Lezione 2 04/03/2026

mercoledì 4 marzo 2026 14:38

Lezione #2

04/03/2026

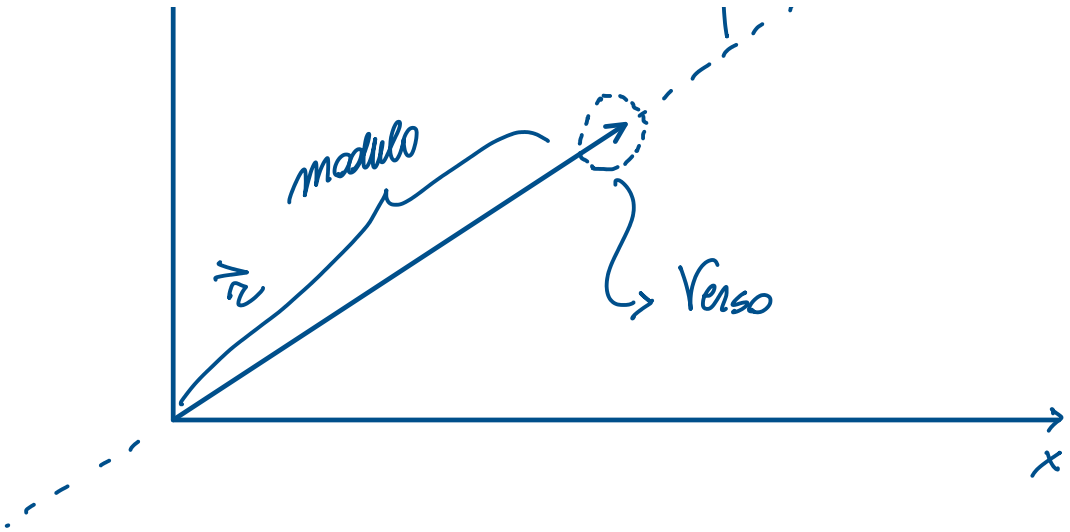
Grandezze fisiche → u d m

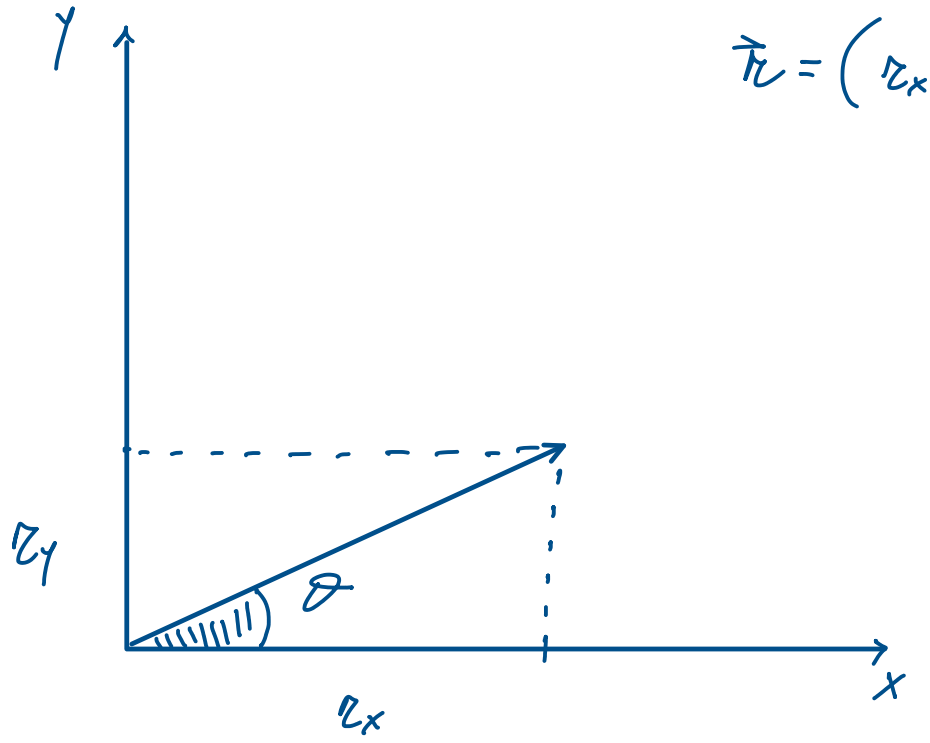
↳ SI
1 Lunghezza — m
2 massa — kg
3 tempo — s
4 Intensità di corrente — A
5 " luminosa — cd
6 quantità di sostanza — mol
7 Temperatura — K

mKs

Vettori:

$\vec{r}$ { Modulo, Direzione, Verso





$\vec{r} = (r_x ; r_y)$

θ = angolo che $\vec{r}$ forma con $\hat{x}$

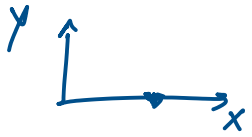
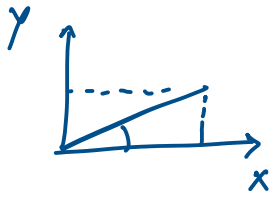
$|\vec{r}| = r$

$$\begin{cases} r_x = r\cos\theta \\ r_y = r\sin\theta \end{cases}$$

Angoli "notevoli":

θ	$\cos\theta$	$\sin\theta$

y ^

	θ	$\cos\theta$	$\sin\theta$
	$0°$	1	0
	$30°$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$
	$45°$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
	$60°$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
	$90°$	0	1

- Direzione e verso

$$\begin{cases} z_y = z \sin\theta \\ z_x = z \cos\theta \end{cases}$$

$$\frac{z_y}{z_x} = \frac{z \sin\theta}{z \cos\theta} = \operatorname{tg}\theta$$

$$\varphi = \operatorname{arctg}\left(\frac{z_y}{z_x}\right)$$

- Modulo $|\vec{z}| = z$:

$$z = \sqrt{z_x^2 + z_y^2}$$

Somma / Differenza vettoriale :

$$\vec{z}_{TOT} = \vec{z}_1 \pm \vec{z}_2$$

$$\vec{z}_{TOT} = (z_{TOT,x} \; ; \; z_{TOT,y})$$

$$\vec{z}_1 = (z_{1x} \; ; \; z_{1y})$$

$$\vec{z}_2 = (z_{2x} \; ; \; z_{2y})$$

$$\vec{z}_{TOT} = \begin{cases} z_{TOT,x} = z_{1x} \pm z_{2x} \\ z_{TOT,y} = z_{1y} \pm z_{2y} \end{cases}$$

$$|\vec{r}_{TOT}| = \sqrt{r_{TOT,x}^2 + r_{TOT,y}^2}$$

Esercizio:

Formica del deserto "Desert Ant":

Una formica del deserto alle ore 12:00 (50°) esce in cerca di cibo.

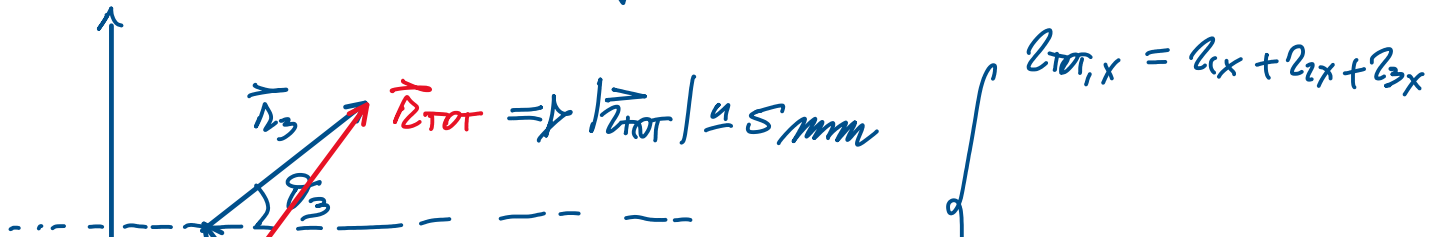
Sapendo che compie 3 passi $\vec{r}_1, \vec{r}_2, \vec{r}_3$

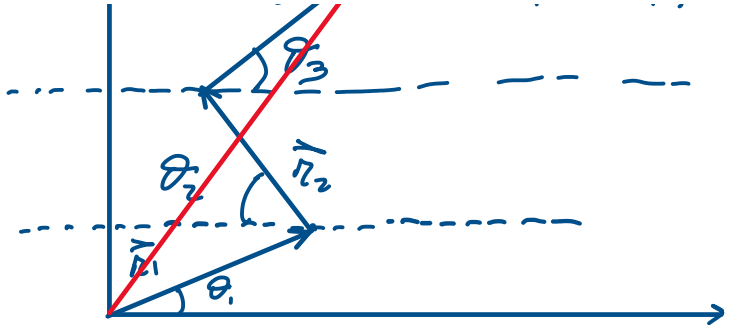
$|\vec{r}_1| = |\vec{r}_2| = |\vec{r}_3| = 2\ mm$ e che ogni spostamento forma un angolo $\vartheta_1 = 30°$

$\vartheta_2 = 60°$ e $\vartheta_3 = 45°$

Calcolare la distanza percorsa

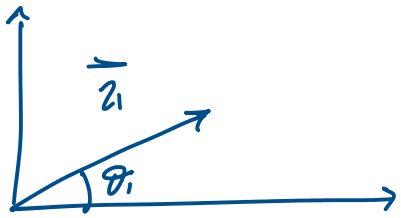
$$\vec{r}_{TOT} = \vec{r}_1 + \vec{r}_2 + \vec{r}_3$$





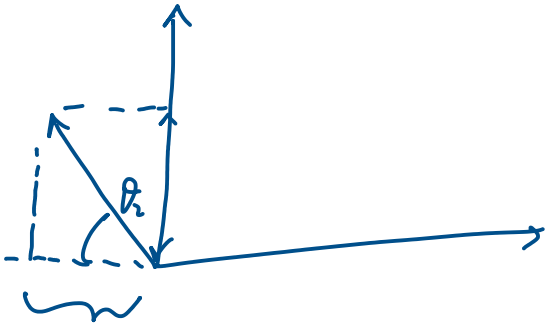
$$\begin{cases} r_{tot,y} = r_{1y} + r_{2y} + r_{3y} \end{cases}$$

$\vec{r}_1$:



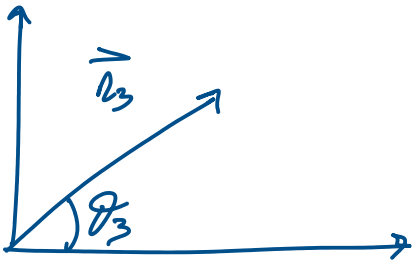
$$\begin{cases} r_{1x} = r_1 \cos\vartheta_1 = 2 \cdot \frac{\sqrt{3}}{2} = \sqrt{3} \\ r_{1y} = r_1 \sin\vartheta_1 = 2 \cdot \frac{1}{2} = 1 \end{cases}$$

$\vec{r}_2$



$$\begin{cases} r_{2x} = -2\,\frac{1}{2} = -1 \\ r_{2y} = 2\,\frac{\sqrt{3}}{2} = \sqrt{3} \end{cases}$$

$\vec{r}_3$



$$\begin{cases} r_{3x} = 2\,\frac{\sqrt{2}}{2} = \sqrt{2} \\ r_{3y} = 2\,\frac{\sqrt{2}}{2} = \sqrt{2} \end{cases}$$

$$\begin{cases} r_{tot,x} = \sqrt{3} - 1 + \sqrt{2} = 2{,}1463 \text{ mm} \\ r_{tot,y} = 1 + \sqrt{3} + \sqrt{2} = 4{,}1463 \text{ mm} \end{cases}$$

$$r_{TOT} = \sqrt{(2{,}1463)^2 + (4{,}1463)^2} = 4{,}6689 \text{ mm}$$

$$r_{TOT} = 4{,}6689\ 10^{-3} \text{ m}$$

mm

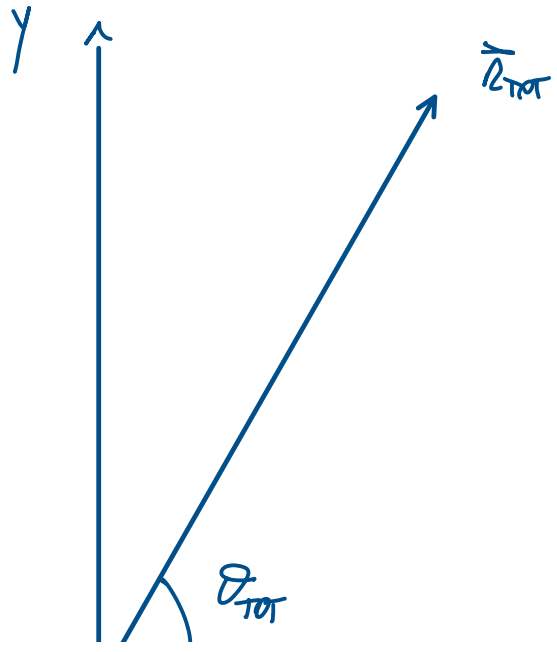
milli

$$\boxed{r_{TOT} \simeq 5\ 10^{-3} \text{ m}}$$

All'andata (random walk) la formica ha percorso

$r_{ANDATA} = 2 \cdot 3 = 6$ mm, al ritorno ha percorso

$r_{TOT} = 5$ mm



$$\vartheta_{TOT} = \arctg\left(\frac{4{,}1463}{2{,}1463}\right)$$

$$\vartheta_{TOT} = 62{,}6320°$$

$$\vartheta_{TOT} \simeq 63°$$

CINEMATICA

↳ Descrizione del moto Trascurando ~~cause~~

Alcune ipotesi:

1) Punto materiale → $S = V = 0$

nessuna estensione spaziale

.

massa $\neq 0$

2) $v \ll c$

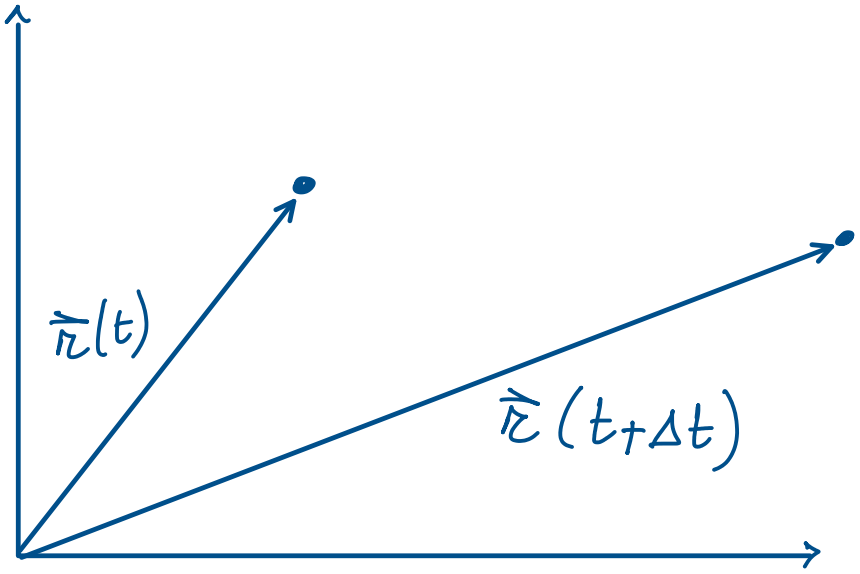
↳ velocità della luce

3) distanze >> distanze atomiche

Posizione

$\vec{r}(t)$

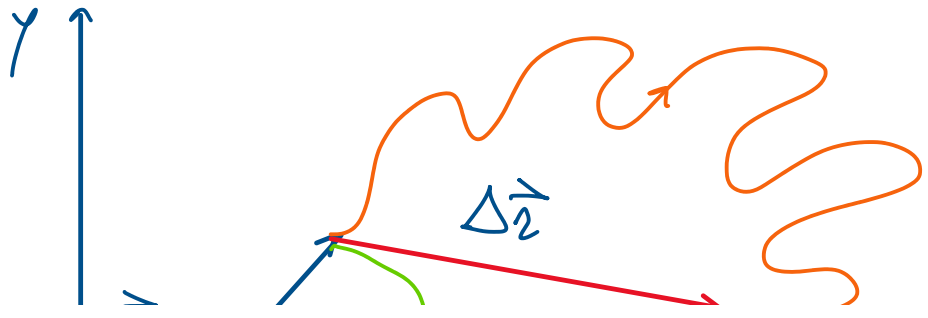
Posizione al Tempo t

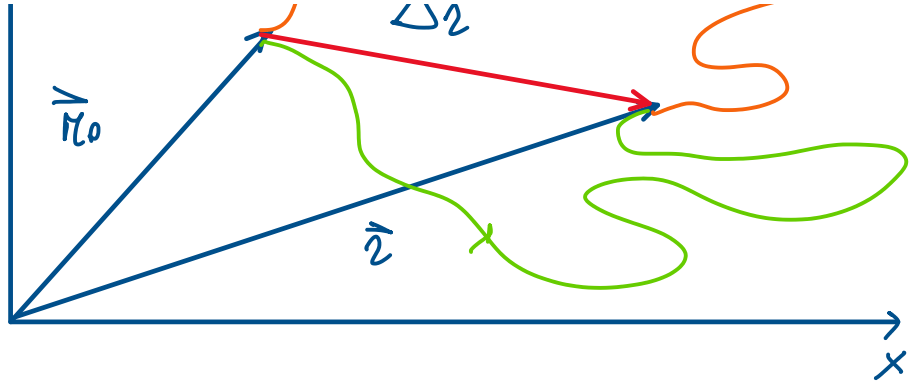


In un intervallo di Tempo Δt $\quad \vec{r}(t) \to \vec{r}(t+\Delta t)$

$$\begin{cases} t_{INIZIALE} = t_{IN} = 0 \\ t_{FIN} = t \end{cases} \qquad \begin{cases} \vec{r}(0) = \vec{r}_0 \\ \vec{r}(t) = \vec{r} \end{cases}$$

Vettore spostamento $\quad \Delta\vec{r} = \vec{r} - \vec{r}_0$





$\Delta\vec{r}$ non dipende dal percorso ma solo dallo stato iniz. e finale

$$\vec{v}_{MEDIA} = \frac{\Delta\vec{r}}{\Delta t}$$

$\Delta\vec{r}$ → SPOSTAMENTO

Δt → intervallo di tempo in cui è avvenuto

$$[\vec{v}] = \frac{m}{s}$$

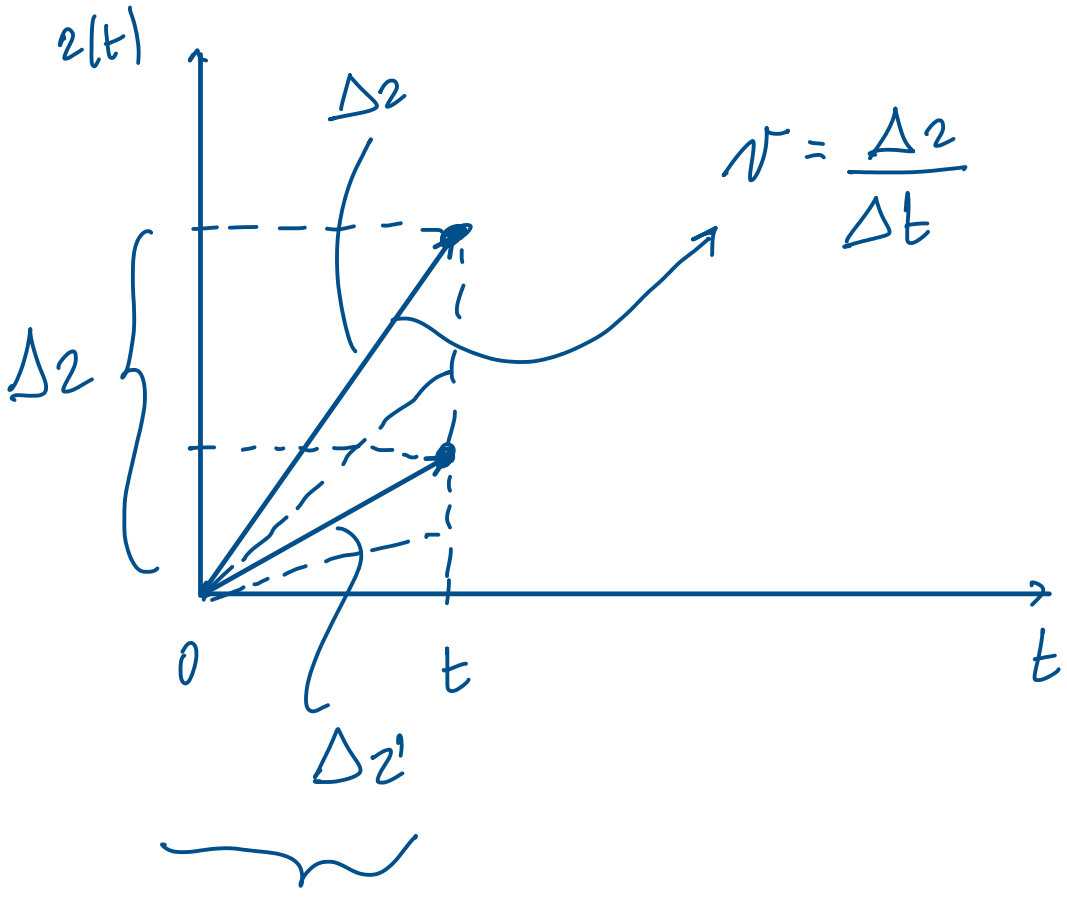
Delle volte $[v] = km/h$:

$$km/h = 10^3\, m / 60\, min = \frac{10^3\, m}{60 \cdot 60\, s}$$

$$= \frac{10^3}{3{,}6\,10^3}\ m/s$$

$$km/h = \frac{1}{3{,}6}\ m/s$$

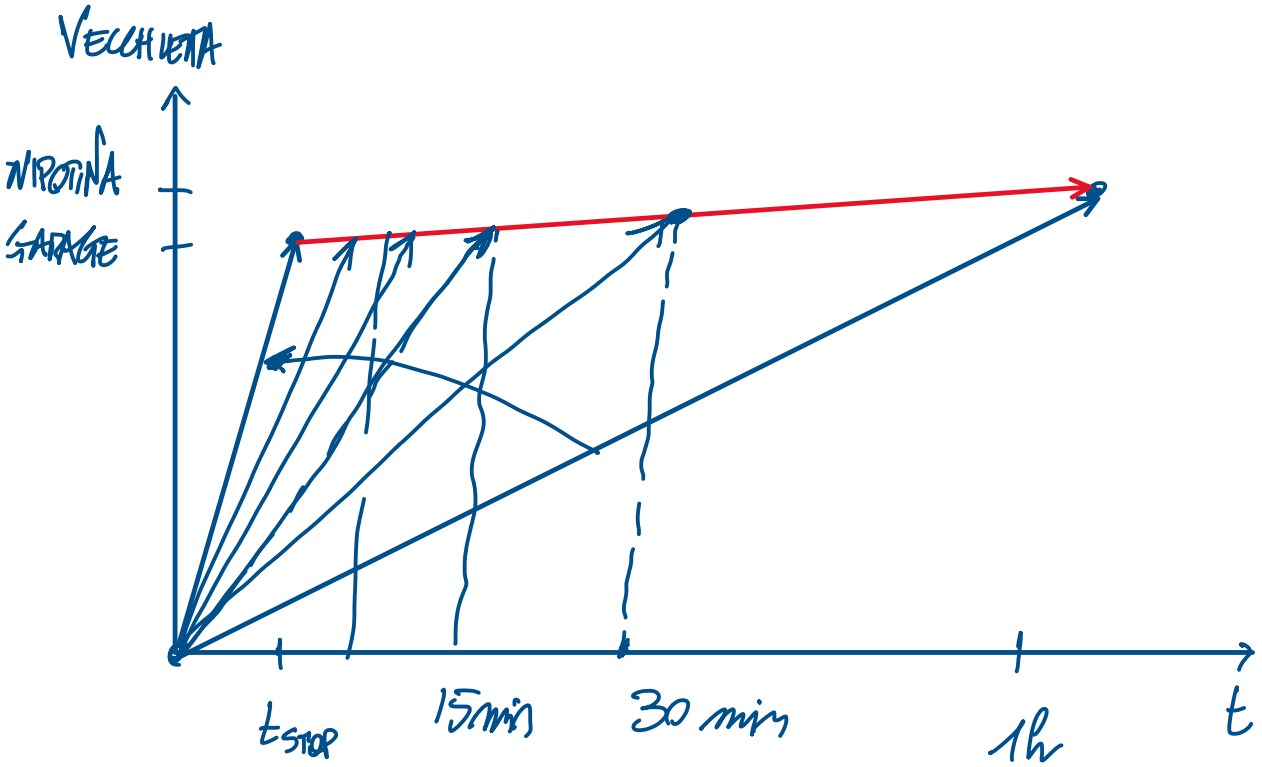
$$m/s = 3{,}6\ km/h$$



Δt

Delle volte la $\vec{v}_M$ non è "adatta" a descrivere il fenomeno che osservo:

$$v = \frac{\Delta s}{\underbrace{\Delta t}}$$



Se Δt lo faccio diventare piccolo $\vec{v}_M$ diventa sempre + accurata $\Delta t \to 0$

$$\lim_{\Delta t \to 0} \frac{\Delta \vec{r}}{\Delta t} = \frac{d\vec{r}}{dt}$$

$$\vec{v}_{IST.} = \frac{d\vec{r}}{dt}$$

Accelerazione:

$$\vec{a}_M = \frac{\Delta \vec{v}}{\Delta t}$$

$$\vec{a}_{IST} = \frac{d\vec{v}}{dt}$$

$$[\vec{a}] = \frac{m}{s}\,\frac{1}{s} = m/s^2$$