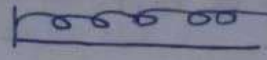
الحركة التوافقية البسيطة



اتجاهه ← وأنا عندما تتحرك في الاتجاه المعاكس

$$F = -kx$$

$$m\ddot{x} = -kx$$

$$\ddot{x} = -\frac{k}{m}x \qquad \frac{k}{m} = \omega$$

$$\ddot{x} = -\omega^2 x$$

$$v\frac{dv}{dx} = -\omega^2 x$$

$$v\,dv = -\omega^2 x\,dx$$

$$\frac{1}{2}v^2 = -\frac{1}{2}\omega^2 x^2 + c$$

أقصى مسافة $x = a$ و $v = 0$

$$0 = -\frac{1}{2}\omega^2 a^2 + c$$

$$c = \frac{1}{2}\omega^2 a^2$$

$$\frac{1}{2}v^2 = -\frac{1}{2}\omega^2 x^2 + \frac{1}{2}\omega^2 a^2$$

$$v^2 = -\omega^2 x^2 + \omega^2 a^2$$

$$v^2 = \omega^2(a^2 - x^2) \qquad v = \sqrt{\omega^2(a^2 - x^2)}$$

$$\frac{dx}{dt} = \sqrt{\omega^2(a^2 - x^2)} \qquad \frac{dx}{\sqrt{\omega^2(a^2 - x^2)}} = dt$$

$$\frac{dv}{\omega\sqrt{a^2 - x^2}} = dt$$

$$\int \frac{dv}{\sqrt{a^2 - x^2}} = \int \omega\,dt \qquad \cos^{-1}\frac{x}{a} = \omega t + \varepsilon$$

$$\frac{x}{a} = \cos(\omega t + \varepsilon)$$

$$x = a\cos(\omega t + \varepsilon)$$

$$x = a\cos\omega t\cos\varepsilon - a\sin\omega t\sin\varepsilon$$

Constant Constant

$A = a\cos\varepsilon$
$B = -a\sin\varepsilon$
$\Big] \Rightarrow x = A\cos\omega t + B\sin\omega t$

$V_{max} = a\omega$
$F_{max} = a\omega^2$

$a = \sqrt{A^2 + B^2}$
$\varepsilon = -\tan^{-1}\frac{B}{A}$

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

$\nu = \frac{1}{T} = \frac{\omega}{2\pi}$ التردد

[1] Find The Preiodic Time for:.

$x'' = -25x$

$x'' = -\omega^2 x$ $\quad \omega^2 = 25 \quad \omega = 5$

$T = \frac{2\pi}{\omega} = \frac{2}{5}\pi$

[2] Calculate The V_{max} and F_{max} For simple harMonic Motion with Period time $\frac{\pi}{4}$ and amplitude 25m

$a = 25\,m$ السعة (amplitude)

$T = \frac{2\pi}{\omega} = \frac{\pi}{4} \Rightarrow \omega = 8$

↳ Period Time

$V_{max} = a\omega = 25 * 8 = 200\ m/s$
$f_{max} = a\omega^2 = 25 * (8)^2 = 1600\ m/s^2$

[3] $x = 0.45\cos\frac{\pi}{4}t - 0,28\sin\frac{\pi}{4}t$

prove that the motion represent a simple harMonic Motion Calculate The amplitude, T (Period Time)

harmonic motion $\Rightarrow F = -\omega^2 x$

$v = -0.45 \times \frac{\pi}{4} \sin \frac{\pi}{4} t - 0.28 \times \frac{\pi}{4} \cos \frac{\pi}{4} t$

$F = -0,45 \times \frac{\pi^2}{4^2} \cos \frac{\pi}{4} t + 0,28 \times \frac{\pi^2}{4^2} \sin \frac{\pi}{4} t$

$\underbrace{-\frac{\pi^2}{4^2}}_{-\omega^2} \underbrace{\left[+0,45 \cos \frac{\pi}{4} t - 0,28 \sin \frac{\pi}{4} t\right]}_{x}$

$= -\omega^2 x$ ✓✓ represent harmoinc motion

(2) $x = A \cos \omega t + B \sin \omega t$

$A = 0,45 \qquad B = -0,28$

$a = \sqrt{A^2 + B^2} = \sqrt{(0,45)^2 + (-0,28)^2} = 0,53$

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

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

$\frac{2\pi}{\frac{\pi}{4}} = 2\pi * \frac{4}{\pi} = 8$

$F_{max} = a\omega^2 = 0,53 \times 8^2 = 33.92$

$\varepsilon = -\tan^{-1} \frac{B}{A} = -\tan^{-1} \frac{-0,28}{0,45} = 31,89$

intial prase angle