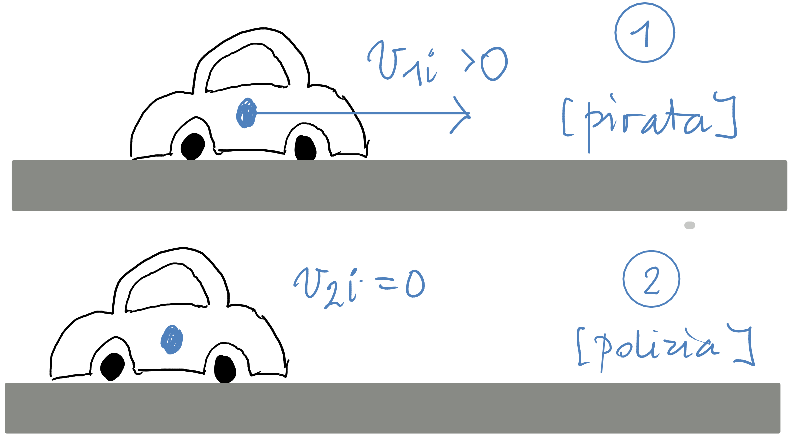
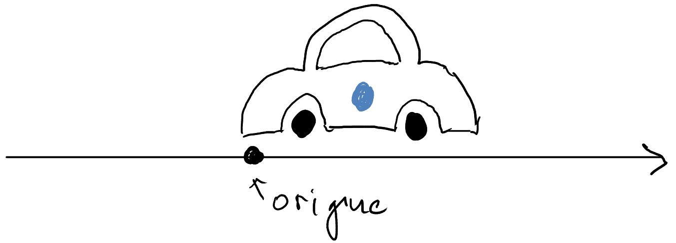
CINEMATICA 1D



velocità costante
accelerazione costante
→ Dopo quanto tempo 2 raggiunge 1 ?

Moto unidimensionale → linea retta → punto



Posizione : distanza del punto rispetto all'origine

segno + se sono dal lato della freccia e' − viceversa

Tempo : intervallo di tempo trascorso a partire da un istante di riferimento

→ relative!

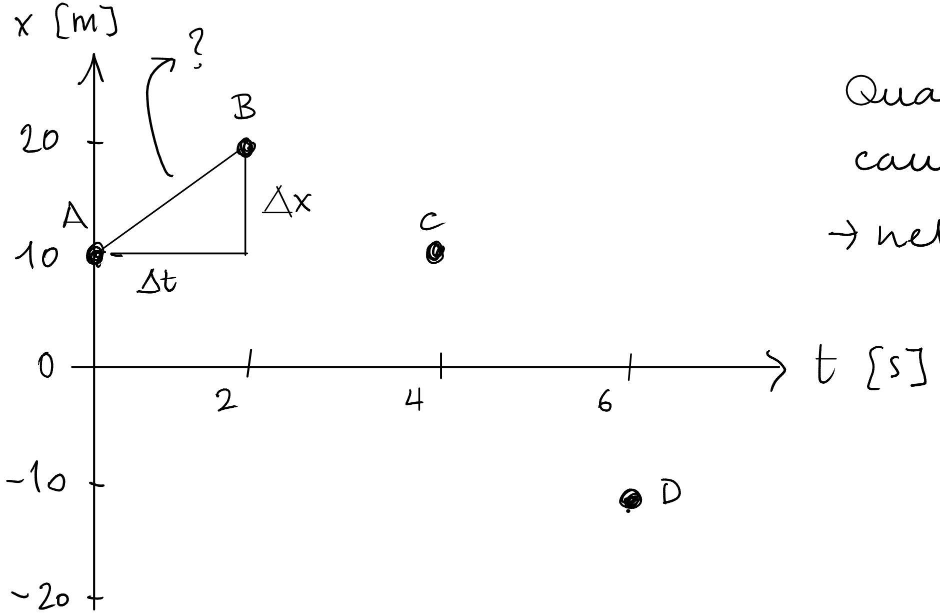
$A = (t_A, x_A)$ $\quad (t_i, x_i)$ → coordinate → evento

$B = (t_B, x_B)$ $\quad (t_f, x_f)$ → stato

Intervallo di tempo : $\Delta t \equiv t_B - t_A$

Spostamento : $\Delta x \equiv x_B - x_A$

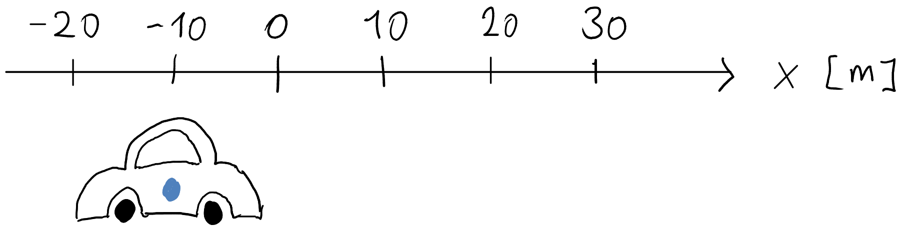
VELOCITÀ



Quanto rapidamente cambia la posizione?

→ nell'unità di tempo

	t [s]	x [m]
A	0	10
B	2	20
C	4	10
D	6	-10



AB $\begin{cases} \Delta t = 2\,s \\ \Delta x = 10\,m \end{cases}$

CD $\begin{cases} \Delta t = 2\,s \\ \Delta x = -20\,m \end{cases}$

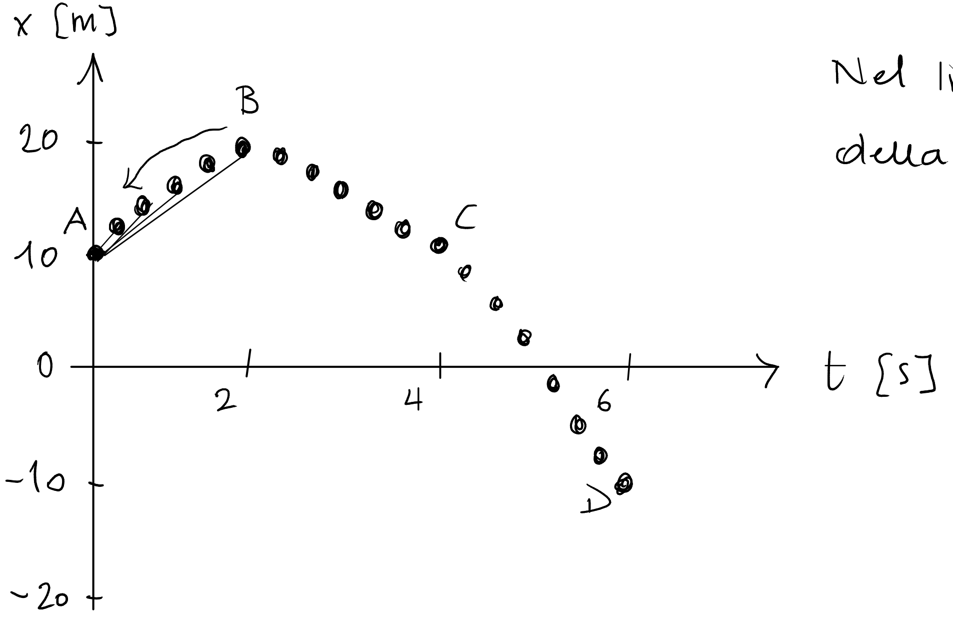
$v_{xm} \equiv \dfrac{\Delta x}{\Delta t}$ <u>velocità media</u>

$[v_{xm}] = \dfrac{L}{T}$ SI: $\dfrac{m}{s}$

$\dfrac{\Delta t}{\Delta x} \equiv ?$

$$AB: \quad v_{xm} = \frac{10}{2}\ \frac{m}{s} = 5\ m/s$$

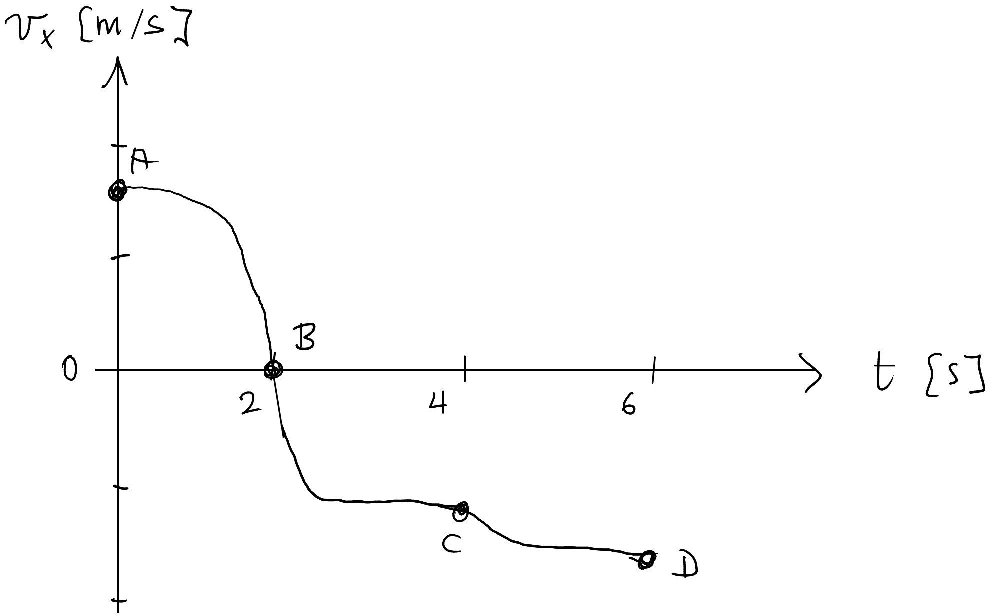
$$AC: \quad v_{xm} = \frac{0}{4}\ \frac{m}{s} = 0\ m/s$$



Nel limite in cui Δt diventa piccolo ottengo una buona stima della velocità in A:

$$\boxed{v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt} \qquad \underline{\text{velocità}}}$$

SI: $\frac{m}{s}$

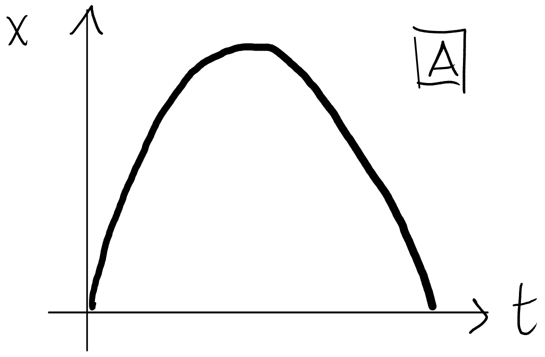


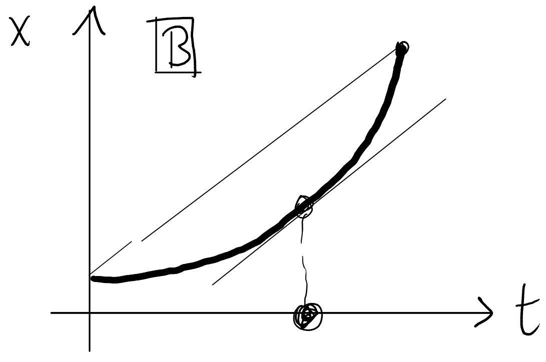
Esercizio: velocità media / istantanea

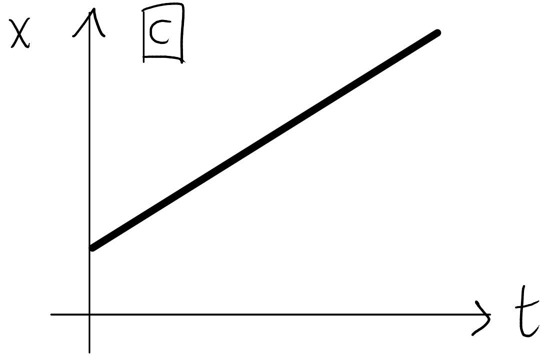
A palla lanciata verso l'alto che poi ricade a terra

B auto che aumenta la velocità da 0 km/h a 100 km/h

C sonda spaziale che si muove nel vuoto a velocità costante







Modello 1: moto rettilineo uniforme → velocità costante

$$v_x = v_{xm} = cost$$

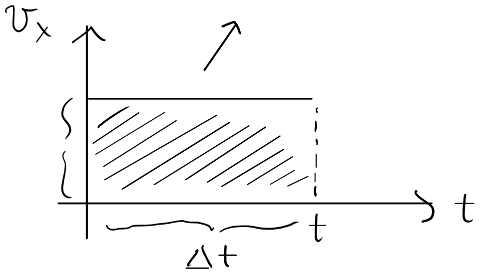
$$\frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = v_x \qquad \forall\, t_f$$

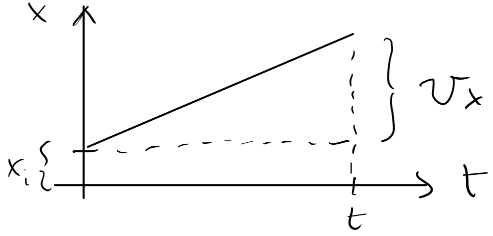
$$x_f - x_i = v_x(t_f - t_i)$$

$$x_f = v_x(t_f - t_i) + x_i$$

spostamento ≡ area compresa tra $v_x(t)$ e l'asse t

⚠ può essere + o −





Leggi orarie del moto

$$\begin{cases} v_x = cost \\ x = v_x(t - t_i) + x_i \end{cases}$$

$$\Delta x = x - x_i$$

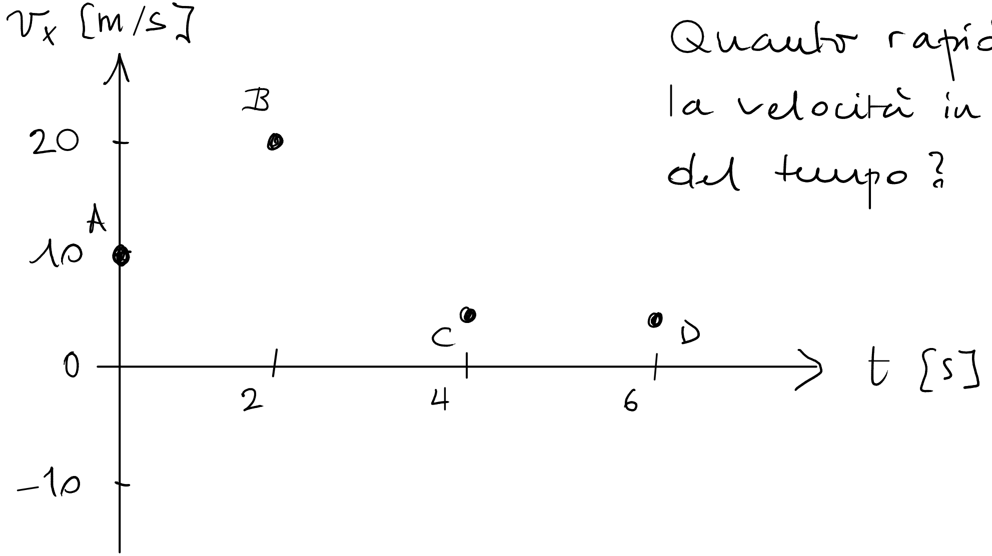
Calcolo integrale

$$v_x = cost$$

$$\frac{dx}{dt} = v_x$$

$$\int_{t_i}^{t_f} \frac{dx}{dt}\,dt = \int_{t_i}^{t_f} v_x\,dt \rightarrow x_f - x_i = v_x \int_{t_i}^{t_f} dt = v_x(t_f - t_i) \rightarrow x = v_x(t - t_i) + x_i$$

ACCELERAZIONE



Quanto rapidamente cambia la velocità in funzione del tempo?

	t[s]	v_x [m/s]
A	0	10
B	2	20
C	4	5
D	6	5

AB: $\begin{cases} \Delta v_x = 10 \text{ m/s} \\ \Delta t = 2 \text{ s} \end{cases} \rightarrow$

$\downarrow$

$a_{xm} = 5 \text{ m/s}^2$

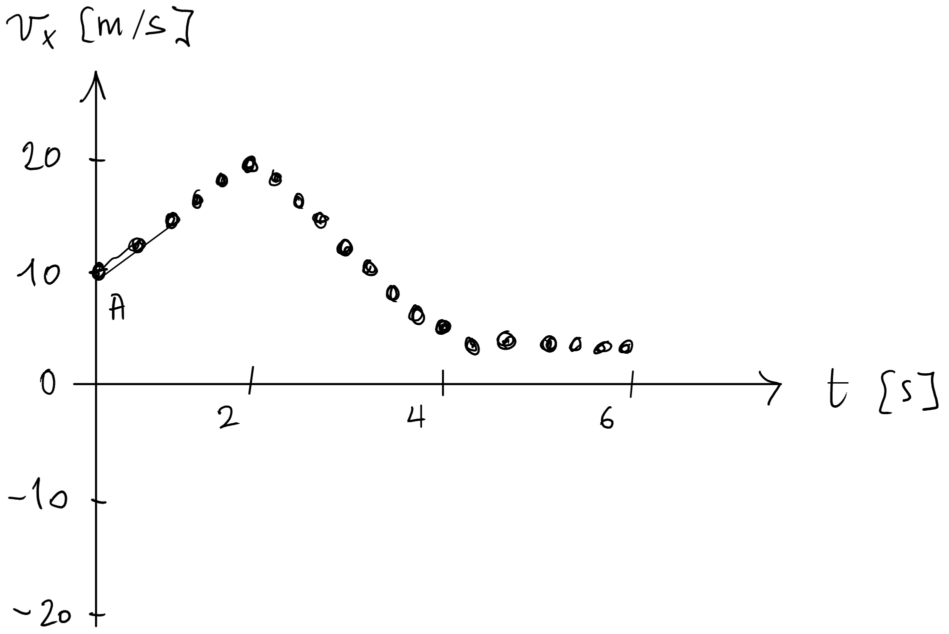
$$a_{xm} \equiv \frac{\Delta v_x}{\Delta t}$$ <u>accelerazione media</u>

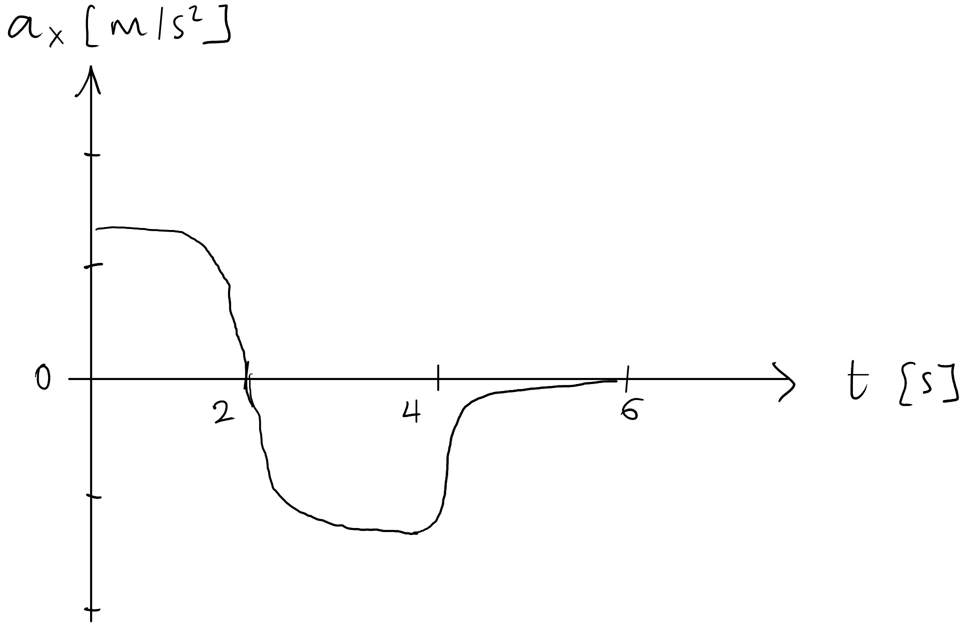
$[a_{xm}] = \frac{L}{T^2}$ SI: $\frac{m}{s^2}$

BC: $\begin{cases} \Delta v_x = -15 \text{ m/s} \\ \Delta t = 2 \text{ s} \end{cases}$

$\downarrow$

$a_{xm} = -7.5 \frac{m}{s^2}$





$$\lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t} \equiv a_x$$ <u>accelerazione</u>

SI: $\frac{m}{s^2}$

$$a_x = \frac{dv_x}{dt} = \frac{d}{dt}\left(\frac{dx}{dt}\right) = \frac{d^2x}{dt^2}$$

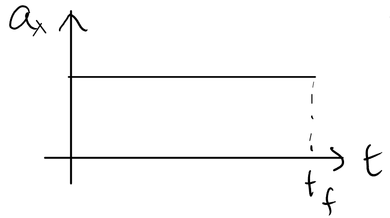
Modello 2: moto uniformemente accelerato $\rightarrow$ accelerazione costante

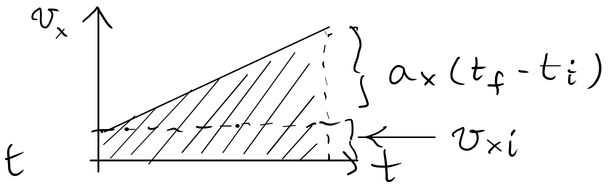
ES: caduta libera

$$a_x = a_{xm} = \text{cost} \quad \forall t$$

$$\frac{v_{xf} - v_{xi}}{t_f - t_i} = a_x$$

$$v_{xf} = v_{xi} + a_x (t_f - t_i) \rightarrow v_x = v_{xi} + a_x (t - t_i)$$





$$\Delta x = \frac{1}{2} a_x (t_f - t_i)^2 + v_{xi} (t_f - t_i)$$

$$x_f = \frac{1}{2} a_x (t_f - t_i)^2 + v_{xi} (t_f - t_i) + x_i \rightarrow$$

<u>Leggi orarie del moto</u>

$$\begin{cases} a_x = \text{cost} \\ v_x = a_x (t - t_i) + v_{xi} \\ x = \frac{1}{2} a_x (t - t_i)^2 + v_{xi} (t - t_i) + x_i \end{cases}$$

Calcolo integrale

$$\frac{dv}{dt} = a_x = \text{cost}$$

$$\int_{t_i}^{t_f} \frac{dv}{dt} dt = \int_{t_i}^{t_f} a_x \, dt \rightarrow v_{xf} - v_{xi} = a_x (t_f - t_i) \rightarrow v = a_x (t - t_i) + v_{xi}$$

$$\frac{dx}{dt} = a_x (t - t_i) + v_{xi} \rightarrow \int_{t_i}^{t_f} \frac{dx}{dt} dt = \int_{t_i}^{t_f} a_x (t - t_i) \, dt + \int_{t_i}^{t_f} v_{xi}$$

$$\begin{cases} t' = t - t_i \\ dt' = \frac{dt'}{dt} dt = dt \end{cases}$$

$$x_f - x_i = a_x \int_0^{t_f - t_i} t' \, dt' + v_{xi}(t_f - t_i) = \frac{1}{2} a_x (t_f - t_i)^2 + v_{xi}(t_f - t_i)$$

$$\rightarrow x = \frac{1}{2} a_x (t - t_i)^2 + v_{xi}(t - t_i) + x_i$$