Fondamenti di fisica generale

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Mercoledì 2 novembre 2022

12:05-13:00

in AULA

LEZ 5

MOTO CIRCOLARE

VELOCITA'

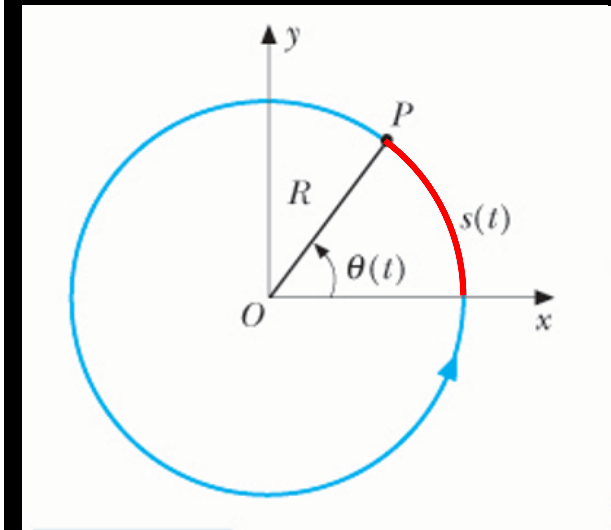
s(t) = R θ(t)

ascissa curvilinea

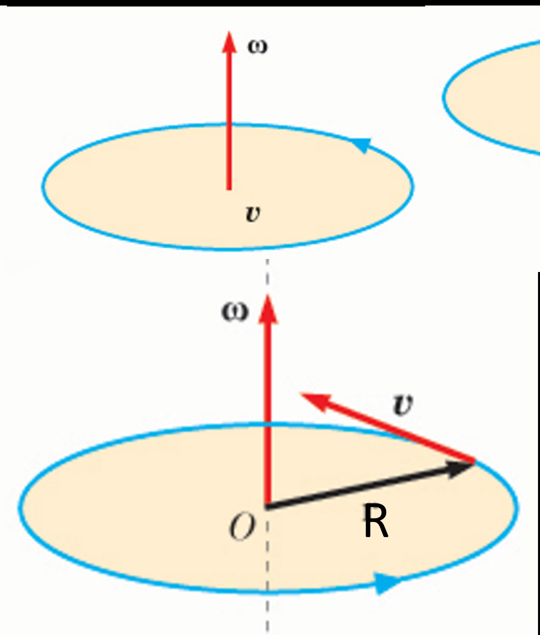
$$v(t) = \frac{ds}{dt} = \frac{d(R\theta)}{dt} = R\frac{d\theta}{dt} = R\,\omega$$

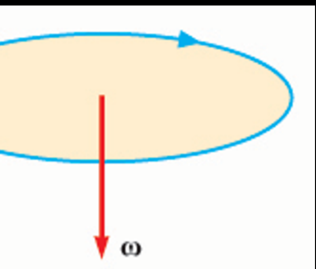
velocità tangenziale (derivata <-> tangente alla curva)

velocità angolare



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

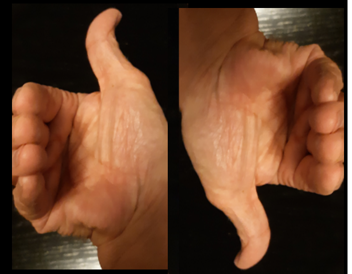


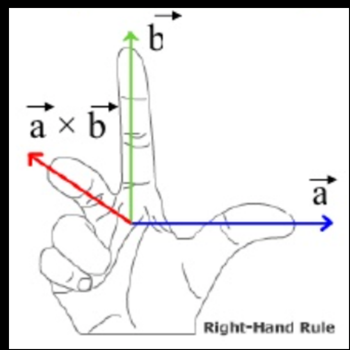


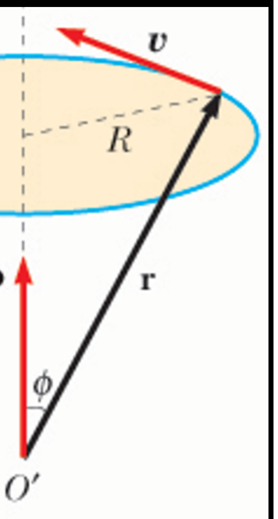
$$\vec{v} = \vec{\omega} \times \vec{r}$$

$$|\vec{v}| = \omega\, r \sin\phi$$

$$|\vec{v}| = \omega R$$







r sinϕ = R

MOTO VARIO

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

ACCELERAZIONE

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{d(v\,\hat{u}_T)}{dt} = \frac{dv}{dt}\hat{u}_T + v\frac{d\hat{u}_T}{dt} = \cdots = \frac{dv}{dt}\hat{u}_T - \omega^2\vec{R} = \frac{dv}{dt}\hat{u}_T + \frac{v^2}{R}\hat{u}_N = \overrightarrow{a_T} + \overrightarrow{a_N}$$

$v = \omega R \rightarrow \omega = v/R$

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

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

centripeta $-\omega^2\vec{R} = \frac{v^2}{R}\hat{u}_N$

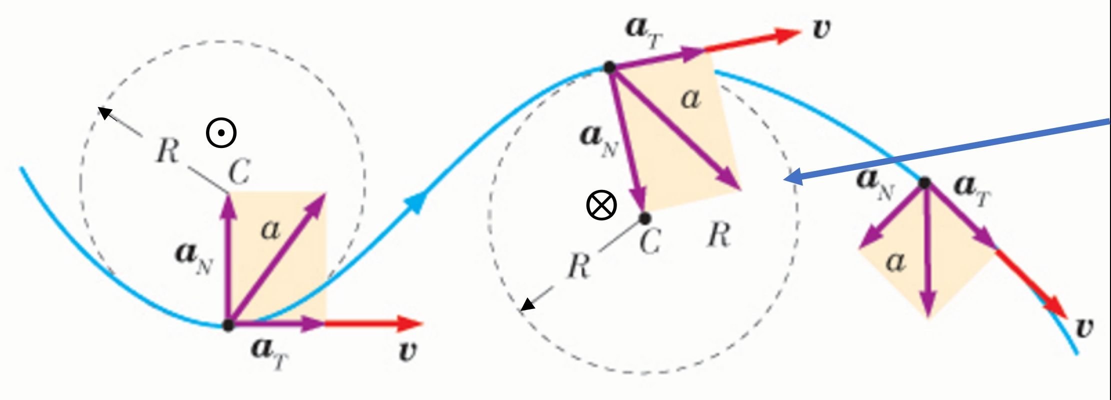


Figura 2.5
Componenti dell'accelerazione di un punto lungo una traiettoria piana.

Mazzoldi, Nigro, Voci
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EdiSES, 2007

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

se non c'è accelerazione tangenziale
il moto è uniforme

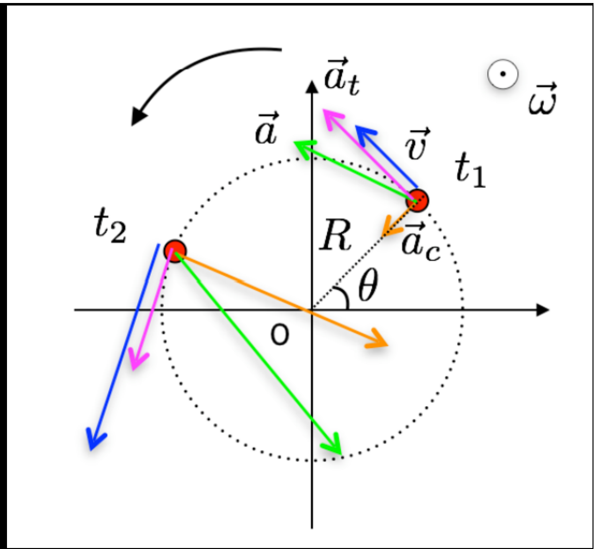
se non c'è accelerazione centripeta
il moto è rettilineo

MOTO CIRCOLARE UNIFORMEMENTE ACCELERATO

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

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

$$\vec{a}_N = -\omega^2 \vec{R}$$



Un punto si muove di moto circolare.

Parte da fermo con accelerazione angolare α fino a raggiungere la velocità angolare $\omega(t)$.

Quale angolo $\theta(t)$ ha percorso?

α costante: moto circolare uniformemente accelerato

$\alpha(t) = d\omega/dt = \alpha$ $\quad d\omega = \alpha\, dt$ $\quad \int_{\omega_0}^{\omega(t)} d\omega = \int_0^t \alpha\, dt$ $\quad \omega(t) - \omega_0 = \alpha\, t$

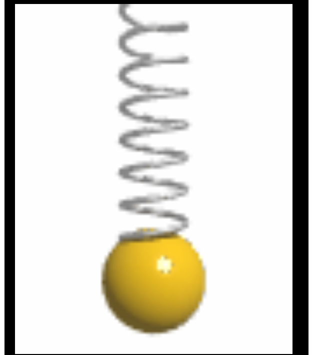
$\omega(t) = \omega_0 + \alpha\, t$

$\omega(t) = d\theta/dt$ $\quad d\theta = \omega(t)\, dt$ $\quad \int_{\vartheta_0}^{\vartheta(t)} d\theta = \int_0^t \omega(t)\, dt = \int_0^t (\omega_0 + \alpha\, t)\, dt$

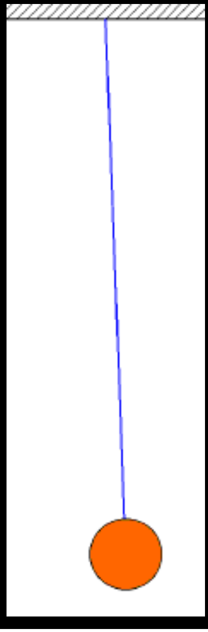
$\theta(t) - \theta_0 = \omega_0\, t + ½\, \alpha\, t^2$

$\theta(t) = \theta_0 + \omega_0\, t + ½\, \alpha\, t^2$

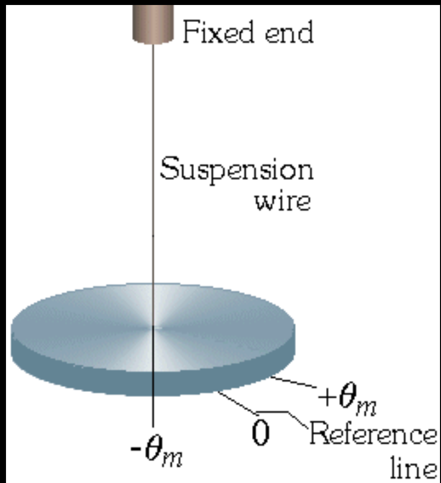
MOTO ARMONICO



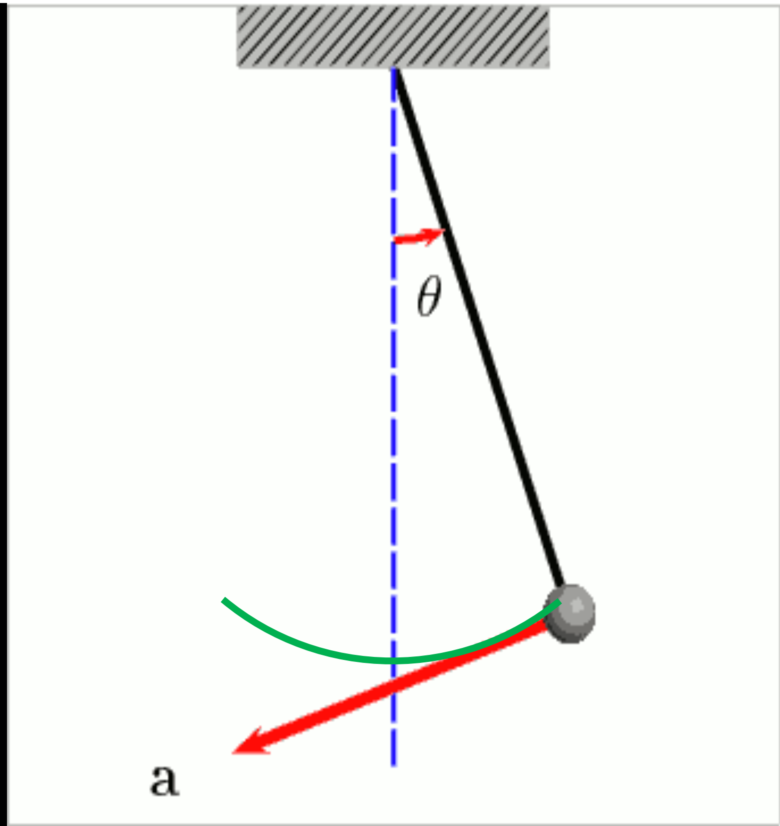
molla



pendolo



pendolo torsionale



traiettoria circolare

velocità tangente alla traiettoria

accelerazione tangenziale e centripeta

UN BREVE RIPASSO ?

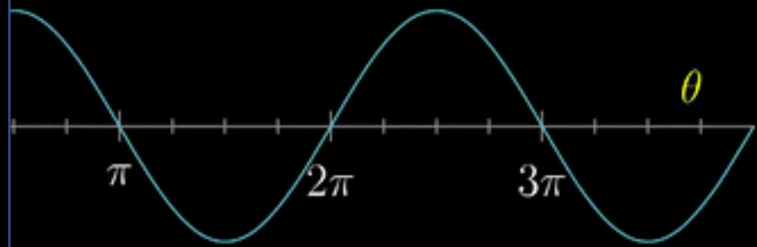
DERIVATE

$$y(x) = \sin(x) \rightarrow \frac{dy}{dx} = \cos(x)$$

$$y(x) = \cos(x) \rightarrow \frac{dy}{dx} = -\sin(x)$$

$x(\vartheta) = \cos(\vartheta)$

$-\sin(\vartheta)$



funzione armonica

$$x(t) = A\sin(\omega t + \varphi) \rightarrow \frac{dx}{dt} = A\,\frac{d\sin(\omega t + \varphi)}{d(\omega t + \varphi)}\,\frac{d(\omega t + \varphi)}{dt} = A\,\omega\cos(\omega t + \varphi)$$

$$y(x) = f[g(x)] \rightarrow \frac{dy}{dx} = \frac{df}{dg} \times \frac{dg}{dx}$$

$$x(t) = A\cos(\omega t + \varphi) \rightarrow \frac{dx}{dt} = A\,\frac{d\cos(\omega t + \varphi)}{d(\omega t + \varphi)}\,\frac{d(\omega t + \varphi)}{dt} = -A\,\omega\sin(\omega t + \varphi)$$

MOTO ARMONICO

- $x(t) = A\cos(\omega t + \varphi)$
- $v(t) = \frac{dx}{dt} = -A\omega\sin(\omega t + \varphi)$
- $a(t) = \frac{dv}{dt} = \frac{d}{dt}\frac{dx}{dt} = \frac{d^2x}{dt^2} = -A\omega^2\cos(\omega t + \varphi) = -\omega^2 x(t)$
- $\frac{d^2x}{dt^2} + \omega^2 x = 0$

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

dopo un periodo T…

$$[\omega(t + T) + \varphi] = [\omega t + \varphi] + 2\pi$$

$$\omega T = 2\pi$$

- $x(t) = A\sin(\omega t + \varphi)$
- $v(t) = \frac{dx}{dt} = A\omega\cos(\omega t + \varphi)$
- $a(t) = \frac{dv}{dt} = \frac{d}{dt}\frac{dx}{dt} = \frac{d^2x}{dt^2} = -A\omega^2\sin(\omega t + \varphi) = -\omega^2 x(t)$
- $\frac{d^2x}{dt^2} + \omega^2 x = 0$

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

pulsazione ↑ (ω) frequenza ↑ (f)

Fondamenti di fisica generale

adalberto.sciubba@uniroma1.it

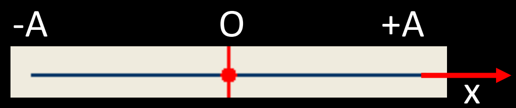
Mercoledì 2 novembre 2022

14:00-15:00

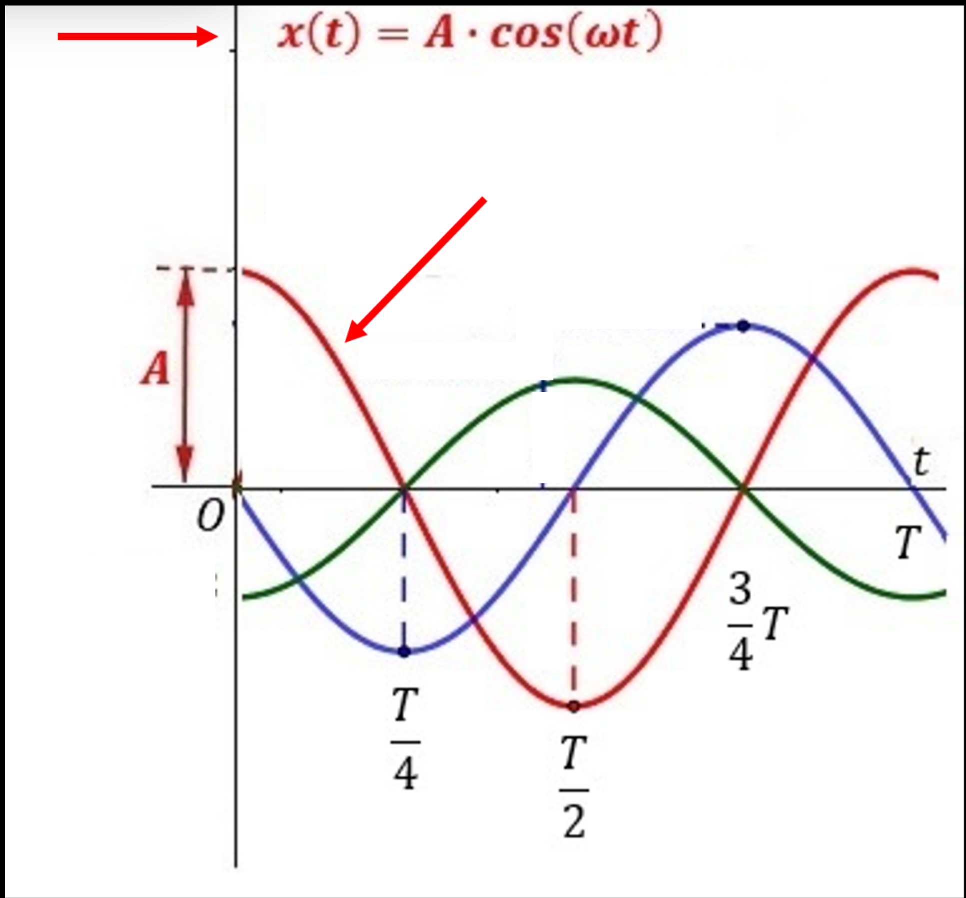
asincrona **ett-wttu-agt**

MOTO ARMONICO

POSIZIONE



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



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

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

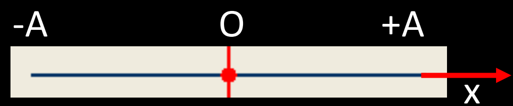
$$\omega\frac{T}{2} = \frac{2\pi}{2} = \pi$$

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

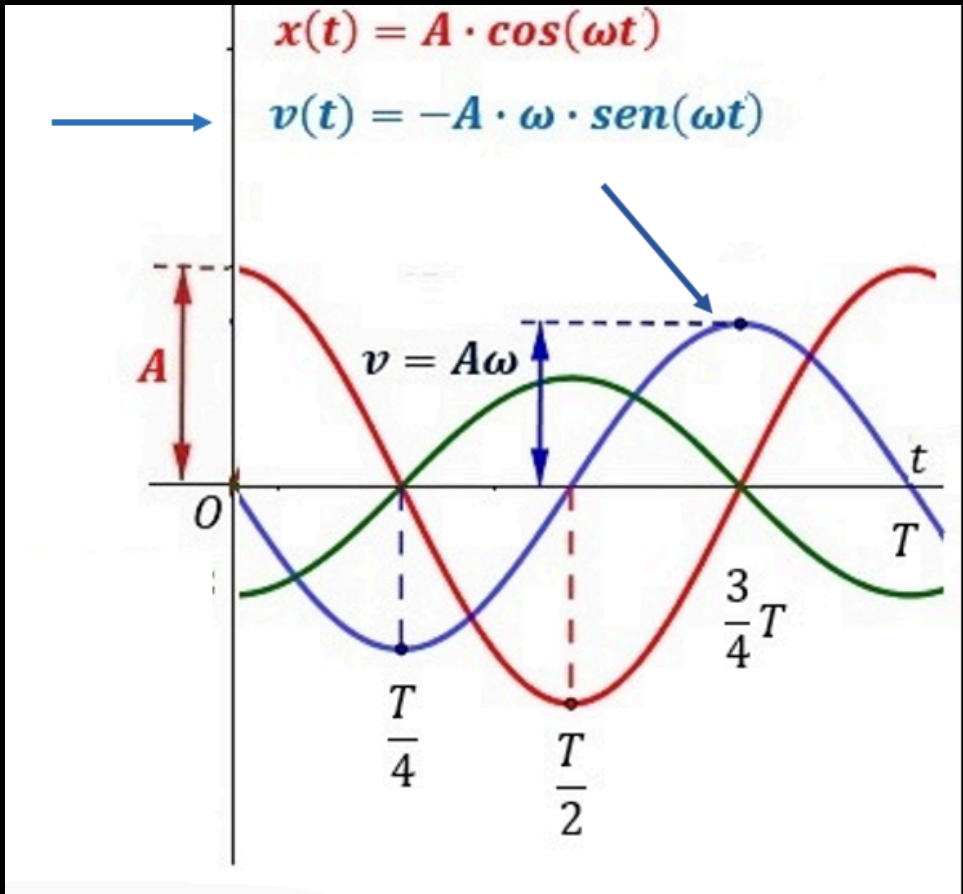
$$\omega T = 2\pi$$

MOTO ARMONICO

VELOCITA'



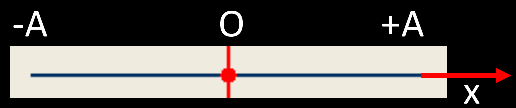
se x(0) = A allora $x(t) = A\cos(\omega t)$



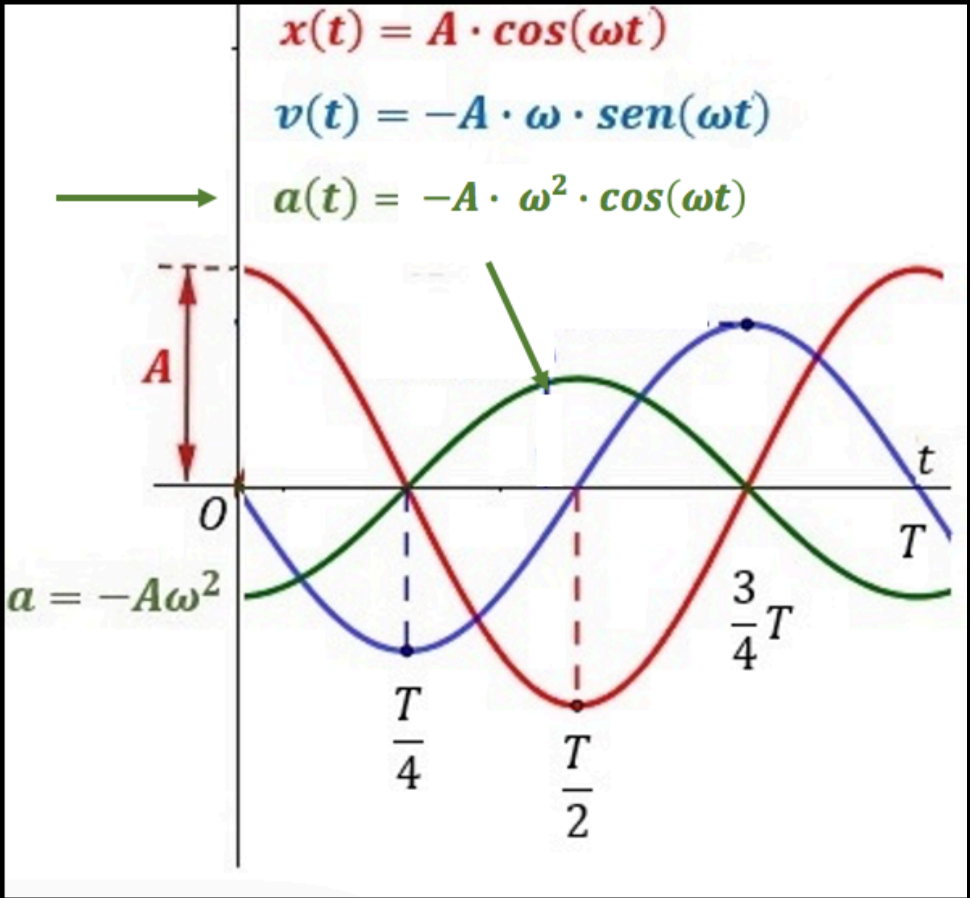
$$v(t) = \frac{dx}{dt} = -A\,\omega\,\sin(\omega t)$$

MOTO ARMONICO

ACCELERAZIONE



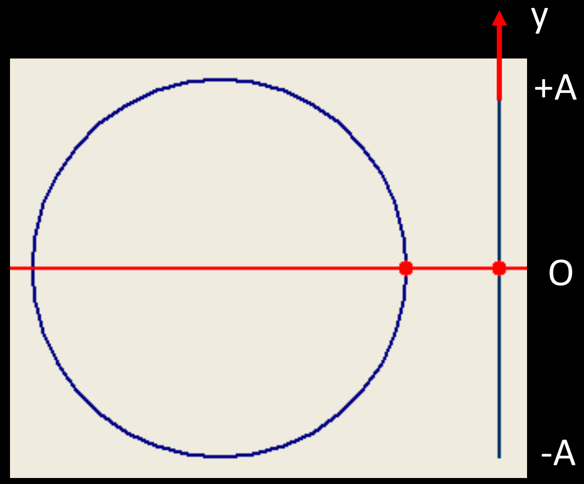
se $x(0) = A$ allora $x(t) = A\cos(\omega t)$

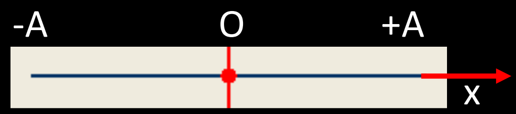


$$v(t) = \frac{dx}{dt} = -A\,\omega\,\sin(\omega t)$$

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

MOTO ARMONICO

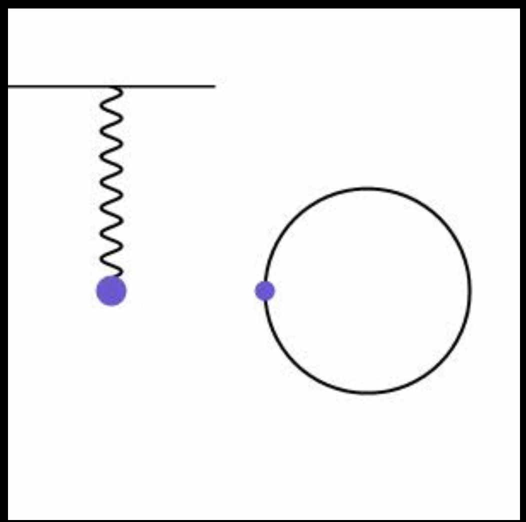


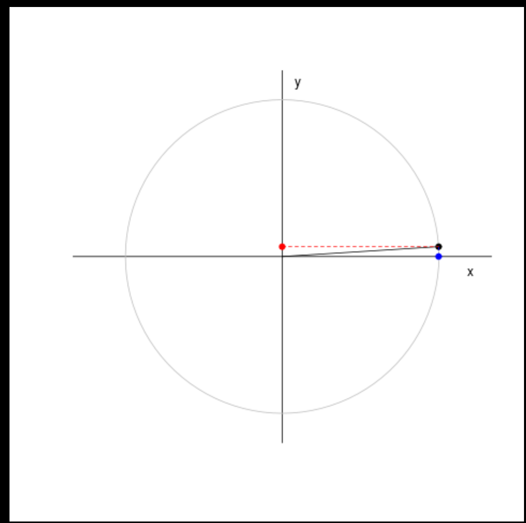


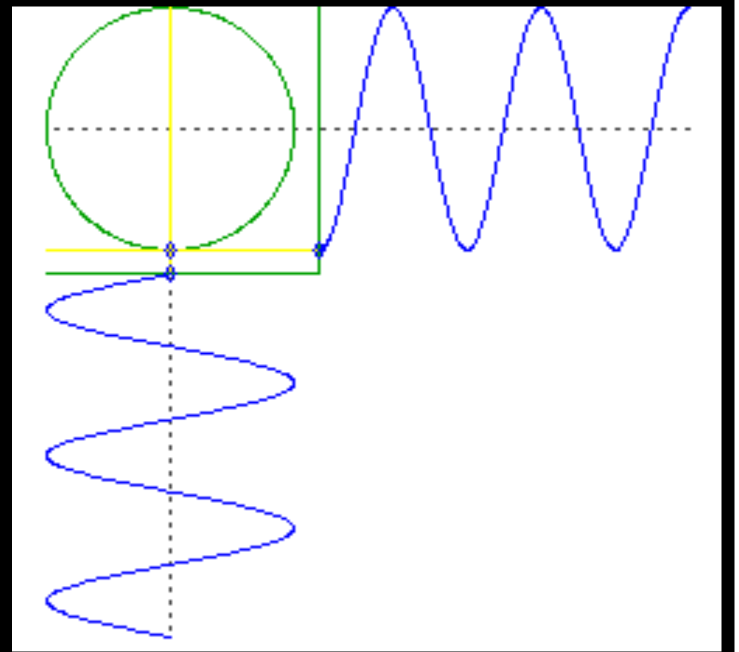
e MOTO CIRCOLARE UNIFORME

ω pulsazione 2π/T

ω velocità angolare v/A





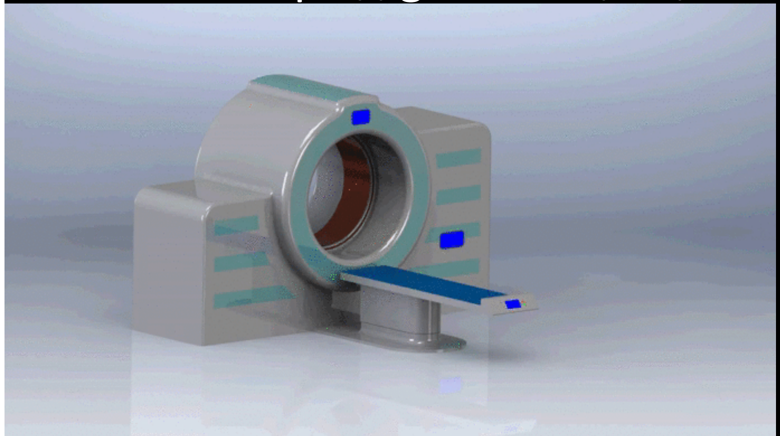


MOTO LINEARE - MOTO CIRCOLARE

https://gifer.com/en/Fb9T

X-ray computed tomography

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

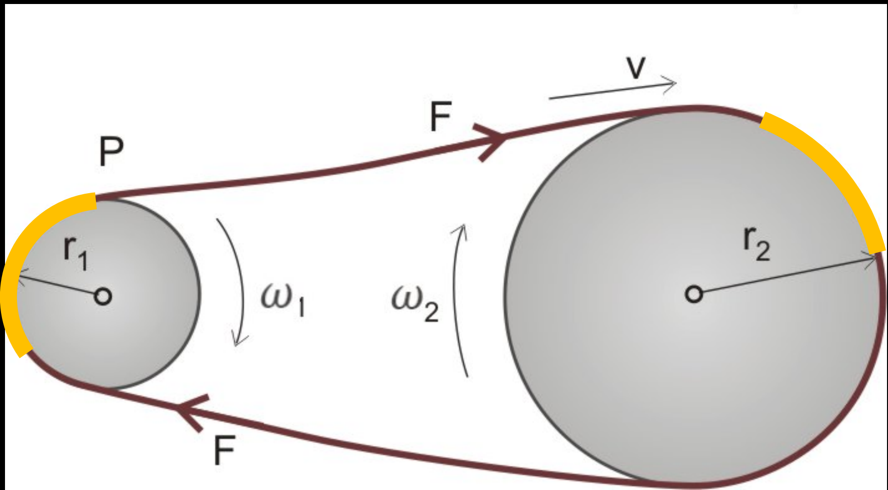


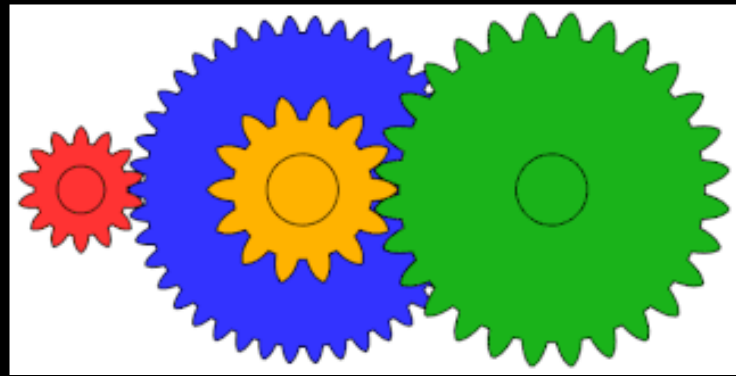
magnetic resonance

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

MOTO CIRCOLARE cinghia/catena

TRASMISSIONE MOTO





$s = \theta_1 r_1 = \theta_2 r_2 \quad v = \omega_1 r_1 = \omega_2 r_2$

ingranaggi