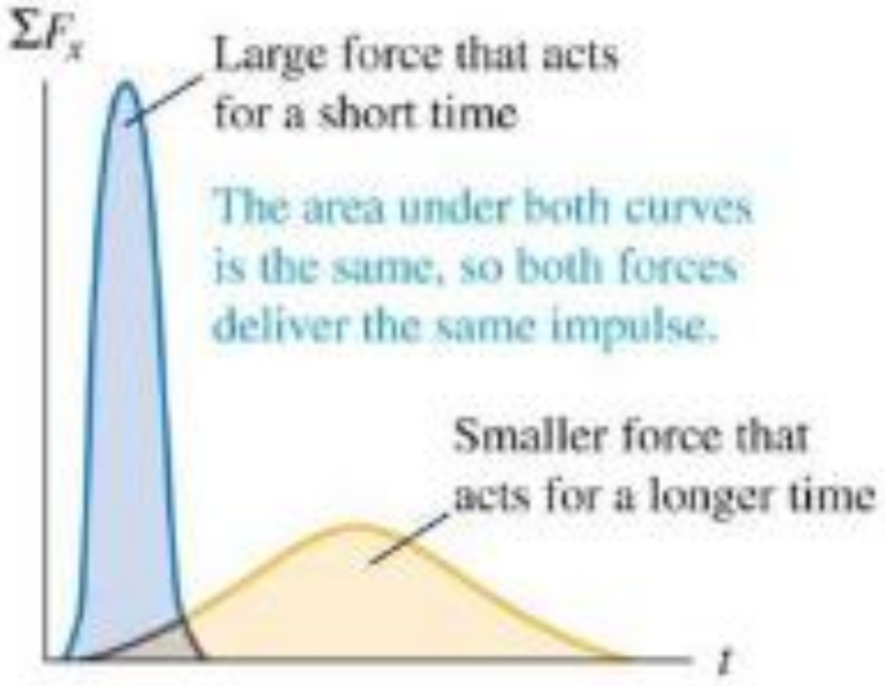
$$Fdt = mdv$$

You apply an impulse on an object and you get an equal change in momentum

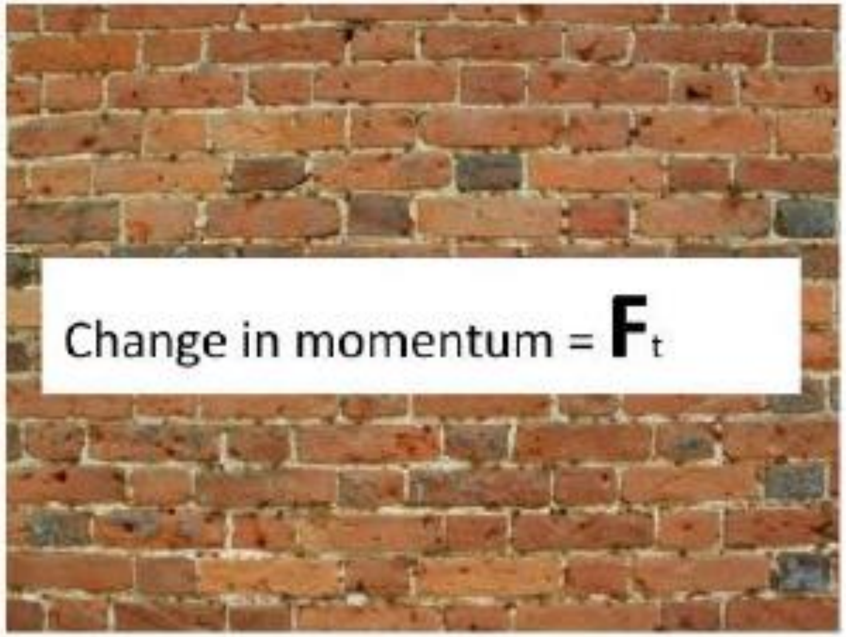
$$\int_{pi}^{pf} dp = \int_{vi}^{vf} mdv = \int_{ti}^{tf} Fdt = I$$

Impulse = change in momentum

$$F\Delta t = m\Delta v$$



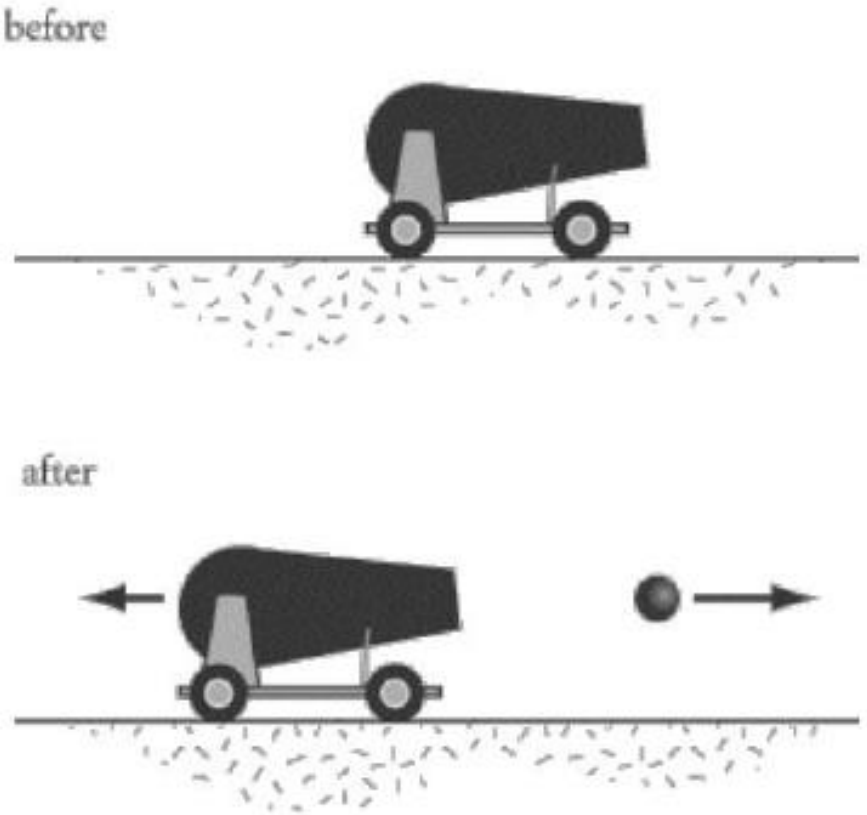
Drive your car into a brick wall, or into a pile of hay?
WHY?



- Both would have the same change in momentum to bring your car to a stop...BUT:
  - The brick wall has a greater force over a smaller period of time
  - The hay has a smaller force over a greater period of time

- Law of Conservation of Momentum:
  - In the absence of an external force, the momentum of a system remains unchanged.

$$\frac{d\vec{P}}{dt} = \sum \vec{F}^{ext} = 0$$

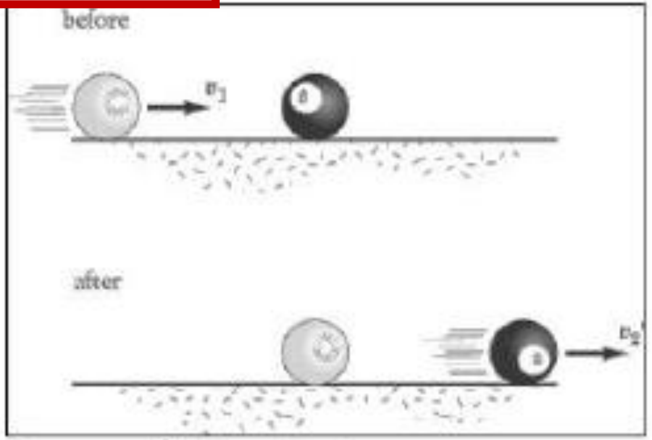


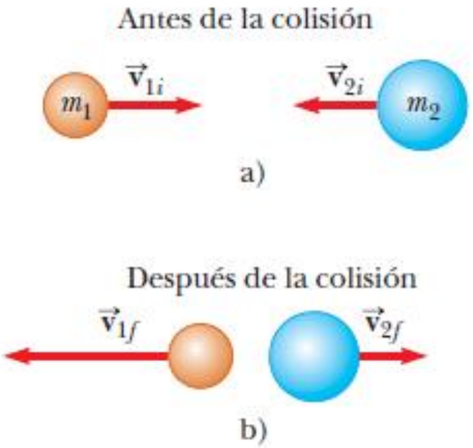
The momentum gained by the cannonball, is equal and opposite to the momentum gained by the cannon. So the system has not gained or lost momentum.

Conservation of Momentum
Collisions

Net Momentum before collision = Net Momentum after collision

- Elastic Collision: A collision in which colliding objects rebound without lasting deformation or generation of heat
  - Ex: molecules of gas, billiard ball





En una **colisión elástica**, tanto la **cantidad de movimiento** como la **energía cinética del sistema se conserva.**

Colisiones elásticas

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f} \rightarrow m_1(v_{1i} - v_{1f}) = m_2(v_{2f} - v_{2i})$$ Ec. 1

$$\tfrac{1}{2} m_1 {v_{1i}}^2 + \tfrac{1}{2} m_2 {v_{2i}}^2 = \tfrac{1}{2} m_1 {v_{1f}}^2 + \tfrac{1}{2} m_2 {v_{2f}}^2 \rightarrow m_1({v_{1i}}^2 - {v_{1f}}^2) = m_2({v_{2f}}^2 - {v_{2i}}^2)$$

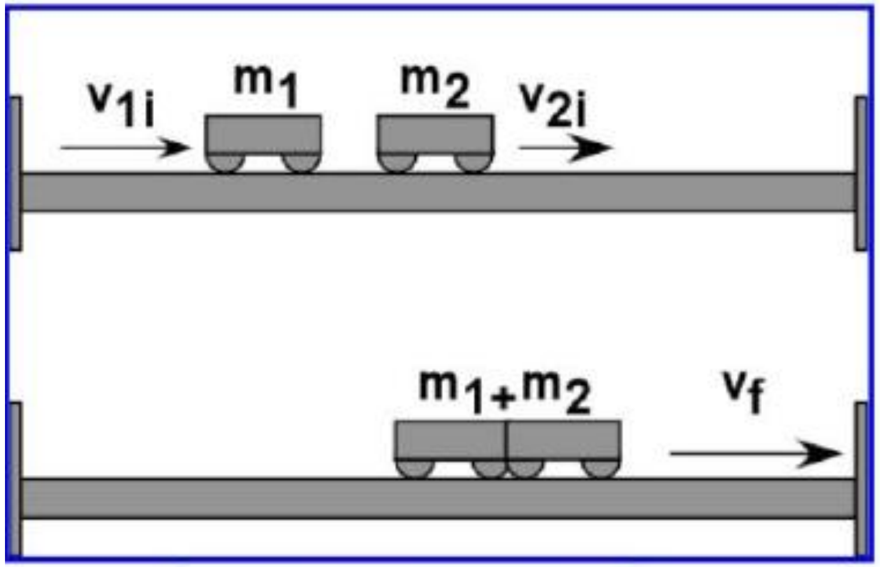
$$m_1(v_{1i} - v_{1f})(v_{1i} + v_{1f}) = m_2(v_{2f} - v_{2i})(v_{2f} + v_{2i})$$ Ec. 2

- Inelastic Collision: A collision in which colliding objects become distorted, generate heat, and possibly stick together.
  - Ex: One car hitting another

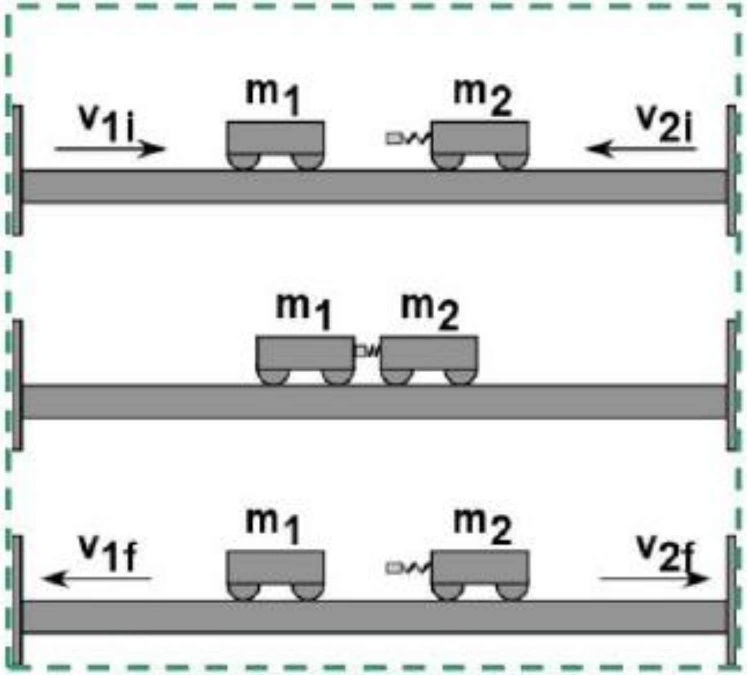
Colisiones Inelásticas

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$\frac{1}{2} m_1 {v_{1i}}^2 + \frac{1}{2} m_2 {v_{2i}}^2 \neq \frac{1}{2} m_1 {v_{1f}}^2 + \frac{1}{2} m_2 {v_{2f}}^2$$



Elastic or Inelastic?



Elastic or Inelastic?

Colisiones elásticas

Conservación de Energia

$$m_1(v_{1i} - v_{1f})(v_{1i} + v_{1f}) = m_2(v_{2f} - v_{2i})(v_{2f} + v_{2i})$$

Conservación de P

$$m_1(v_{1i} - v_{1f}) = m_2(v_{2f} - v_{2i})$$

$$\frac{m_1(v_{1i} - v_{1f})(v_{1i} + v_{1f})}{m_1(v_{1i} - v_{1f})} = \frac{m_2(v_{2f} - v_{2i})(v_{2f} + v_{2i})}{m_2(v_{2f} - v_{2i})}$$

$$v_{1i} + v_{1f} = v_{2f} + v_{2i}$$

$$v_{1i} - v_{2i} = -(v_{1f} - v_{2f})$$

COEFICIENTE DE RESTITUCIÓN

$$r = \frac{v_{1f} - v_{2f}}{v_{1i} - v_{2i}},$$

$$r = ?$$

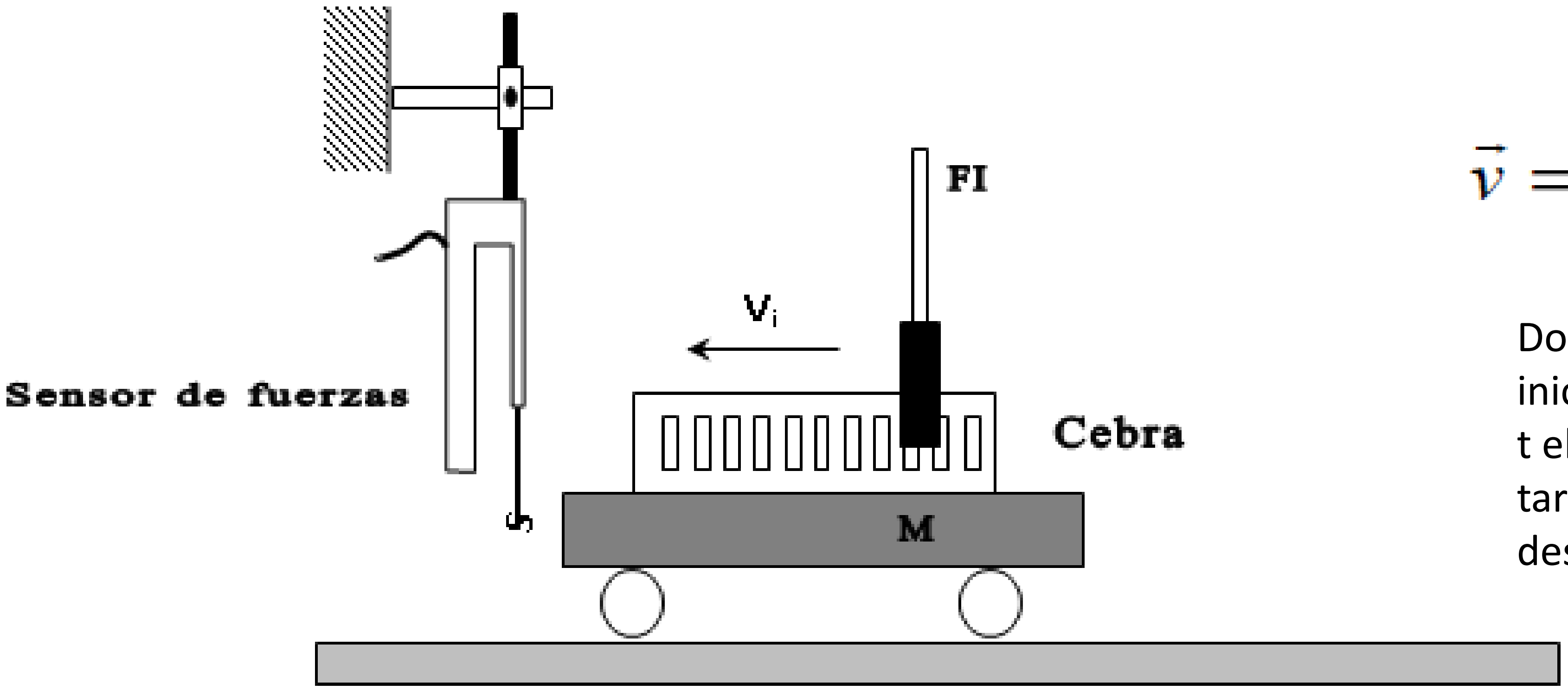
$r =$? Cuanto vale para cada tipo de colisión?

https://phet.colorado.edu/sims/html/collision-lab/latest/collision-lab_all.html

CONCEPTOS UTILES PARA LA PRACTICA:

variación de la energía cinética $\Delta T = \Delta\left(\frac{1}{2} m\bar{v}^2\right) = \int \bar{F}\, dx,$ $\bar{F}$ son las fuerzas externas ejercidas sobre el sistema.

ANALICEMOS EL MONTAJE:

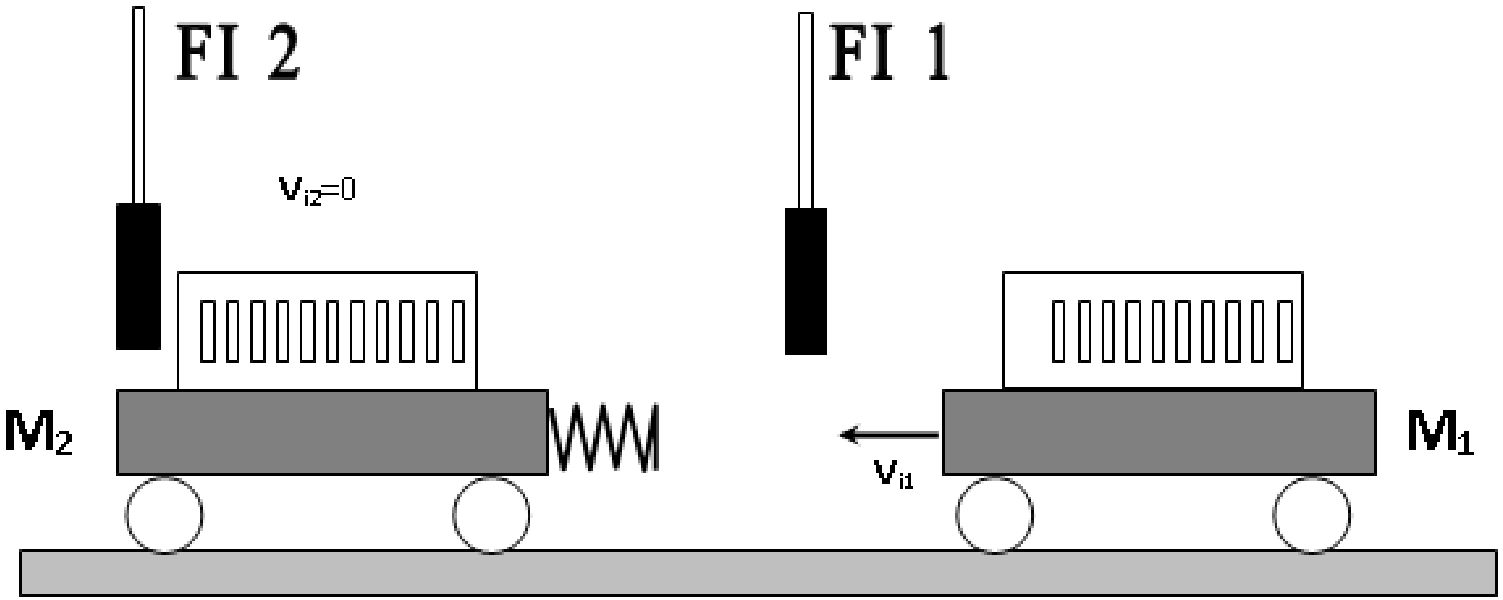


La velocidad media entre dos puntos estará dada por

$$\vec{v} = \frac{\Delta\vec{x}}{\Delta t} = \frac{\vec{x}_f - \vec{x}_i}{\Delta t}$$

Donde x_i y x_f son las posiciones iniciales, Δx su diferencia y delta t el intervalo de tiempo que se tardo en realizar el desplazamiento

MONTAJE 2:



Montar los carritos y los sensores para:

CHOQUE ELASTICO

CHOQUE PLASTICO

CHOQUE INELASTICO CON COEFICIENTE DE RESTITUCION A ELECCION