Simple Harmonic Motion (SHM)

Kinematics	Position as a function of time	$x = A\sin(\omega\ t + \varphi_0)$ $x = A\cos(\omega\ t + \varphi_0)$
	Velocity as a function of time	$v = A\,\omega\cos(\omega\ t + \varphi_0)$ $v = -A\,\omega\sin(\omega\ t + \varphi_0)$
	Acceleration as a function of time	$a = -A\,\omega^2\sin(\omega\ t + \varphi_0)$ $a = -A\,\omega^2\cos(\omega\ t + \varphi_0)$
	Velocity as a function of position	$v = \pm\omega\ \sqrt{A^2 - x^2}$
	Acceleration as a function of position	$a = -\omega^2 x$
	Maximun velocity	$v_{MAX} = A\,\omega$
	Maximun acceleration	$a_{MAX} = A\,\omega^2$
Dynamics Spring mass system	Hooke's Law	$F = -k\,x$
	Relationship between spring constant, angular frequency and mass	$k = \omega^2 m$
	Maximun force	$F_{MAX} = k\,A,\quad F_{MAX} = m\,\omega^2 A$
Energy	Kinetic energy	$E_{KIN} = \frac{1}{2} m\,v^2\,;\quad E_{KIN} = \frac{1}{2} k\left(A^2 - x^2\right)$
	Potential energy	$E_{POT} = \frac{1}{2} k\,x^2$
	Mechanical energy	$E_{MEC} = \frac{1}{2} k\,A^2$
Pendulum	Period of swing of a simple gravity pendulum	$T \cong 2\pi\sqrt{\frac{L}{g}}$
	Relationship between frequency, period and angular frequency	$f = \frac{1}{T};\quad \omega = 2\,\pi\,f$

Symbol	Magnitude	S.I. unit
x	Position	m
v	Velocity	m / s
a	Acceleration	m / s^2
A	Amplitude (maximum displacement)	m
ω	Angular frequency	rad / s
t	Time	s
φ_0	Phase	rad
F	Force	N
m	Mass	kg
k	Spring constant	N / m
E_{KIN}	Kinetic energy	J
E_{POT}	Potential energy (spring)	J
E_{MEC}	Mechanical energy	J

f	Frequency	Hz
L	Length of the pendulum	m
g	Acceleration of gravity	m / s^2
T	Period	s

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