Introducción a la Física (2013)

Universidad Industrial de Santander

- Unidad: 01
- Clase: 09
- Fecha: 20130613J
- Contenido: De la Energía a las Leyes de Newton
- Web: http://halley.uis.edu.co/fisica_para_todos/
- Archivo: 20130613J-LN-energia-y-newton.pdf

En el episodio anterior

$$E_{mecanica} = E_{cinetica} + E_{potencial}$$

$$E_{m_1} = \frac{1}{2}mv_1^2 + mgy_1$$

$$\Delta E_m = E_{m_2} - E_{m_1}$$

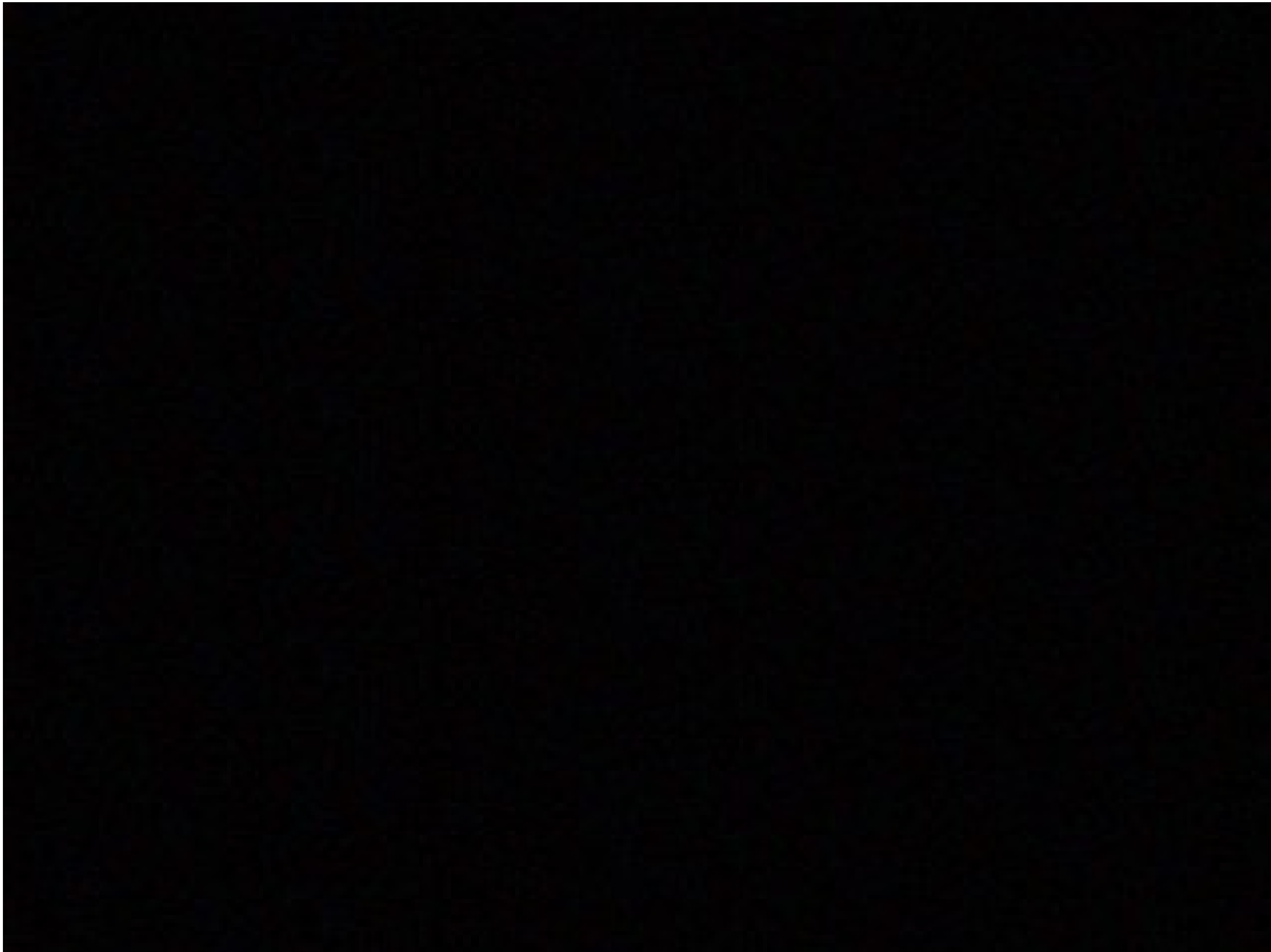
$$\Delta E_m = \Delta\left(\frac{1}{2}mv^2 + mgh\right)$$

$$\Delta E_m = \frac{1}{2}m\Delta v^2 + mg\Delta y$$

$$E_{m_2} = \frac{1}{2}mv_2^2 + mgy_2$$

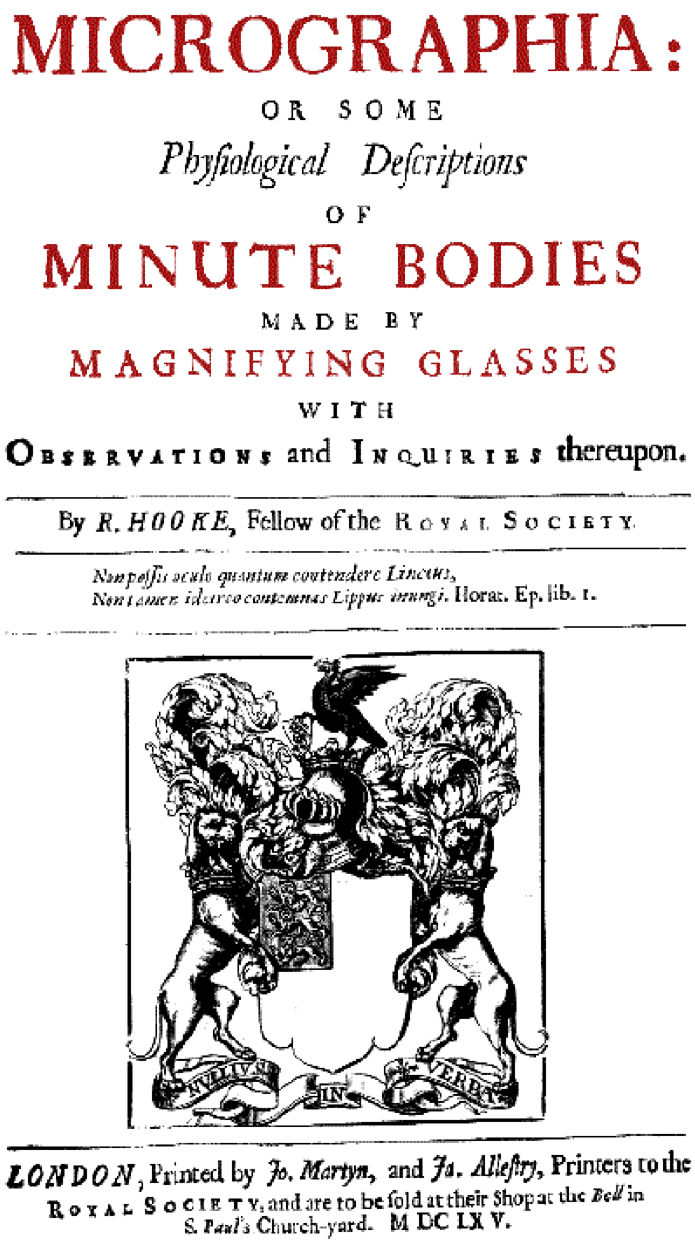
y

Algunos ejemplos de conservación



http://www.youtube.com/watch?v=HNkqy-qsheY

El genio olvidado de Robert Hooke



MICROGRAPHIA:
OR SOME
Physiological Descriptions
OF
MINUTE BODIES
MADE BY
MAGNIFYING GLASSES
WITH
OBSERVATIONS and INQUIRIES thereupon.

By *R. HOOKE*, Fellow of the ROYAL SOCIETY.

Non possis oculo quantum contendere Linceus,
Non tamen idcirco contemnas Lippus inungi. Horat. Ep. lib. 1.

LONDON, Printed by *Jo. Martyn*, and *Ja. Allestry*, Printers to the ROYAL SOCIETY, and are to be sold at their Shop at the *Bell* in S. *Paul's* Church-yard. M DC LX V.

http://naukas.com/2013/06/11/el-genio-olvidado-de-robert-hooke/

Paréntesis informativo

$$(v_2)^2 - (v_1)^2 = (v_2 - v_1)(v_2 + v_1)$$

$$(v_2)^2 - (v_1)^2 = \Delta v 2 v_m$$

$$v_m = \frac{v_1 + v_2}{2}$$

$$\Delta E_m = \frac{1}{2} m (2 v_m \Delta v) + m g \Delta y$$

$$\frac{\Delta E_m}{\Delta t} = m v_m \frac{\Delta v}{\Delta t} + m g \frac{\Delta y}{\Delta t}$$

Pero la energía mecánica se conserva

$$\frac{\Delta E_m}{\Delta t} = 0 = m v_m \frac{\Delta v}{\Delta t} + mg \frac{\Delta y}{\Delta t}$$

En el mundo de lo pequeño

$$v_m \sim \frac{\Delta y}{\Delta t} \Rightarrow m \frac{\Delta v}{\Delta t} = -mg$$

$$ma = -mg$$

En general para un potencial

$$E_{mecanica} = E_{cinetica} + E_{potencial}$$

$$E_{m_1} = \frac{1}{2}mv_1^2 + U(y_1)$$

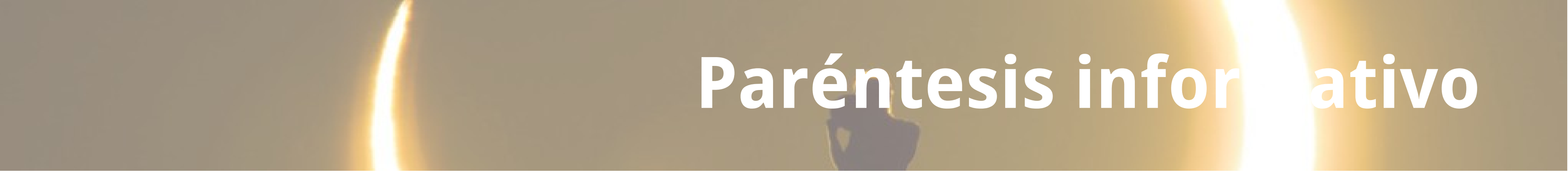
$$\Delta E_m = E_{m_2} - E_{m_1}$$

$$\Delta E_m = \Delta\left(\frac{1}{2}mv^2 + U(y)\right)$$

$$\Delta E_m = \frac{1}{2}m\Delta v^2 + \Delta U$$

$$E_{m_2} = \frac{1}{2}mv_2^2 + U(y_2)$$

y



Paréntesis informativo

$$(v_2)^2 - (v_1)^2 = (v_2 - v_1)(v_2 + v_1)$$

$$(v_2)^2 - (v_1)^2 = \Delta v 2 v_m$$

$$v_m = \frac{v_1 + v_2}{2}$$

$$\Delta E_m = \tfrac{1}{2} m (2 v_m \Delta v) + \Delta U(y)$$

$$\frac{\Delta E_m}{\Delta t} = m v_m \frac{\Delta v}{\Delta t} + \frac{\Delta U(y)}{\Delta y} \frac{\Delta y}{\Delta t}$$

Y del mismo modo

$$\frac{\Delta E_m}{\Delta t} = 0 = m v_m \frac{\Delta v}{\Delta t} + \frac{\Delta U(y)}{\Delta y}\frac{\Delta y}{\Delta t}$$

En el mundo de lo pequeño

$$v_m \sim \frac{\Delta y}{\Delta t} \Rightarrow m\frac{\Delta v}{\Delta t} = -\frac{\Delta U(y)}{\Delta y}$$

$$ma = -\frac{\Delta U(y)}{\Delta y} = F_U$$

y.... ¿Para varias energías potenciales?

$$E_m = \frac{1}{2}mv_2^2 + U_1(y) + U_2(y) + \cdots + U_n(y)$$

$$\frac{\Delta E_m}{\Delta t} = 0 = mv_m\frac{\Delta v}{\Delta t} + \left(\frac{\Delta U_1(y)}{\Delta y} + \frac{\Delta U_1(y)}{\Delta y} + \cdots + \frac{\Delta U_n(y)}{\Delta y}\right)\frac{\Delta y}{\Delta t}$$

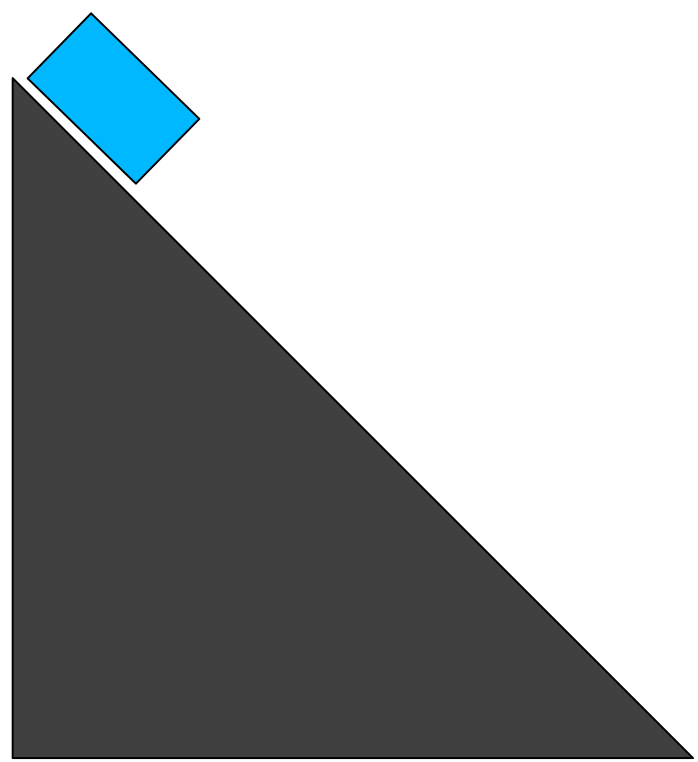
Y otra vez

$$ma = -\frac{\Delta U_1(y)}{\Delta y} - \frac{\Delta U_1(y)}{\Delta y} + \cdots - \frac{\Delta U_n(y)}{\Delta y} = F_{U_1} + F_{U_2} + \cdots + F_{U_n}$$

$$ma = \sum_{i=1}^{n} F_{U_i} = F_{U_1} + F_{U_2} + \cdots + F_{U_n}$$

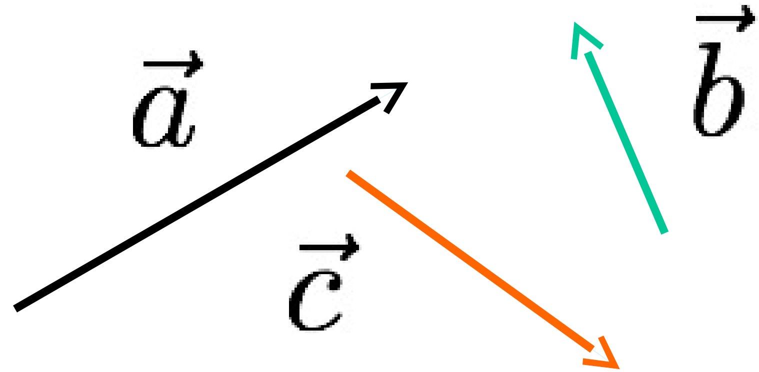
$$ma = \sum_{i=1}^{n} F_{U_i} + \sum_{i=1}^{n} F_{NU_i}$$

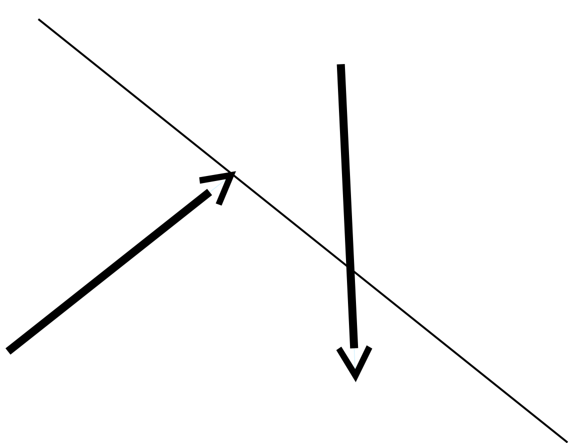
¿todo es en línea recta?

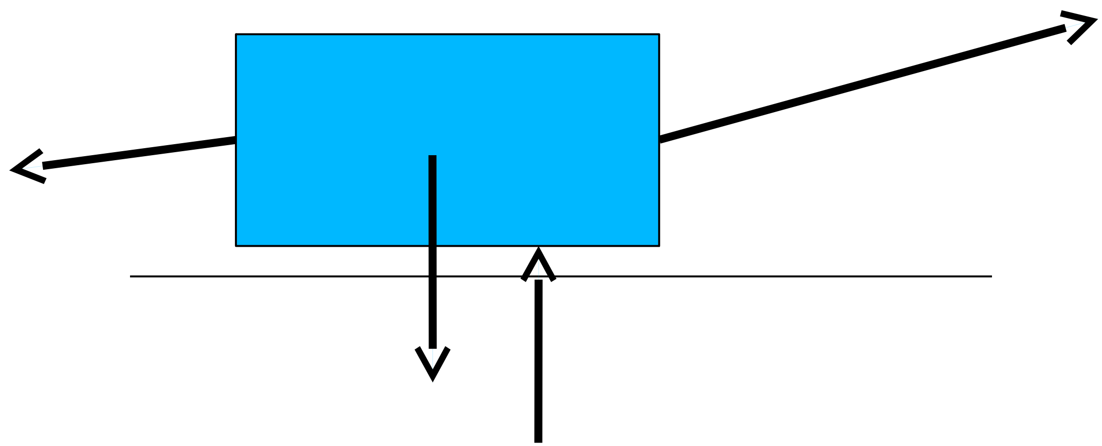


Los vectores

- Vectores
  - Módulo, Dirección y Sentido
  - Las flechas son un buen modelo
  - ¿Velocidad es vector? ¿temperatura es vector? ¿energía es vector? ¿posición es vector? ¿fuerza es vector? ¿presión es vector?

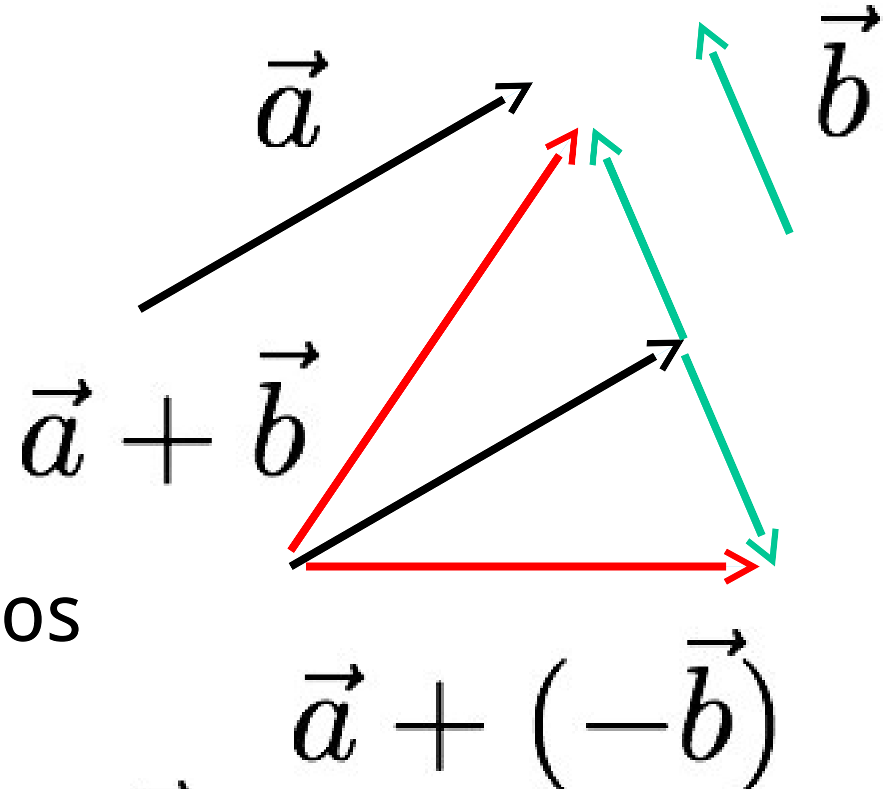


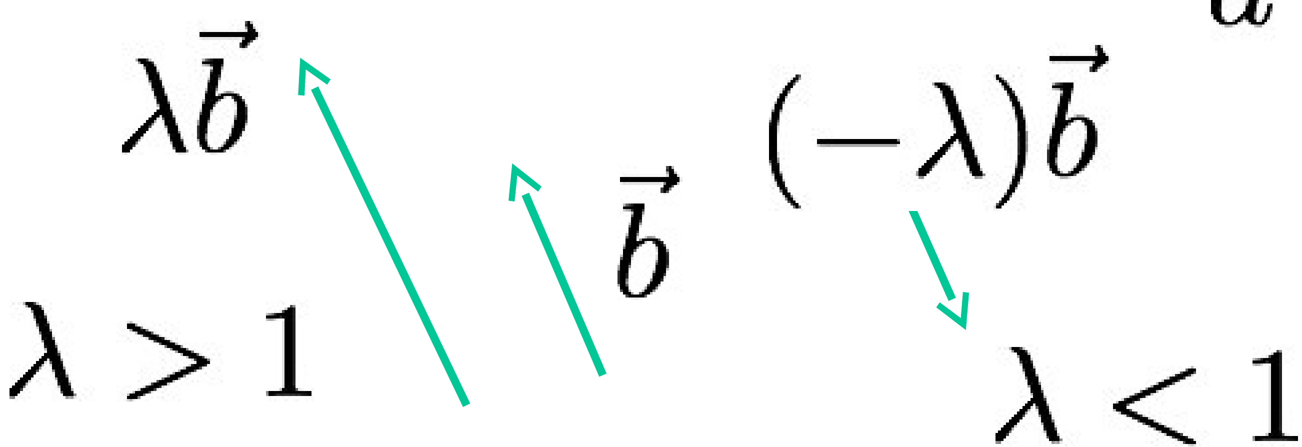




Algebra de vectores

- Los vectores se suman
- Los vectores se restan
- Se multiplican por números





Se multiplican

- Tenemos el producto escalar

$$\vec{a} \cdot \vec{b} = |a||b| \cos \theta_{<_{\vec{a}\ \vec{b}}}$$

$$\vec{a} \perp \vec{b} \Leftrightarrow \vec{a} \cdot \vec{b} = 0$$

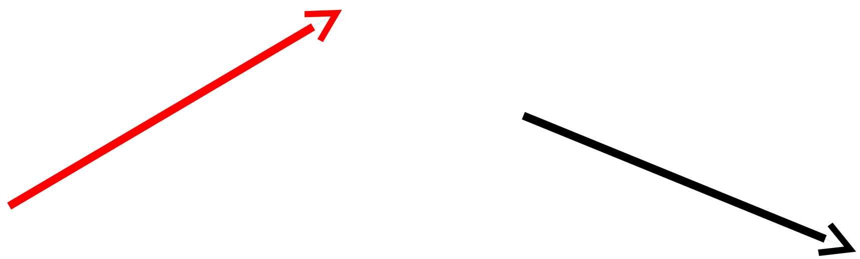
Y se llamarán vectores perpendiculares

- También tendremos el Producto vectorial

$$\vec{a} \times \vec{b} = \vec{c}$$

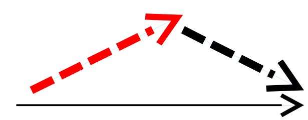
Vectores base

- Dos vectores que no sean colineales forman base



$$\lambda\vec{a} \neq \vec{b}$$

- Dos vectores base, expanden todos los vectores de plano que ellos forma



$$\vec{c} = \alpha\vec{a} + \beta\vec{b}$$

- Tres vectores que no sean coplanares forman base

- Tres vectores base expanden todos los vectores del espacio

Bases Ortonormales

$$\hat{\imath}_1 \cdot \hat{\imath}_2 = \hat{\imath}_1 \cdot \hat{\imath}_3 = \hat{\imath}_3 \cdot \hat{\imath}_2 = 0$$

$$\hat{\imath}_1 \cdot \hat{\imath}_1 = \hat{\imath}_2 \cdot \hat{\imath}_2 = \hat{\imath}_3 \cdot \hat{\imath}_3 = 1$$

- Tres vectores no coplanares ortogonales

$$\vec{a} = a_x\hat{\imath} + a_y\hat{\jmath} + a_z\hat{k}$$

$$\vec{a} = a_1\hat{\imath}_1 + a_2\hat{\imath}_2 + a_3\hat{\imath}_3$$

- Esos números se llaman componentes del vector
- Note que por ser base ortogonal

$$\hat{\imath}_i \cdot \vec{a} = a_i = \begin{cases} \hat{\imath}_1 \cdot \vec{a} = a_1 & i = 1 \\ \hat{\imath}_2 \cdot \vec{a} = a_2 & i = 2 \\ \hat{\imath}_3 \cdot \vec{a} = a_3 & i = 3 \end{cases}$$

Vectores Base

$$\vec{a} = a_1\hat{\imath}_1 + a_2\hat{\imath}_2 + a_3\hat{\imath}_3$$

$$\vec{b} = b_1\hat{\imath}_1 + b_2\hat{\imath}_2 + b_3\hat{\imath}_3$$

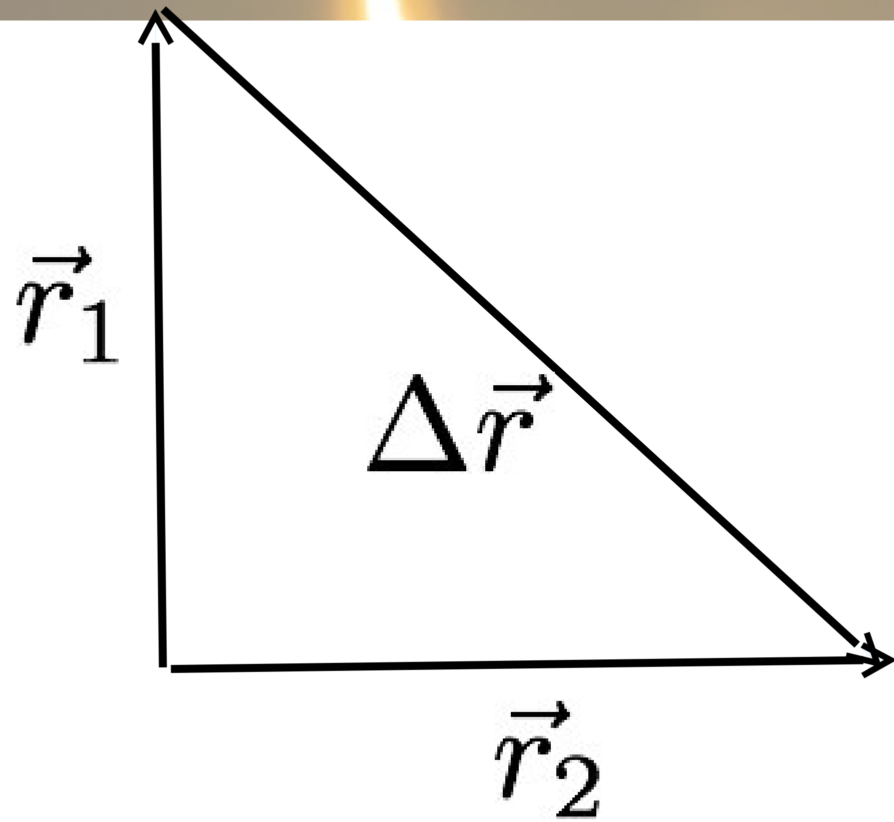
$$\vec{a} + \vec{b} = (a_1 + b_1)\hat{\imath}_1 + (a_2 + b_2)\hat{\imath}_2 + (a_3 + b_3)\hat{\imath}_3$$

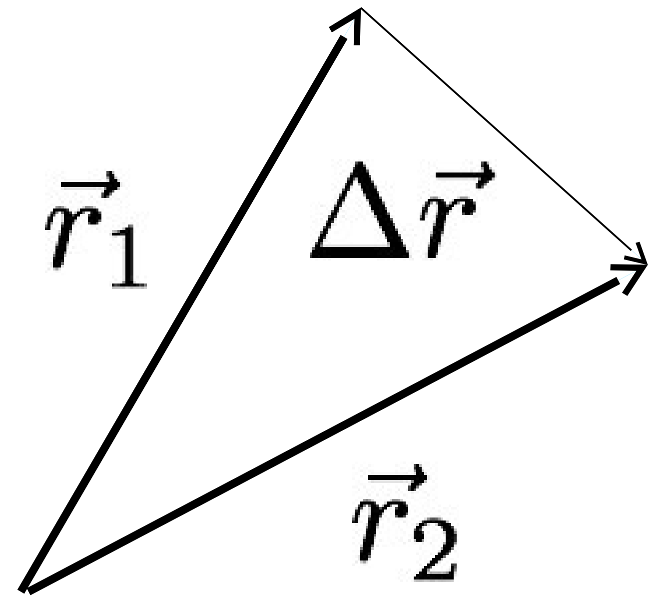
Ahora es fácil sumar vectores: se suman sus componentes

O se restan, componente a componente

$$\vec{a} - \vec{b} = (a_1 - b_1)\hat{\imath}_1 + (a_2 - b_2)\hat{\imath}_2 + (a_3 - b_3)\hat{\imath}_3$$

Los mismos conceptos distintas presentaciones





$$\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k} = x_1\hat{\imath}_1 + x_2\hat{\imath}_2 + x_3\hat{\imath}_3 = \sum_{i=1}^{3} x_i\hat{\imath}_i$$

$$\Delta\vec{r} = \sum_{i=1}^{3}\left(x_{2_i} - x_{1_i}\right)\hat{\imath}_i = \sum_{i=1}^{3}\Delta x_i\hat{\imath}_i$$

Los mismos conceptos.....

$$\vec{v} = \frac{\Delta \vec{r}}{\Delta t} \Rightarrow v_i = \frac{\Delta x_i}{\Delta t} \Rightarrow \begin{cases} v_1 = \frac{\Delta x_1}{\Delta t} & \text{en } \hat{\imath}_1 \\ v_2 = \frac{\Delta x_2}{\Delta t} & \text{en } \hat{\imath}_2 \\ v_3 = \frac{\Delta x_3}{\Delta t} & \text{en } \hat{\imath}_3 \end{cases}$$

$$E_m = \tfrac{1}{2} m (\vec{v})^2 + \textstyle\sum_{i=1}^{n} U_i(\vec{r})$$

$$m\vec{a} = \textstyle\sum_{i=1}^{n} \vec{F}_i$$