Fondamenti di fisica generale

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Martedì 3 novembre 2020

11:00-13:00
(11:00-12:30)

meet.google.com/xsc-vwjs-msg

formula di Poisson: la derivata di un vettore di modulo costante è pari al prodotto vettoriale della velocità di rotazione e del vettore.

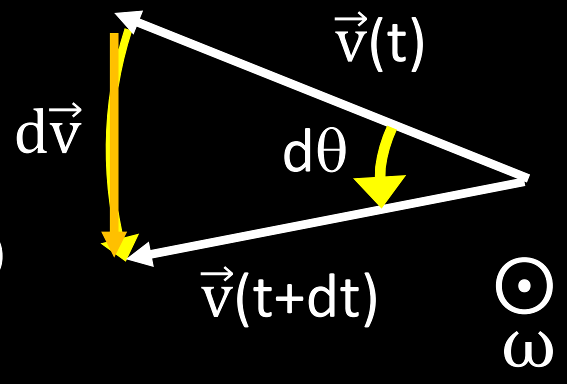
$$\frac{d\vec{v}}{dt} = (\vec{\omega} \times \vec{v})$$

vettore di modulo costante → $(\vec{v})^2 = v_x^2 + v_y^2 + v_z^2 = v^2 =$ costante → $\frac{d(\vec{v})^2}{dt} = 0$

direzione

$$\frac{d(\vec{v})^2}{dt} = \frac{d(\vec{v}\,\vec{v})}{dt} = \frac{d\vec{v}}{dt}\vec{v} + \vec{v}\frac{d\vec{v}}{dt} = 2\,\frac{d\vec{v}}{dt}\vec{v} = 0$$ → $\frac{d\vec{v}}{dt}$ e $\vec{v}$ sono perpendicolari

modulo



$$|d\vec{v}| = |\vec{v}|\; d\theta$$

$$\frac{|d\vec{v}|}{dt} = |\vec{v}|\,\frac{d\theta}{dt} = v\,\omega$$

$$\left|\frac{d\vec{v}}{dt}\right| = |\vec{v}|\;|\vec{\omega}|\,\sin\left(\frac{\pi}{2}\right)$$

verso

$$\frac{d\vec{v}}{dt} = (\vec{\omega} \times \vec{v})$$

Il versore è un vettore di modulo 1... $\frac{d\hat{u}_T}{dt} = (\vec{\omega} \times \hat{u}_T)$

MOTO VARIO

$$\vec{a} = \overrightarrow{a_T} + \overrightarrow{a_N}$$

ACCELERAZIONE

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{d(v\,\hat{u}_T)}{dt} = \frac{dv}{dt}\hat{u}_T + v\frac{d\hat{u}_T}{dt} = \frac{dv}{dt}\hat{u}_T + v(\vec{\omega}\times\hat{u}_T) = \frac{dv}{dt}\hat{u}_T + (\vec{\omega}\times\vec{v}) =$$

$$= \frac{dv}{dt}\hat{u}_T - \omega^2\vec{R} = \frac{dv}{dt}\hat{u}_T + \frac{v^2}{R}\hat{u}_N = \overrightarrow{a_T} + \overrightarrow{a_N}$$

$v = \omega\,R$

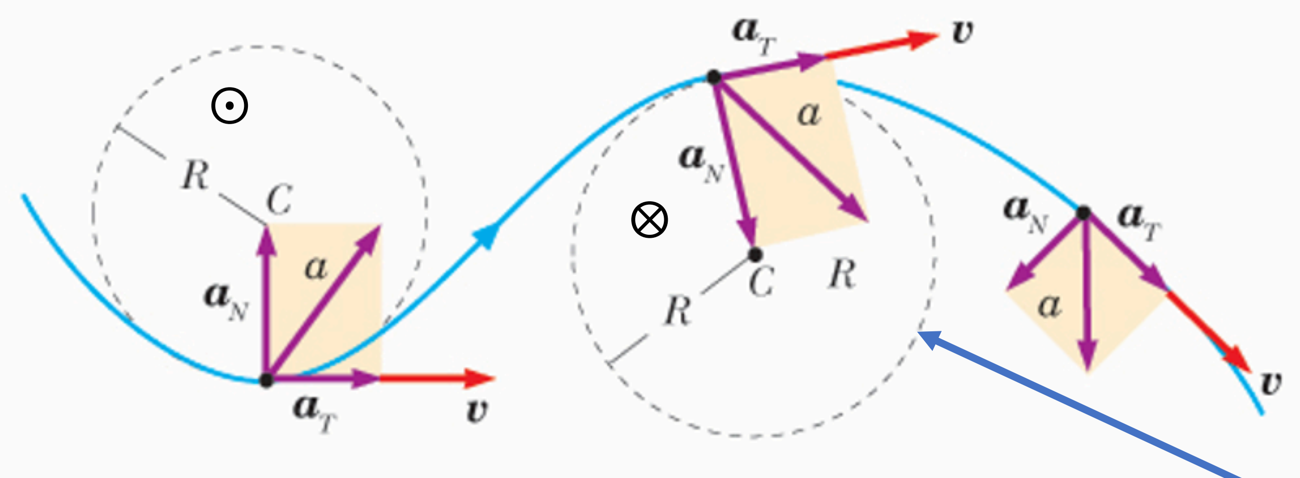


Figura 2.5
Componenti dell'accelerazione di un punto lungo una traiettoria

EdiSES
Mazzoldi, Nigro, Voci
Elementi di Fisica, Meccanica - Termodinamica
EdiSES, 2007

$\hat{u}_N$ punta al centro C

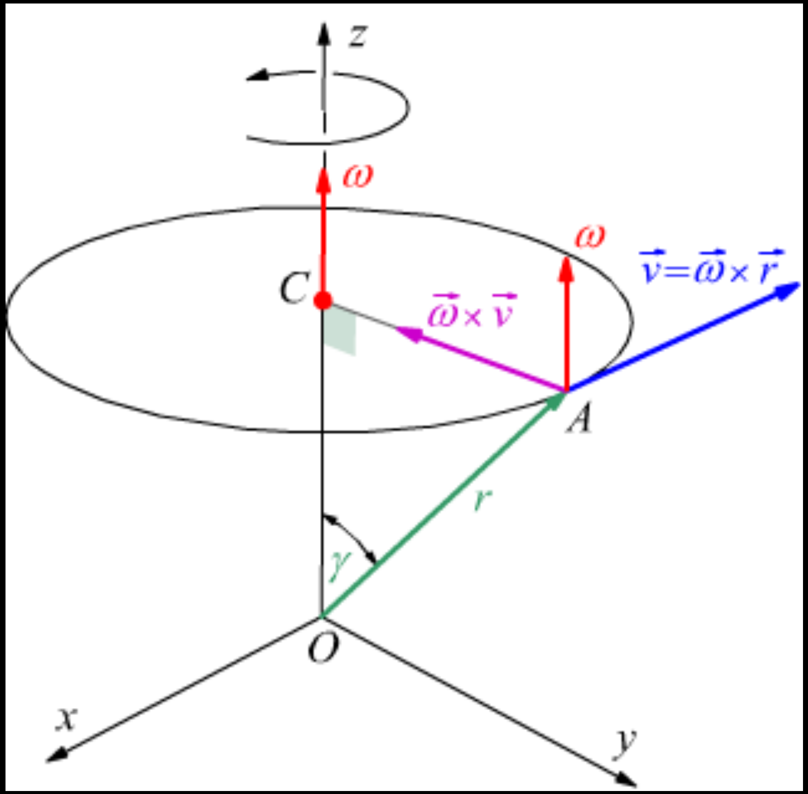
accelerazione tangenziale $\frac{dv}{dt}$ (modulo)

accelerazione normale $\frac{d\hat{u}_T}{dt}$ (direzione)

centripeta

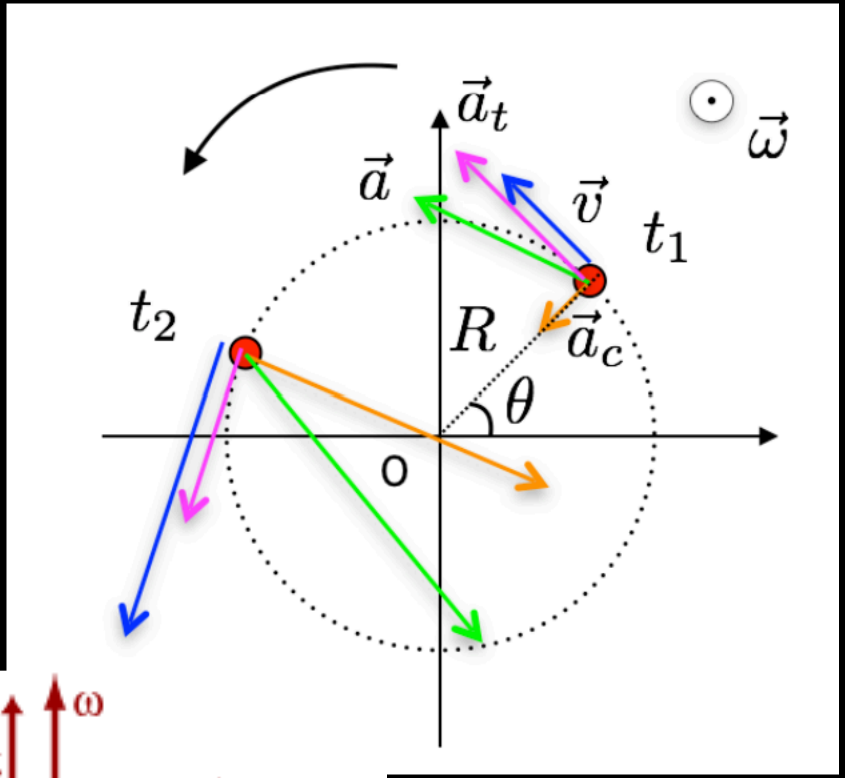
CERCHIO OSCULATORE
approssima la traiettoria nel punto di tangenza
il suo raggio R è il raggio di curvatura

MOTO CIRCOLARE NON UNIFORME

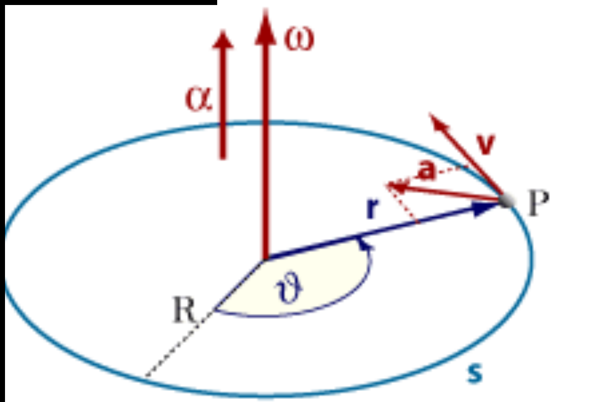


$$\boxed{\vec{v} = \vec{\omega}\times\vec{r}}$$

$$\boxed{\overrightarrow{a_N} = [\vec{\omega}\times(\vec{\omega}\times\vec{r})]}$$

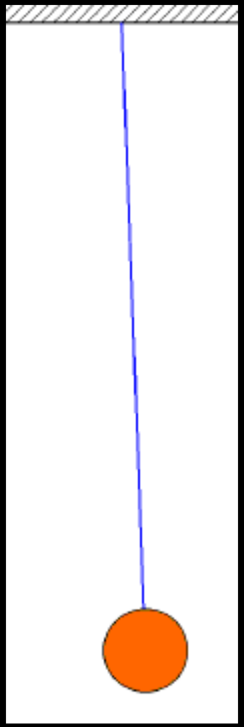


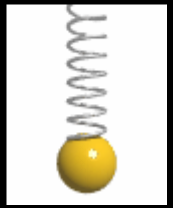
$$\vec{\alpha} = \frac{d\vec{\omega}}{dt}$$ accelerazione angolare

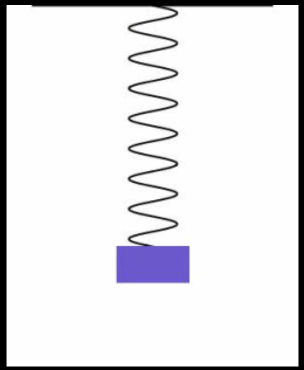


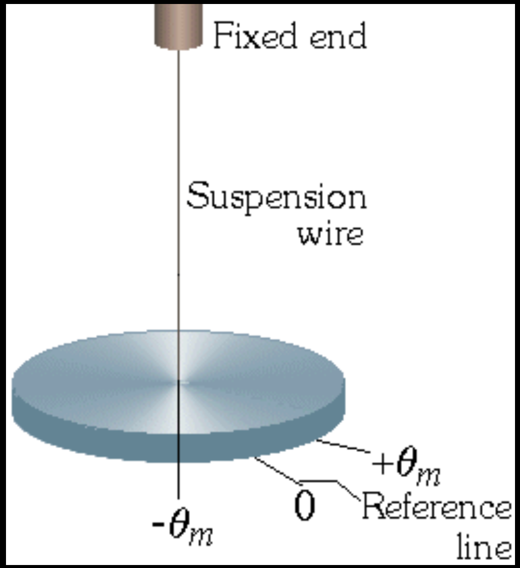
LEZ 3

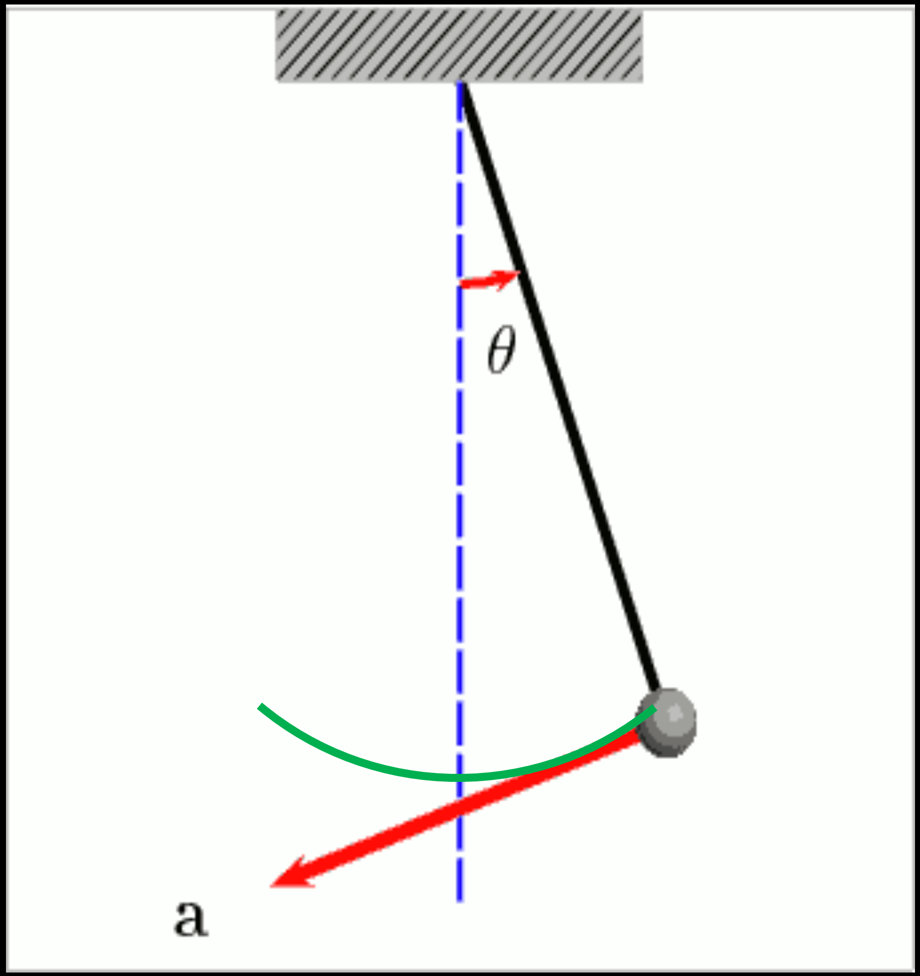
MOTO ARMONICO





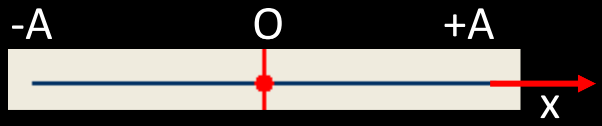




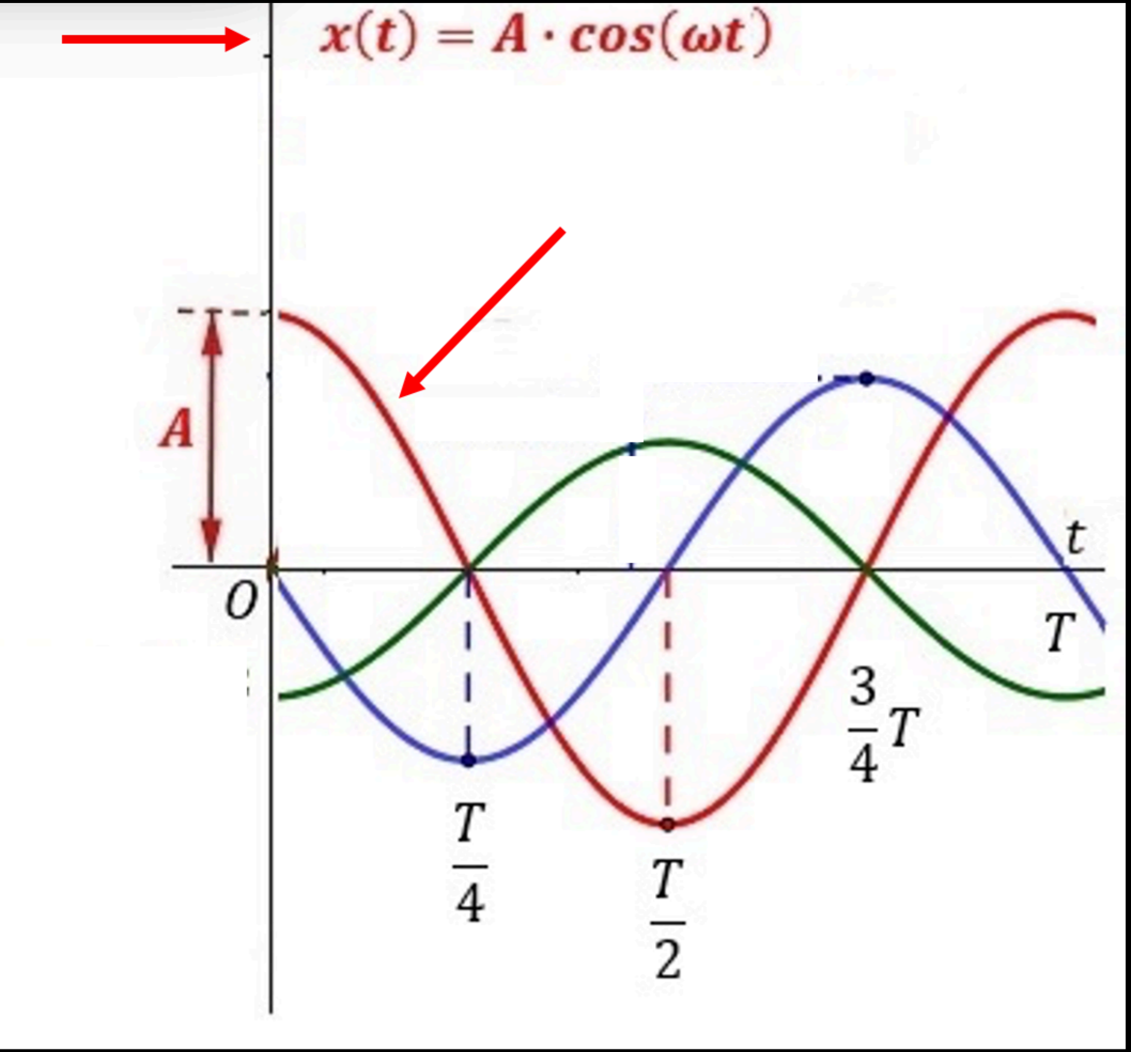


MOTO ARMONICO

POSIZIONE



se $x(0) = A$ allora $x(t) = A\cos(\omega t) = A\sin(\omega t + \pi/2)$



$$\omega = \frac{2\pi}{T}$$

$$\omega\frac{T}{4} = \frac{2\pi}{4} = \frac{\pi}{2}$$

$$\omega\frac{T}{2} = \frac{2\pi}{2} = \pi$$

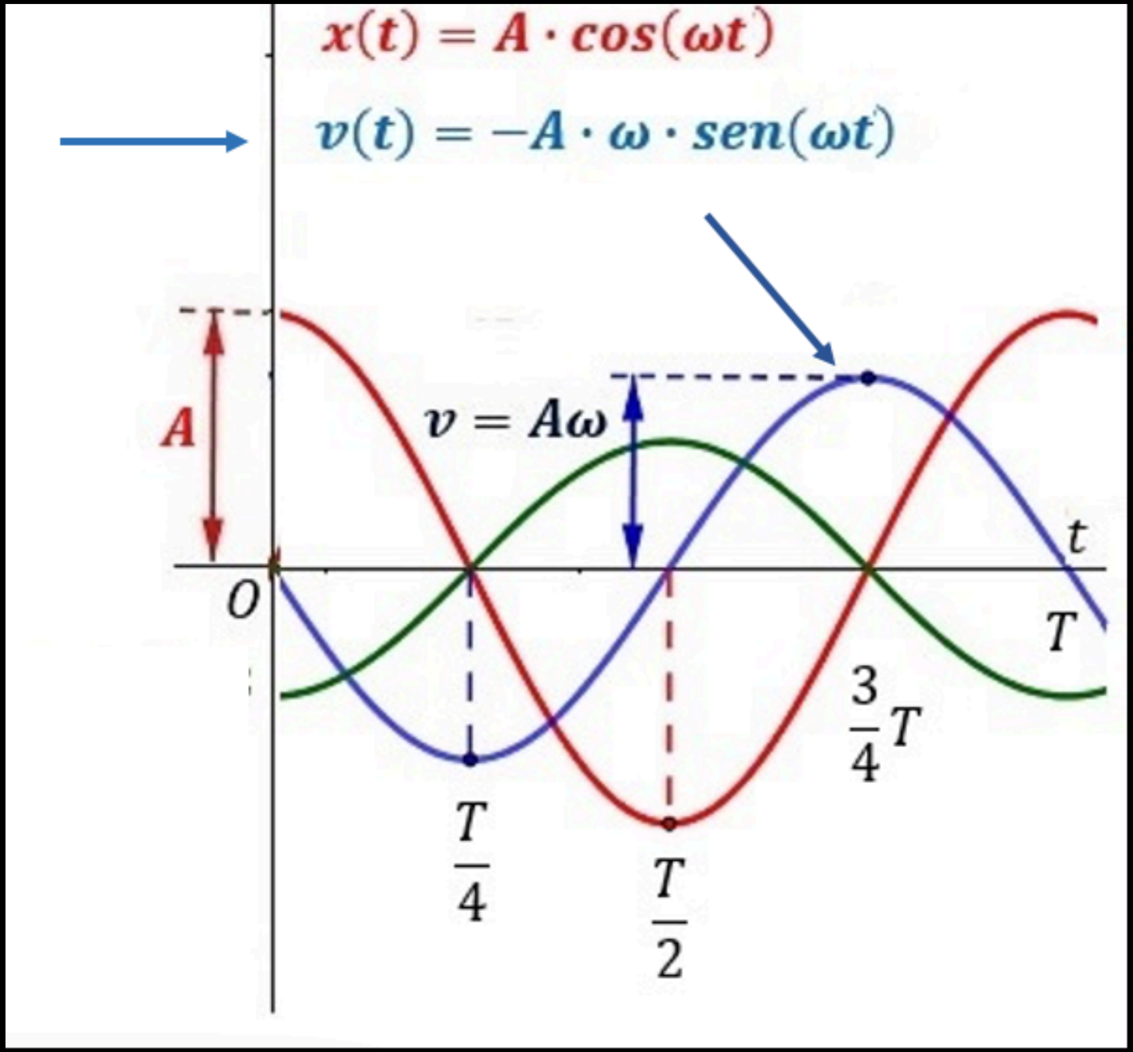
$$\omega\frac{3}{4}T = \frac{3}{4}2\pi = \frac{3}{2}\pi$$

$$\omega T = 2\pi$$

MOTO ARMONICO

VELOCITA'

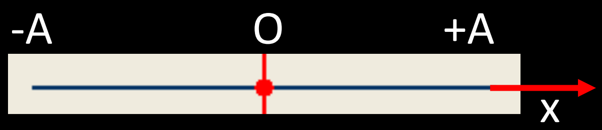
se $x(0) = A$ allora $x(t) = A \cos(\omega t)$



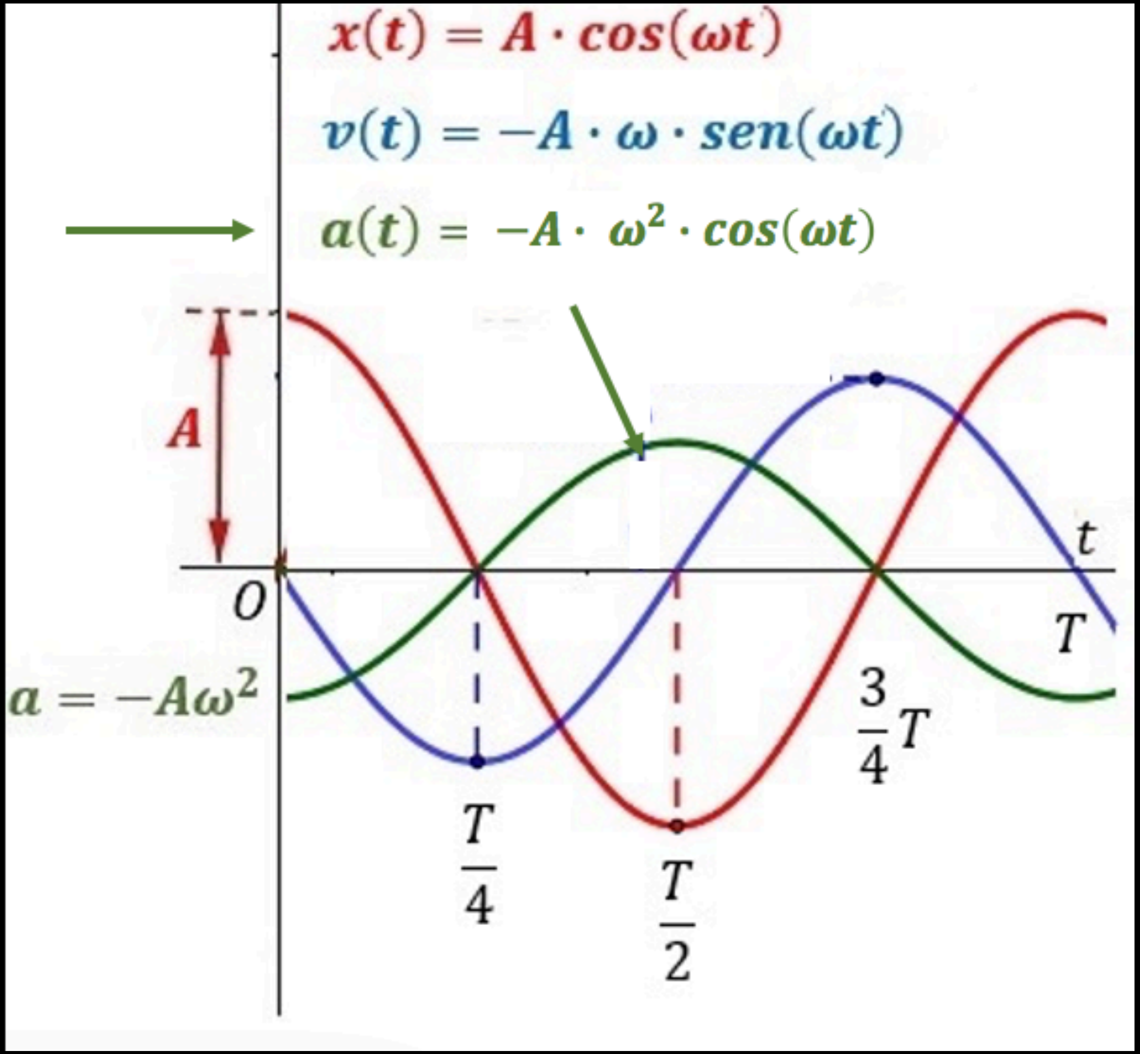
$$v(t) = \frac{dx}{dt} = -A\,\omega \sin(\omega t)$$

MOTO ARMONICO

ACCELERAZIONE



se x(0) = A allora $x(t) = A \cos(\omega t)$

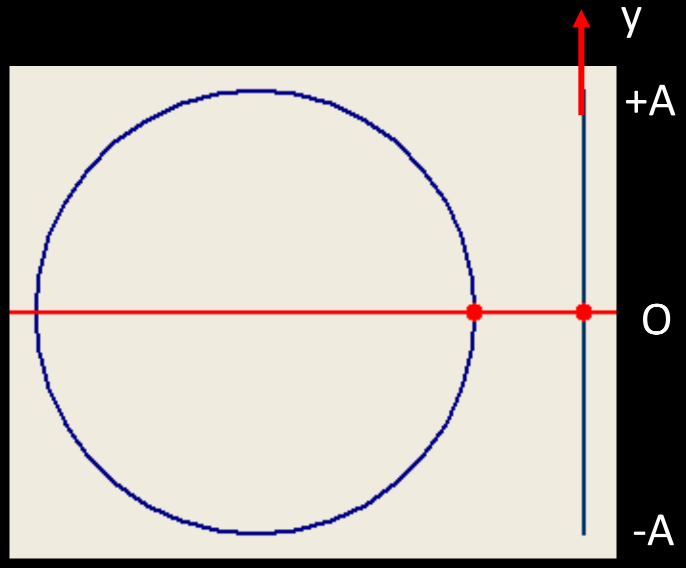


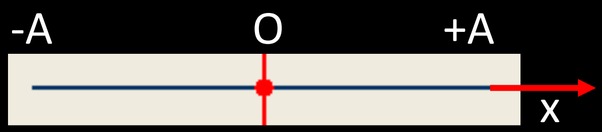
$$v(t) = \frac{dx}{dt} = -A\,\omega \sin(\omega t)$$

$$a(t) = \frac{dv}{dt} = -A\,\omega^2 \cos(\omega t)$$

https://www.geogebra.org/m/ncGtUxze

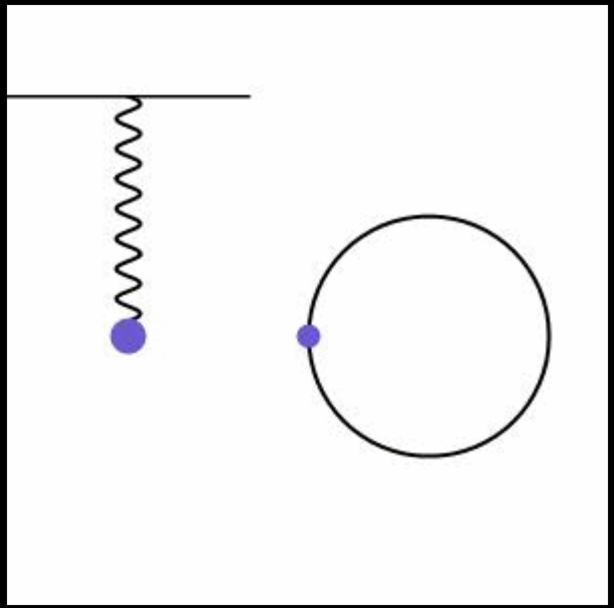
MOTO ARMONICO E MOTO CIRCOLARE

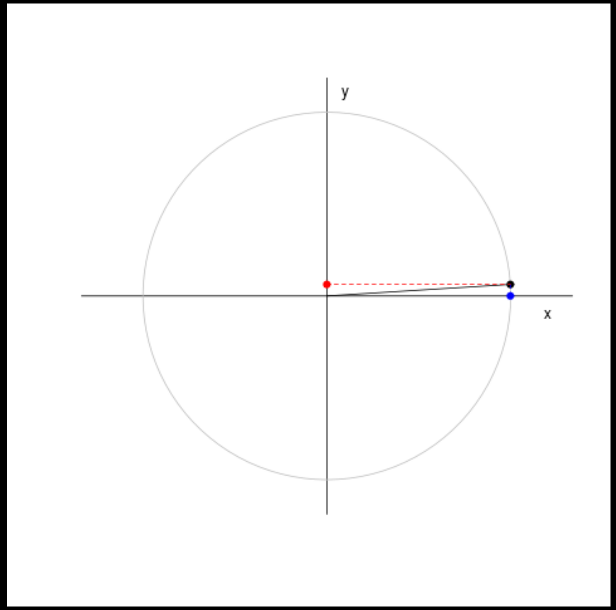


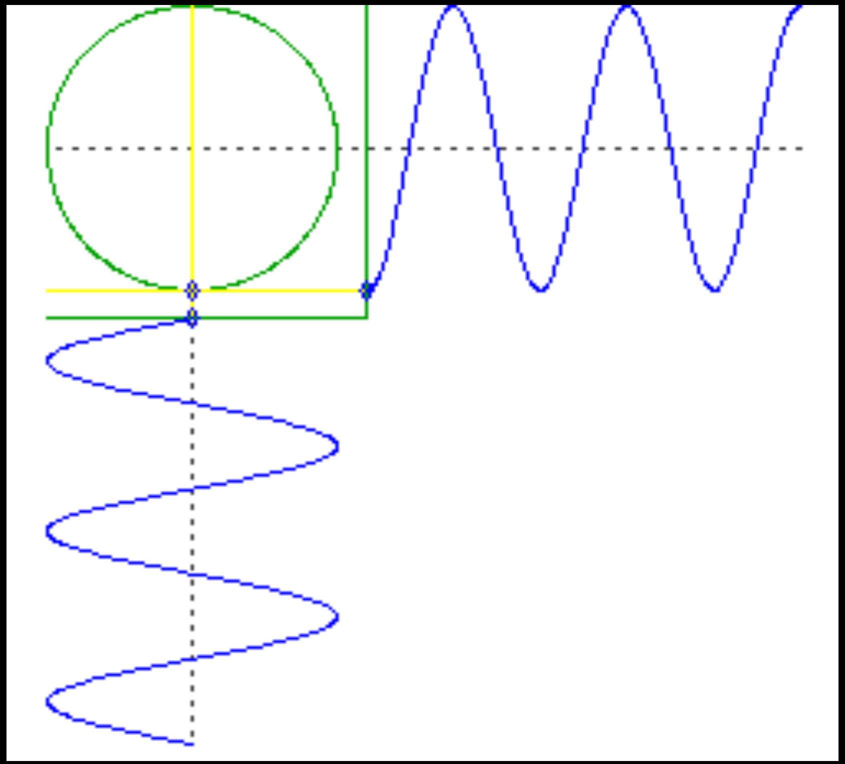


ω pulsazione $2\pi/T$

ω velocità angolare v/R







MOTO ARMONICO

- $x(t) = A\cos(\omega t + \varphi)$
- $v_x(t) = \frac{dx}{dt} = -A\omega\sin(\omega t + \varphi)$
- $a_x(t) = \frac{dv_x}{dt} = \frac{d}{dt}\frac{dx}{dt} = \frac{d^2x}{dt^2} = -A\omega^2\cos(\omega t + \varphi) = -\omega^2 x(t)$
- $\frac{d^2x}{dt^2} + \omega^2 x = 0$

$$\frac{d^2u(t)}{dt^2} + \omega^2 u(t) = 0 \leftrightarrow u(t) \text{ armonica di periodo } T = \frac{2\pi}{\omega}$$

- $y(t) = A\sin(\omega t + \varphi)$
- $v_y(t) = \frac{dy}{dt} = A\omega\cos(\omega t + \varphi)$
- $a_y(t) = \frac{dv_y}{dt} = \frac{d}{dt}\frac{dy}{dt} = \frac{d^2y}{dt^2} = -A\omega^2\sin(\omega t + \varphi) = -\omega^2 y(t)$
- $\frac{d^2y}{dt^2} + \omega^2 y = 0$

MOTO ARMONICO E MOTO CIRCOLARE UNIFORME

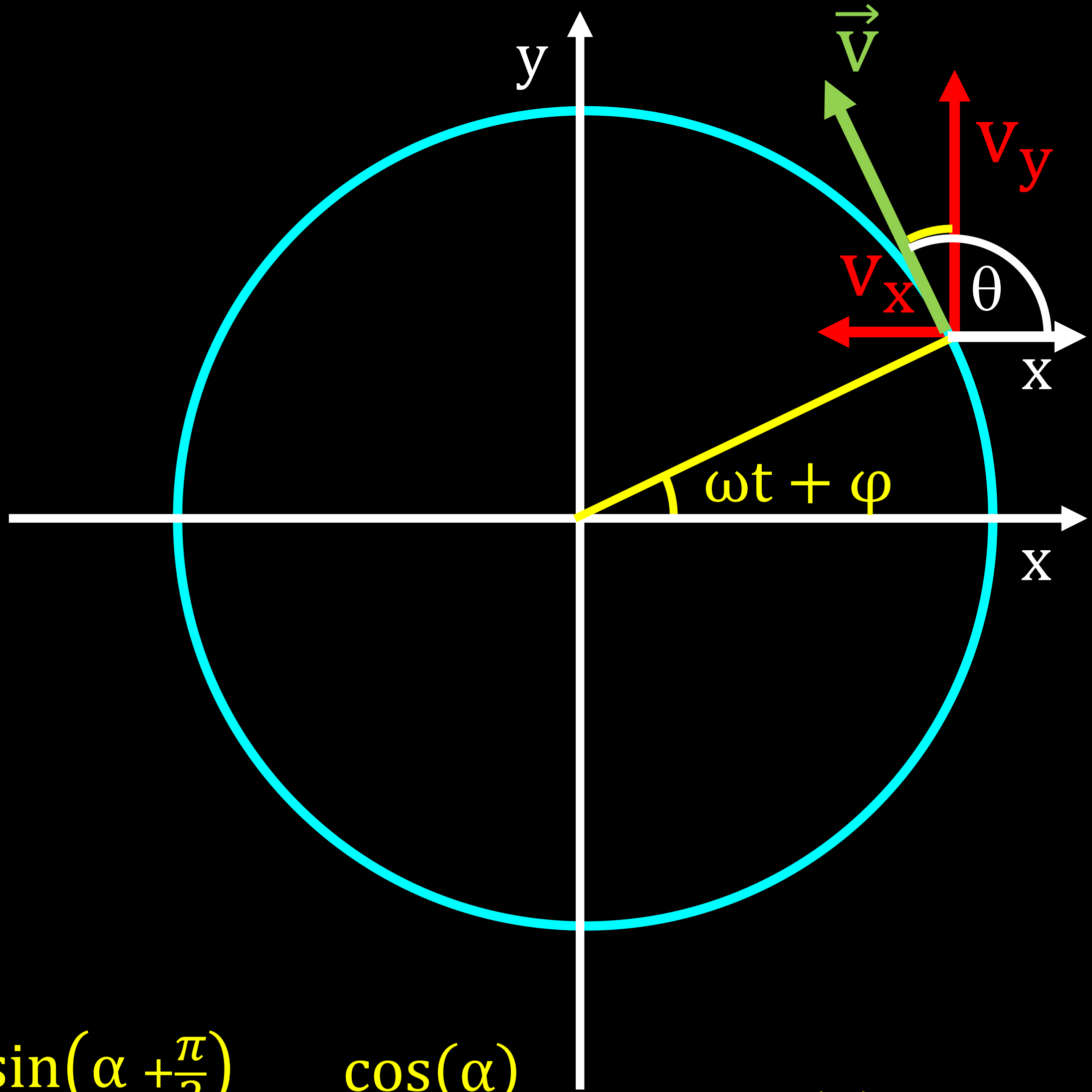
- $x(t) = R\cos(\omega t + \varphi)$
- $v_x(t) = -R\omega \sin(\omega t + \varphi)$
- $a_x(t) = -R\omega^2 \cos(\omega t + \varphi)$
- $y(t) = R\sin(\omega t + \varphi)$
- $v_y(t) = R\omega \cos(\omega t + \varphi)$
- $a_y(t) = -R\omega^2 \sin(\omega t + \varphi)$

- $x^2(t) + y^2(t) = [R\cos(\omega t + \varphi)]^2 + [R\sin(\omega t + \varphi)]^2 = R^2$
- $v^2(t) = v_x^2(t) + v_y^2(t) = [-R\omega \sin(\omega t + \varphi)]^2 + [R\omega\cos(\omega t + \varphi)]^2 = [\omega R]^2$
- $a^2(t) = a_x^2(t) + a_y^2(t) = [-R\omega^2 \cos(\omega t + \varphi)]^2 + [-R\omega^2 \sin(\omega t + \varphi)]^2 = [\omega^2 R]^2$

MOTO ARMONICO E MOTO CIRCOLARE UNIFORME

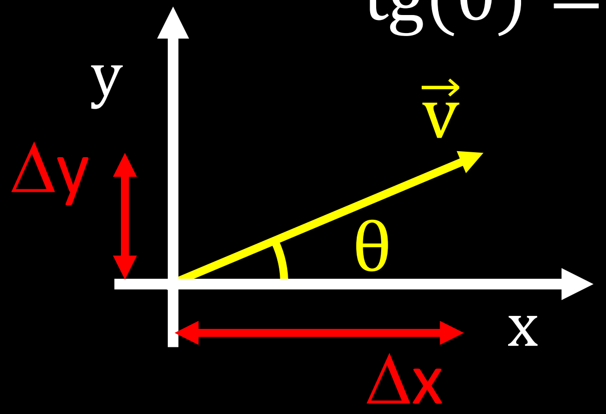
- $x(t) = R\cos(\omega t + \varphi)$
- $v_x(t) = -R\omega\sin(\omega t + \varphi)$

- $y(t) = R\sin(\omega t + \varphi)$
- $v_y(t) = R\omega\cos(\omega t + \varphi)$



$$\frac{v_y}{v_x} = \frac{R\omega\cos(\omega t + \varphi)}{-R\omega\sin(\omega t + \varphi)} = -\operatorname{cotg}(\omega t + \varphi)$$

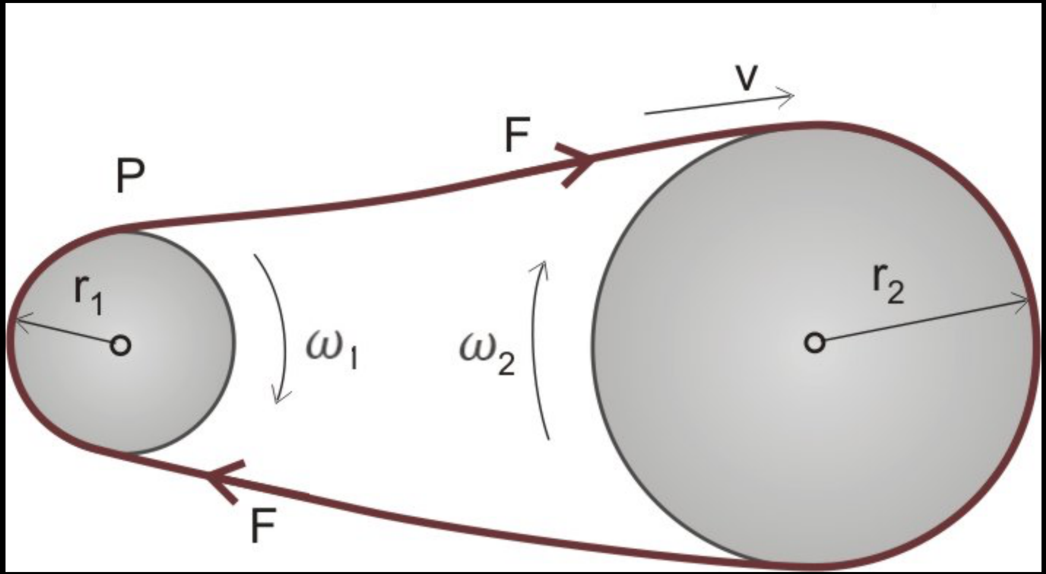
$$\operatorname{tg}(\theta) = \frac{\Delta y}{\Delta x} = \frac{dy}{dx} = \frac{dy}{dt}\,\frac{dt}{dx} = \frac{v_y}{v_x}$$

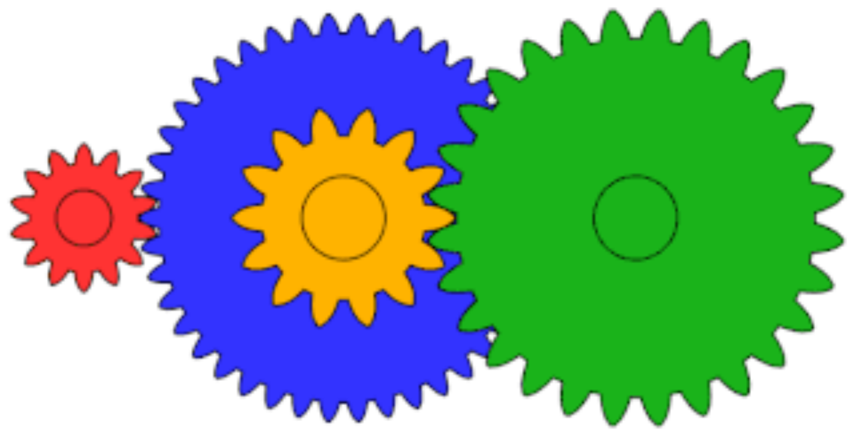


$$\operatorname{tg}\left(\alpha + \frac{\pi}{2}\right) = \frac{\sin\left(\alpha + \frac{\pi}{2}\right)}{\cos\left(\alpha + \frac{\pi}{2}\right)} = \frac{\cos(\alpha)}{-\sin(\alpha)} = -\operatorname{cotg}(\alpha)$$

MOTO CIRCOLARE cinghia/catena

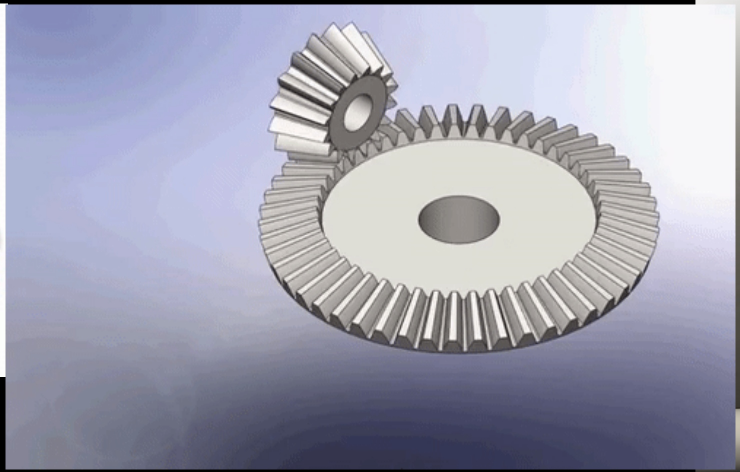
TRASMISSIONE MOTO

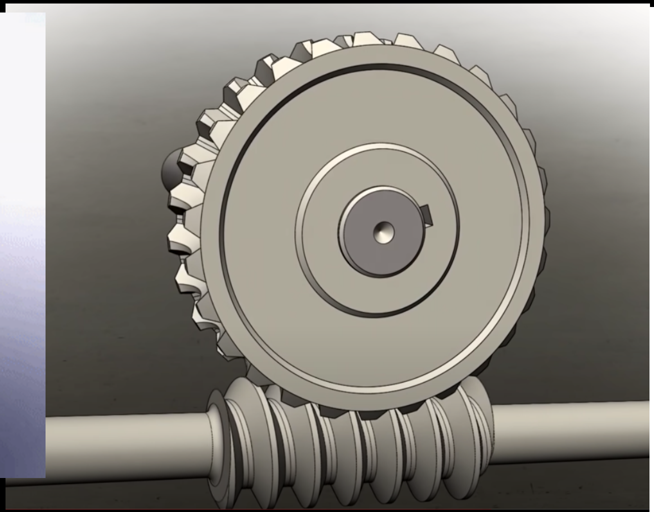


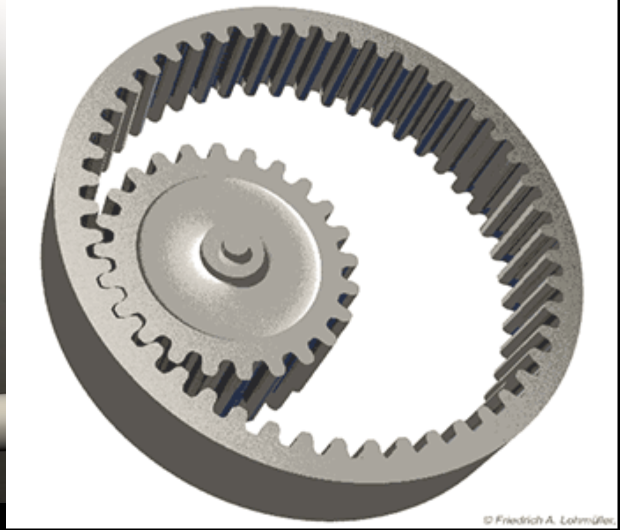


$$v_1 = \omega_1 r_1 = v_2 = \omega_2 r_2$$

ingranaggi



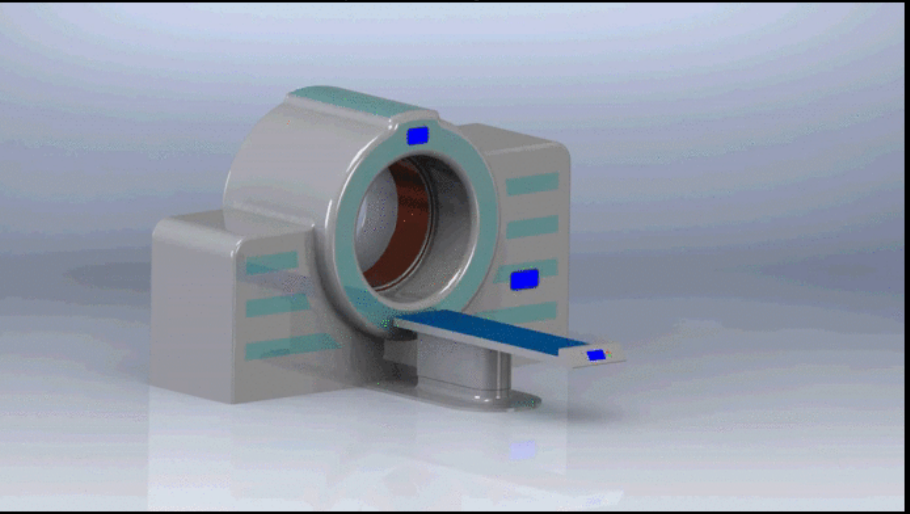




MOTO LINEARE - MOTO CIRCOLARE

https://gifer.com/en/Fb9T

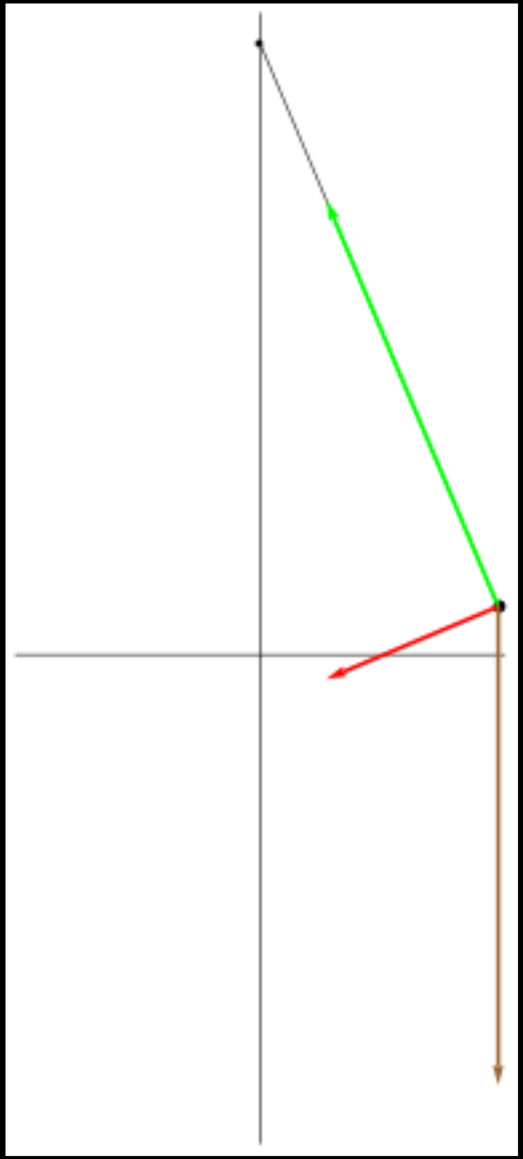
https://www.youtube.com/watch?v=8HX8jyCg6eg

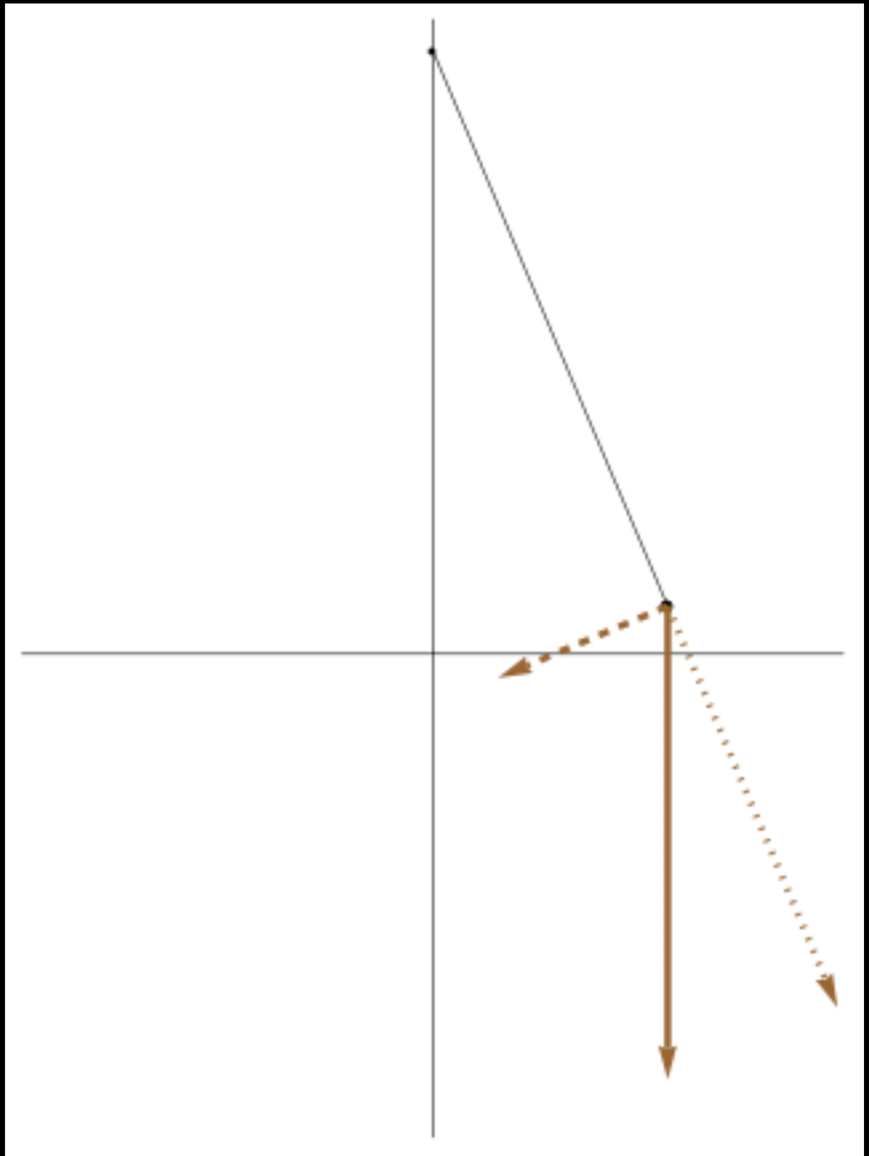


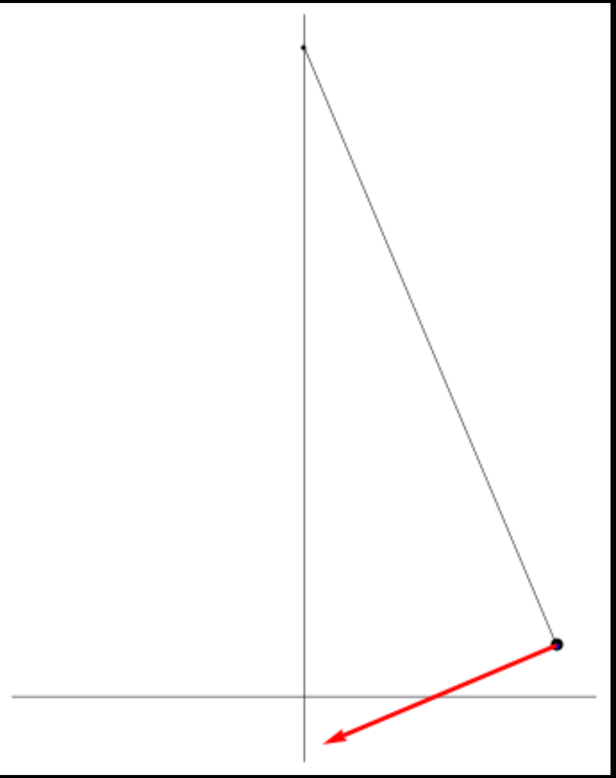
https://grabcad.com/library/mri-magnetic-resonance-imaging-1

MOTO ARMONICO

PENDOLO







Fondamenti di fisica generale

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Lunedì 9 novembre 2020
sincrona: correzione esercizi del giovedì
15:00-17:00
(15:00-16:30)
meet.google.com/xsc-vwjs-msg