Moto periodico: $\boxed{\begin{aligned} x(t) &= x(t+T) \\ v(t) &= v(t+T) \end{aligned}}$

$T \rightarrow$ periodo

Moto armonico semplice:

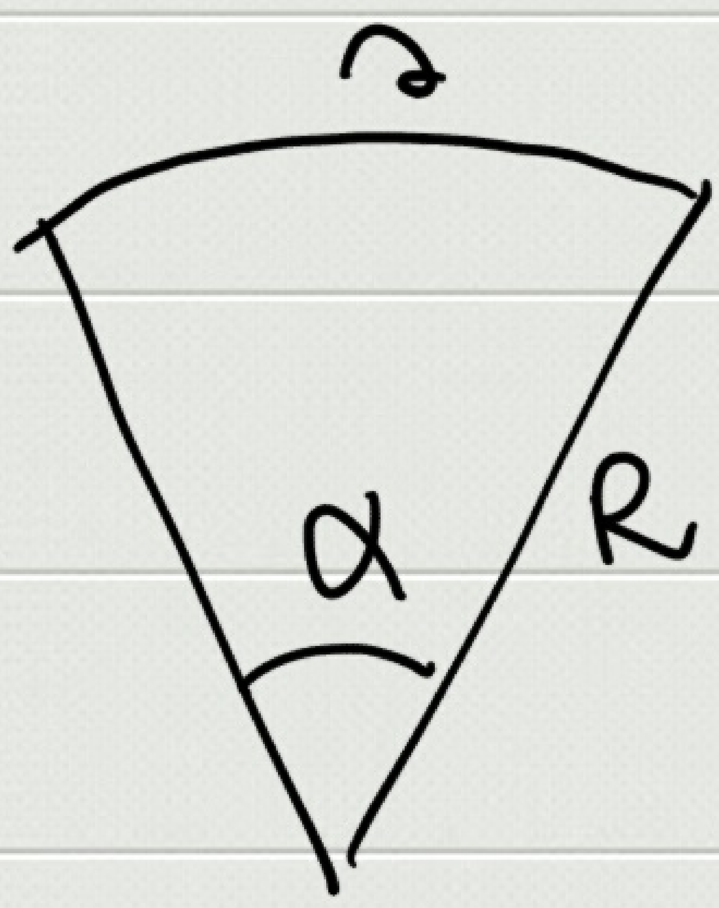
$$\boxed{x(t) = A \sin(\omega t + \phi)}$$

A : ampiezza $[m]$

ϕ : fase iniziale $[rad]$

$\omega t + \phi$: fase $[rad]$

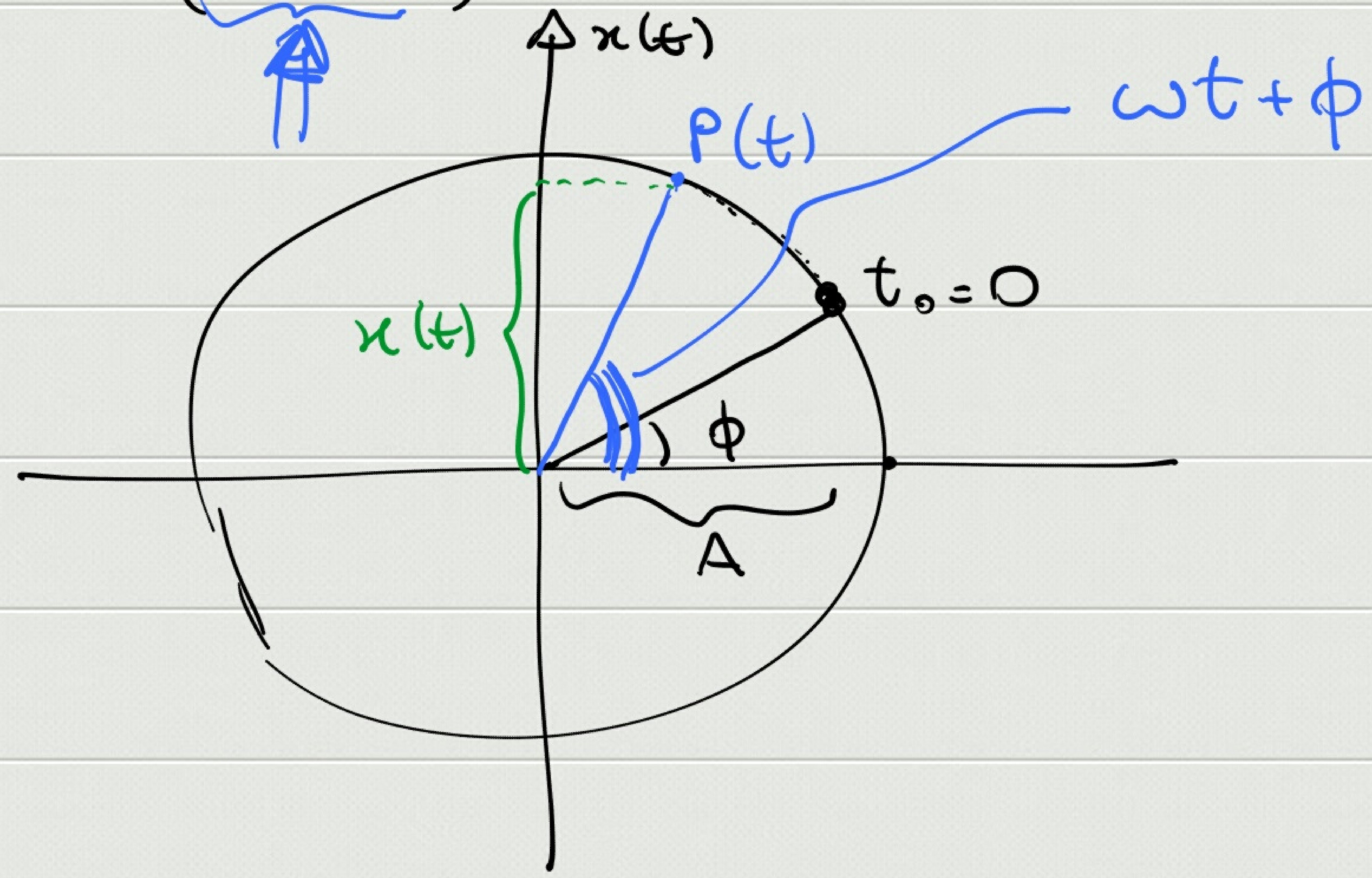
ω : pulsazione $[rad/s]$



$$\boxed{\alpha\,[rad] = \frac{s}{R}}$$

$$\boxed{s = \alpha R}$$

$$x(t) = A \sin(\underbrace{\omega t + \phi}_{\Uparrow})$$

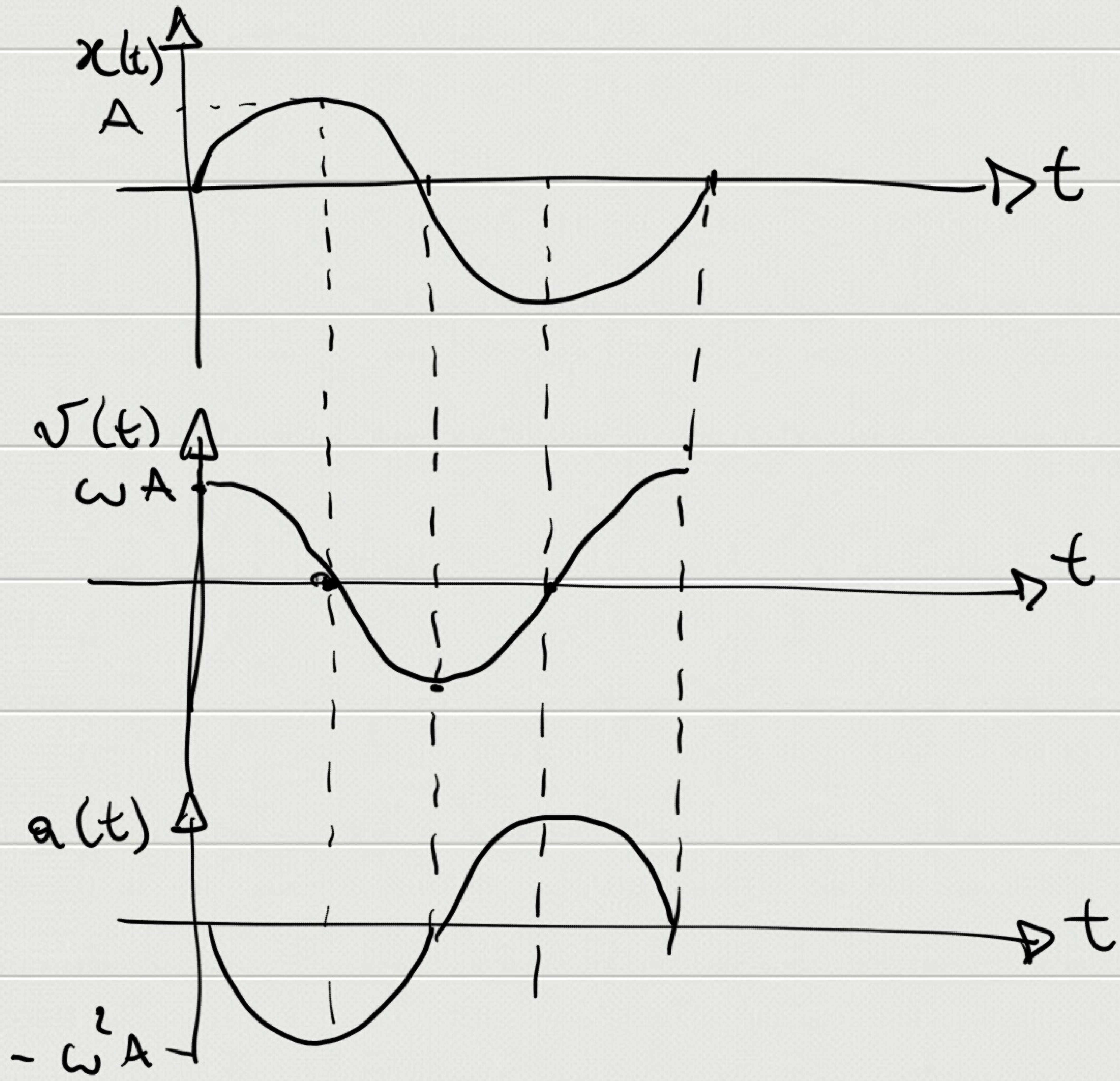


$$v(t) = \frac{dx}{dt} = A\omega \cos(\omega t + \phi)$$

$$a(t) = \frac{dv}{dt} = -A\omega^2 \sin(\omega t + \phi) = -\omega^2 x(t)$$

$\boxed{a \neq cost}$ $\Rightarrow$ moto <u>vario</u>

$\phi = 0$



$$\boxed{x(t) = A \operatorname{sen}(\omega t + \phi)} \qquad (\omega \text{ nota})$$

$$\begin{cases} x_0 = x(t=0) = A \operatorname{sen} \phi \\ v_0 = v(t=0) = A\omega \cos \phi \end{cases}$$

$$\frac{x_0}{v_0} = \frac{1}{\omega} \operatorname{tg} \phi \quad \Rightarrow \quad \phi = \operatorname{arctg}\left(\frac{x_0 \omega}{v_0} \right)$$

$$\begin{cases} x_0^2 = A^2 \sin^2\phi \\ v_0^2 = A^2\omega^2\cos^2\phi \Rightarrow \dfrac{v_0^2}{\omega^2} = A^2\cos^2\phi \end{cases}$$

$$\Rightarrow x_0^2 + \frac{v_0^2}{\omega^2} = A^2(\sin^2\phi + \cos^2\phi) = A^2$$

$$\Rightarrow A = \sqrt{x_0^2 + \frac{v_0^2}{\omega^2}}$$

$$v^2(x) = v_0^2 + 2\int_{x_0}^{x} a(x)\,dx \overset{a=-\omega^2 x}{=} v_0^2 - 2\omega^2 \int_{x_0}^{x} x\,dx =$$

$$= v_0^2 - \cancel{2}\omega^2 \frac{1}{\cancel{2}}(x^2 - x_0^2)$$

$$\Rightarrow \boxed{v^2(x) = v_0^2 + \omega^2(x_0^2 - x^2)}$$

$$\left.\begin{aligned} a &= -\omega^2 x \\ &\parallel \\ &\frac{d^2x}{dt^2} \end{aligned}\right\} \Rightarrow \boxed{\frac{d^2 x}{dt^2} + \omega^2 x = 0}$$

equazione differenziale del moto armonico

$$\Rightarrow \boxed{x(t) = A \sin(\omega t + \phi)}$$

$$\boxed{x(t) = a \sin(\omega t) + b \cos(\omega t)} \quad (*)$$

$$a = A \cos\phi \;;\; b = A \sin\phi$$

$$(*) = A \sin\omega t \cos\phi + A \cos\omega t \sin\phi =$$

$$= A \sin(\omega t + \phi)$$