

GRANDEZZE FISICHE

Definizione operativa → MISURA



Confronto con opportuna
unità di misura

fondamentali:

LUNGHEZZA	MKS	metro m	cgs	cm (10^{-2} m)
		$c = 299\,792\,458$ m/s $\cong 3 \cdot 10^8$ m/s		
		$m \rightarrow \text{luce in } \frac{1}{299\,792\,458} \text{ s}$		
MASSA		kilogrammo kg		(10^{-3} kg) g
TEMPO		secondo s		s
TEMPERATURA		Kelvin K		
Quantità di materia		mole mol		$N_A = 6.022 \cdot 10^{23}$
INTENSITA' DI CORRENTE elettrica		Ampere A		
intensità luminosa		candela cd		

derivate

$$\text{velocità} = \frac{\text{lunghezza}}{\text{tempo}} \quad \frac{\text{m}}{\text{s}}$$

$$\text{accelerazione} = \frac{\text{lunghezza}}{\text{tempo}^2} \quad \frac{\text{m}}{\text{s}^2}$$

$$g = 9,8 \frac{\text{m}}{\text{s}^2}$$

.....
forza, energia
N J

$$1 \text{ N} = 1 \frac{\text{kg m}}{\text{s}^2}$$

$$1 \text{ J} = 1 \frac{\text{kg m}^2}{\text{s}^2}$$

DIMENSIONI delle grandezze fisiche

$$[G] = [L] \cdot [M] \cdot [T^{-2}]$$

$[L]$ → lunghezza

$[M]$ → massa

$[T]$ → tempo

.....

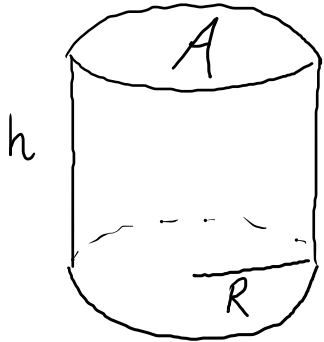
$[H]$ → altra dimensione
da definire

$$[G] = [L^\alpha] [M^\beta] [T^\delta] \dots [H^\zeta]$$

$\alpha, \beta, \gamma, \delta$ opportune

velocità della luce

$$[c] = [L][T^{-1}]$$



$$R = 1 \text{ cm}$$

$$h = 2 \text{ cm}$$

$$A = \pi R^2 = \pi (1 \text{ cm})^2 = \pi \text{ cm}^2$$

$$V = A \cdot h = \pi \text{ cm}^2 \cdot 2 \text{ cm} = 2\pi \text{ cm}^3$$

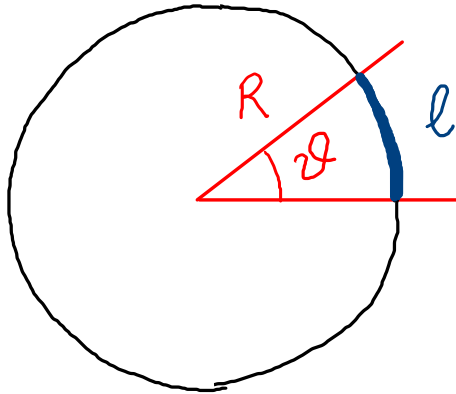
~~$$A + V = ?$$~~

NON HA SENSO !!

$$[A] = [L^2]$$

$$[V] = [L^3]$$

ANGOLI



$$[\theta] = \frac{[L]}{[L]} = [L^0] \quad \text{adimensionali}$$

$$\theta = \frac{l}{R} \quad (I)$$

$$l = \theta \cdot R$$

angolo

giro

piatto

retto

misura in gradi

360°

180°

90°

60°

45°

30°

misura secondo (I)
in radianti

$$\frac{2\pi R}{R} = 2\pi$$

π

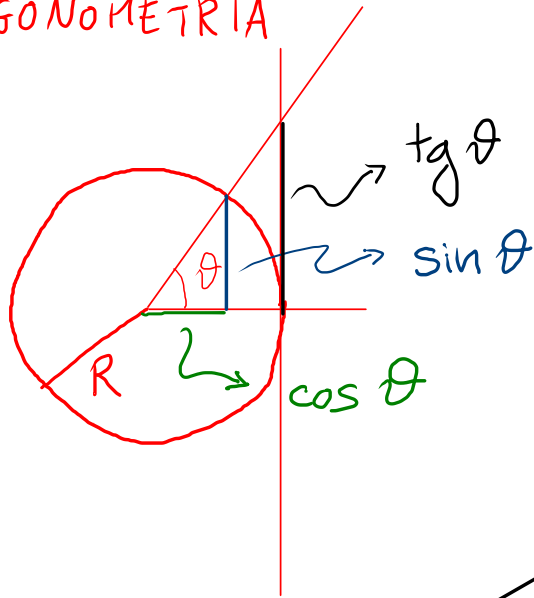
$\pi/2$

$\pi/3$

$\pi/4$

$\pi/6$

TRIGONOMETRIA

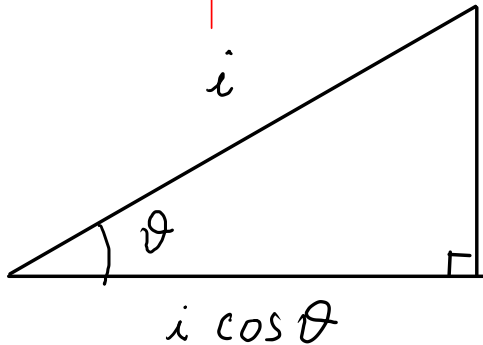


$$R = 1$$

$$\sin \theta \in [-1, 1]$$

$$\cos \theta \in [-1, 1]$$

$$\operatorname{tg} \theta \in (-\infty, +\infty)$$



$$i \cdot \sin \theta$$

CIFRE SIGNIFICATIVE

100 m velocista \rightarrow 3 cifre significative

100 m "ad occhio" \rightarrow 1 cifra significativa

$m = 5$ kg 1 cifra significativa

$m = 5,0$ kg 2 cifre significative

dato1 57,3
dato2 25

somma/sottrazione

$$\begin{array}{r} 57,3 + \\ 25 \\ \hline \end{array}$$

~~82,3~~

non
significativo

82

prodotti/rapparti

$$\begin{array}{r} 57,3 \cdot 25 = 1432,5 \\ \hline = 1400 \end{array}$$

$$0,0058 = 5,8 \cdot 10^{-3}$$

$$0,0058 \text{ m} = 5,8 \cdot 10^{-3} \text{ m} = 5,8 \text{ mm}$$

1,0058 5 cifre significative !

$$c = 299792458 \frac{\text{m}}{\text{s}} \quad 9 \text{ cifre signif.} \quad !!!$$

$$\cong 3 \cdot 10^8 \frac{\text{m}}{\text{s}}$$

Quanto è alto Joe Biden?

$$\begin{aligned} h &= 5 \text{ piedi } 11'' \text{ e } \frac{5}{8}'' = 6 \text{ piedi} - \frac{3}{8}'' \\ &= \cancel{6 \text{ piedi}} \left(\frac{12''}{1 \text{ piede}} \right) - \frac{3}{8}'' = 72'' - \frac{3}{8}'' = \frac{576'' - 3''}{8} = \frac{573''}{8} \\ &= \frac{573}{8}'' = \frac{573}{8}'' \left(\frac{2,54 \text{ cm}}{1''} \right) = \frac{573 \cdot 2,54 \text{ cm}}{8} \\ &= \frac{185,1025 \text{ cm}}{181,9275 \text{ cm}} = \frac{185 \text{ cm}}{182 \text{ cm}} = \frac{1,85 \text{ m}}{1,82 \text{ cm}} \end{aligned}$$

I VETTORI

(scalare vs vettoriale)

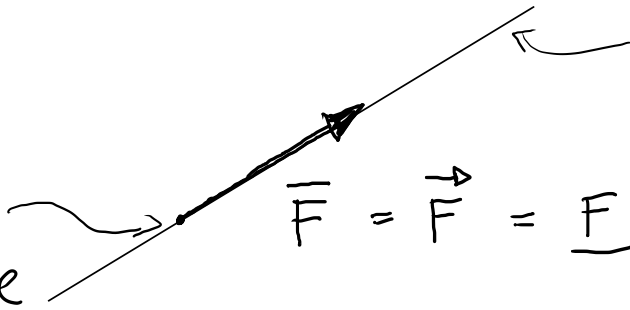
intensità o modulo

direzione

verso

retta di applicazione

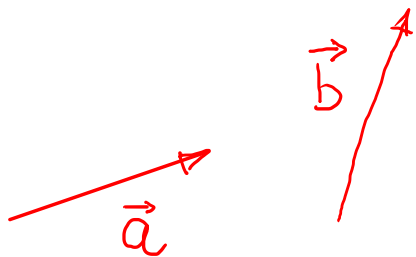
punto di
applicazione


$$\vec{F} = \vec{F} = \underline{F} = \mathbf{F}$$

modulo : $|\vec{F}| = 530 \text{ N}$
di F

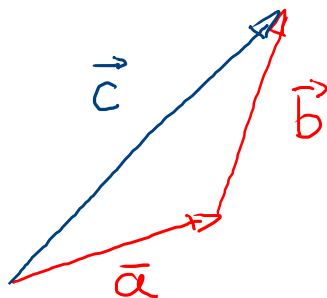
(talvolta $|\vec{F}| = F$ notazione pigra)

SOMMA DI VETTORI

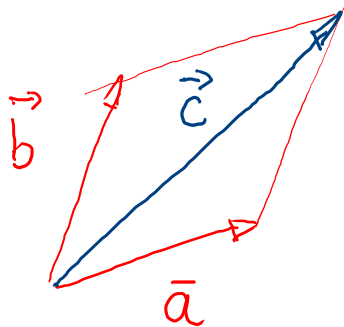


$$\vec{c} = \vec{a} + \vec{b}$$

1. punta-coda



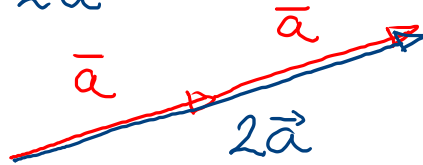
2. regola del parallelogramma



3. componenti (vedi pagine successive)

MOLTIPLICAZIONE DI UN VETTORE PER UNO SCALARE

$$\vec{a} + \vec{a} = 2\vec{a}$$

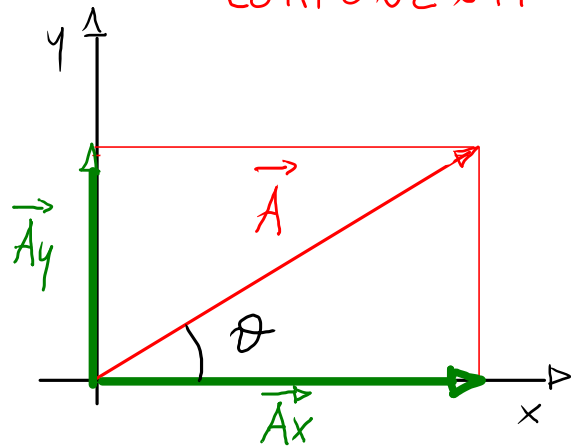


$$m \in \mathbb{R}$$
$$m\vec{a}$$

$$m\vec{a} \left\{ \begin{array}{l} |m\vec{a}| = |m| \cdot |\vec{a}| \\ \text{direzione} \quad \text{è quella di } \vec{a} \\ \text{verso} \quad \text{quello di } \vec{a} \quad m > 0 \\ \text{opposto a quello di } \vec{a} \quad m < 0 \end{array} \right.$$

valore assoluto
modulo

COMPONENTI DI UN VETTORE



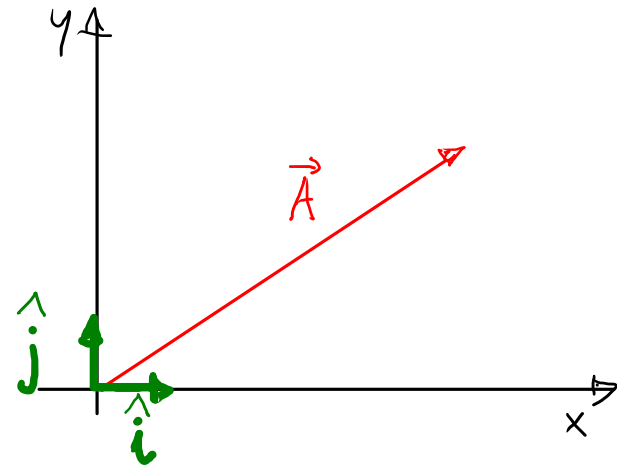
$$\vec{A} = \vec{A}_x + \vec{A}_y$$

vettoriali

\vec{A}_x e \vec{A}_y componenti di \vec{A}

$$|\vec{A}_x| = |\vec{A}| \cdot \cos \vartheta$$

$$|\vec{A}_y| = |\vec{A}| \cdot \sin \vartheta$$



$$\vec{A} = \vec{A}_x + \vec{A}_y = *$$

$$|\hat{i}| = |\hat{j}| = 1$$

versori

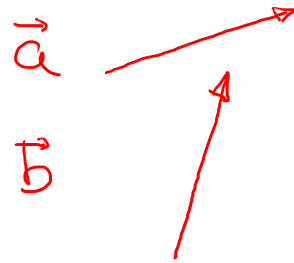
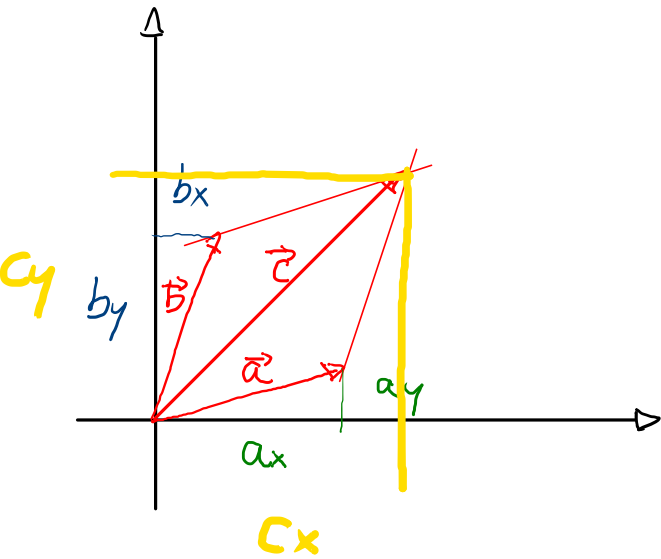
(\hat{k} per l'asse z)

$$* = |\vec{A}_x| \cdot \hat{i} + |\vec{A}_y| \cdot \hat{j}$$

$$= A_x \cdot \hat{i} + A_y \cdot \hat{j}$$

A_x e A_y sono componenti scalari.

SOMMA DI VETTORI MEDIANTE LE COMPONENTI



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

somma tra numeri

$$c_x = a_x + b_x$$

$$c_y = a_y + b_y$$

La somma di vettori \vec{e}

commutativa
associativa

$$\vec{a} + \vec{b} = \vec{b} + \vec{a}$$

$$(\vec{a} + \vec{b}) + \vec{c} = \vec{a} + (\vec{b} + \vec{c})$$

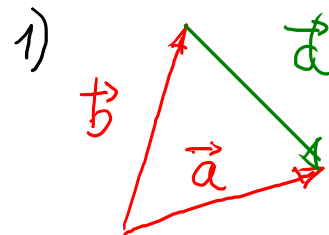
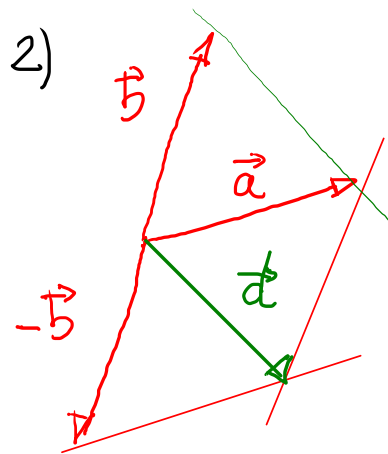
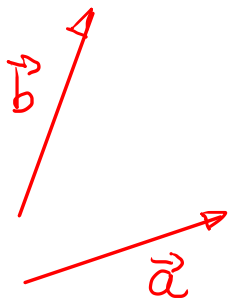
DIFFERENZA TRA VETTORI

$$-\vec{b} = (-1) \cdot \vec{b}$$

$$|-\vec{b}| = |\vec{b}|$$

direzione è quella di \vec{b}
verso opposto

$$\vec{d} = \vec{a} - \vec{b} = \vec{a} + (-\vec{b})$$



3)

$$d_x = a_x - b_x$$
$$d_y = a_y - b_y$$

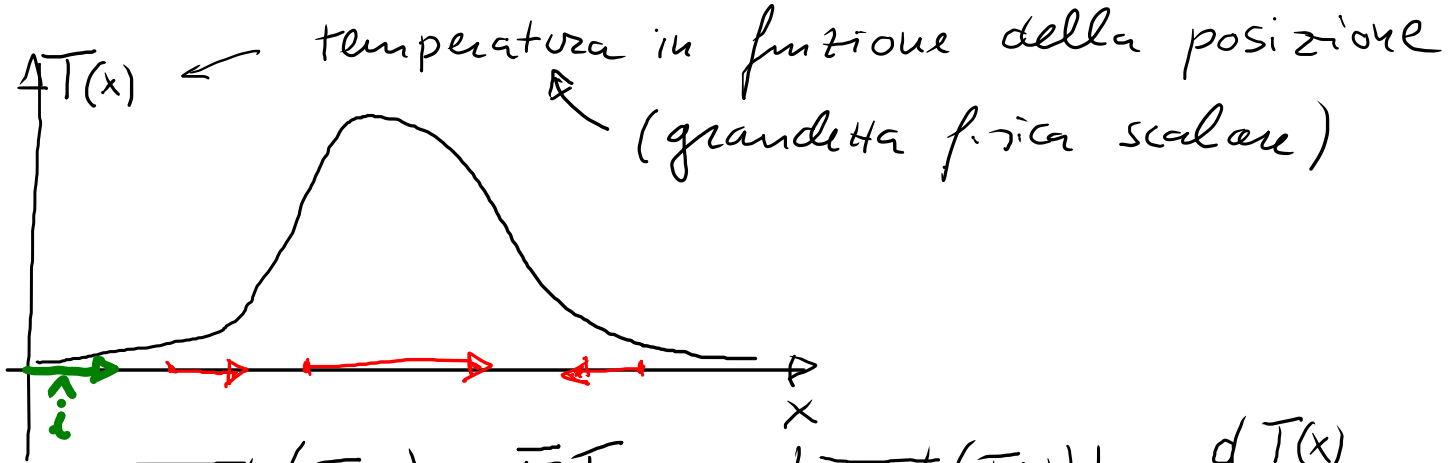
VEETTORE

GRADIENTE

(1D)



phon



$$\overline{\text{grad}}(T(x)) = \vec{\nabla} T(x)$$

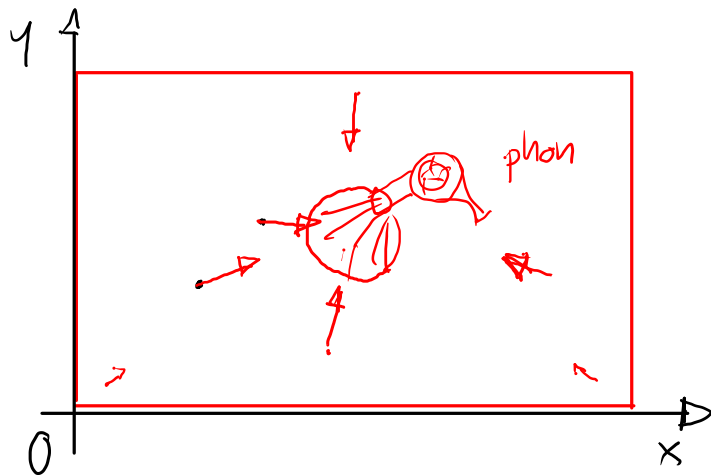
gradiente di T

$$|\overline{\text{grad}}(T(x))| = \frac{dT(x)}{dx}$$

direzione verso

$$+ \frac{dT(x)}{dx} > 0$$
$$- \frac{dT(x)}{dx} < 0$$

VE TTORE GRADIENTE 2D



$T(x, y)$

derivata parziale
rispetto ad x
(y si considera costante)

$$\text{grad } (T(x, y)) = \nabla T(x, y) = \frac{\partial T(x, y)}{\partial x} \hat{i} + \frac{\partial T(x, y)}{\partial y} \hat{j}$$

$$|\nabla T(x, y)| = \sqrt{\left[\frac{\partial T(x, y)}{\partial x} \right]^2 + \left[\frac{\partial T(x, y)}{\partial y} \right]^2}$$