Simple Harmonic Motion

Basics

Angular speed, $\omega = 2\pi f = 2\pi/T$

Period, $T = 2\pi/\omega$

Frequency, $f = 1/T = \omega/2\pi$

$x(t) = A\sin(\omega t)$

$v(t) = \omega A\cos(\omega t)$

$a(t) = -\omega^2 A\sin(\omega t)$

$= -\omega^2 x$ ← because $x(t) = A\sin(\omega t)$

$v_{max} = \omega A = 2\pi A f$

$a_{max} = \omega^2 A$

Springs

$F = -kx$

$\omega = \sqrt{k/m}$

$T = 2\pi\sqrt{m/k}$

$v^2 = \frac{k}{m}(A^2 - x^2)$

$a = \frac{kx}{m}$

Potential Energy

Horizontal spring: $U = ½kx^2$

Vertical spring: $U = ½kx^2 + mgx$

Maximum PE: $U_{max} = ½kA^2$

Pendula (Pendulums?)

The following assumes that the angular displacement, θ, of the pendulum is small enough that $\sin(\theta) \sim \theta$.

Ideal Pendulum

$T = 2\pi\sqrt{\frac{L}{g}}$

Physical Pendulum

$T = 2\pi\sqrt{\frac{I}{mgd}}$

I, here, is moment of inertia

Key to Symbols

A	amplitude, m	I	Moment of inertia	x, d	distance from rest, m
a	acceleration, m/s^2	k	spring constant, N/m	T	Period, sec
f	frequency, Hz	L	pendulum length, m	ω	angular velocity, rad/s