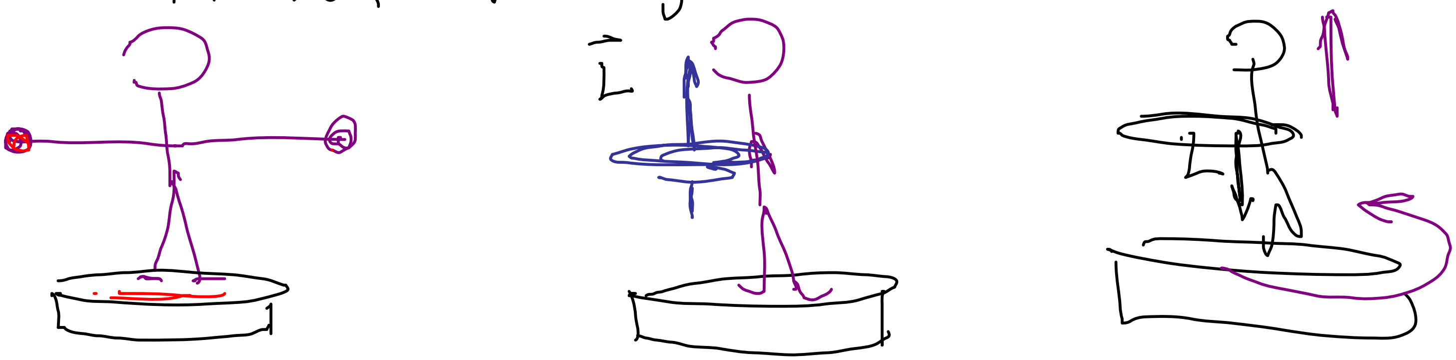
Phys 2110-4 4/12/13

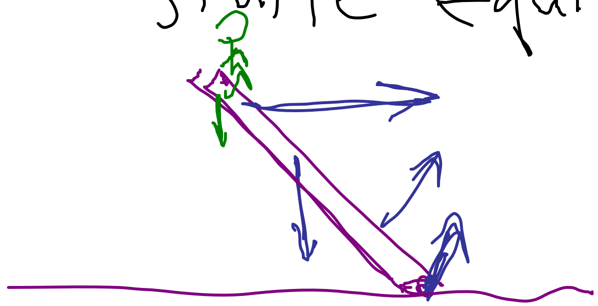
Note Title 4/12/2013

Rotations: Angular Momentum

Chap 11



Ch 12 Static Equilibrium

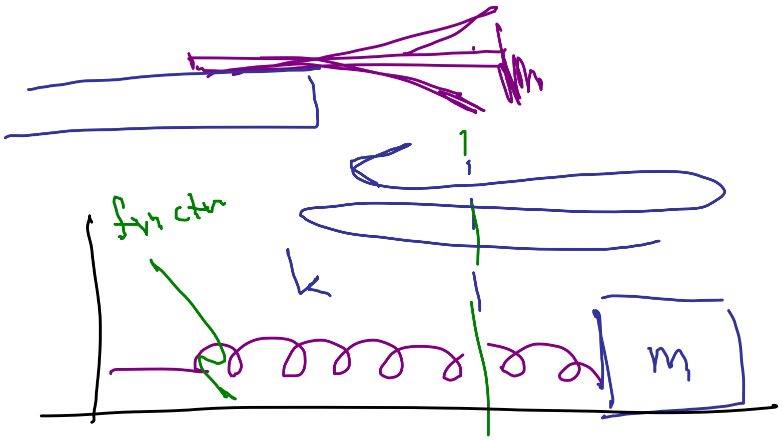


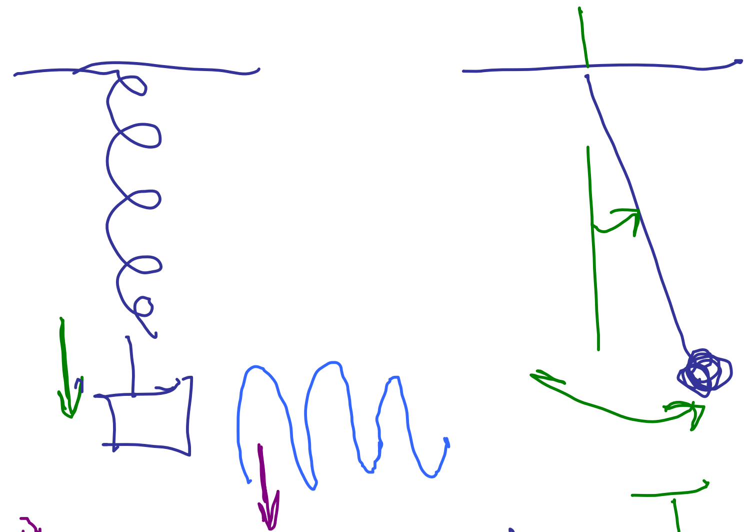
$$\Sigma \vec{F} = 0$$

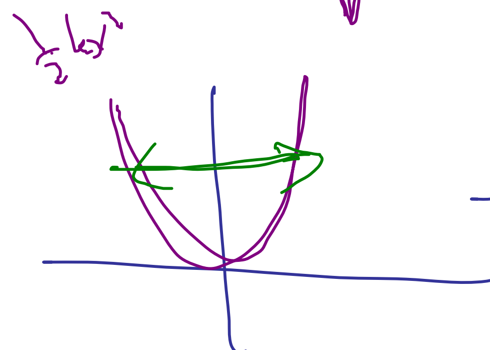
$$\Sigma \vec{\tau} = 0$$

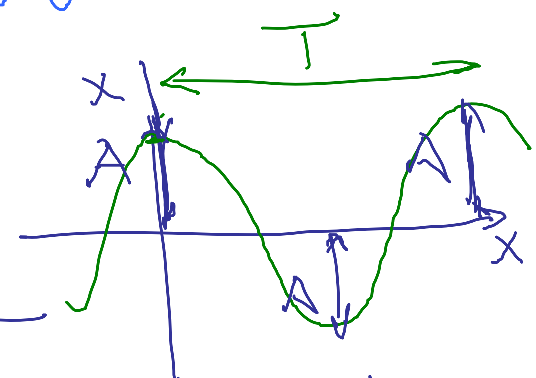
Chap 13 Oscillatory Motion.

Repeating Motion



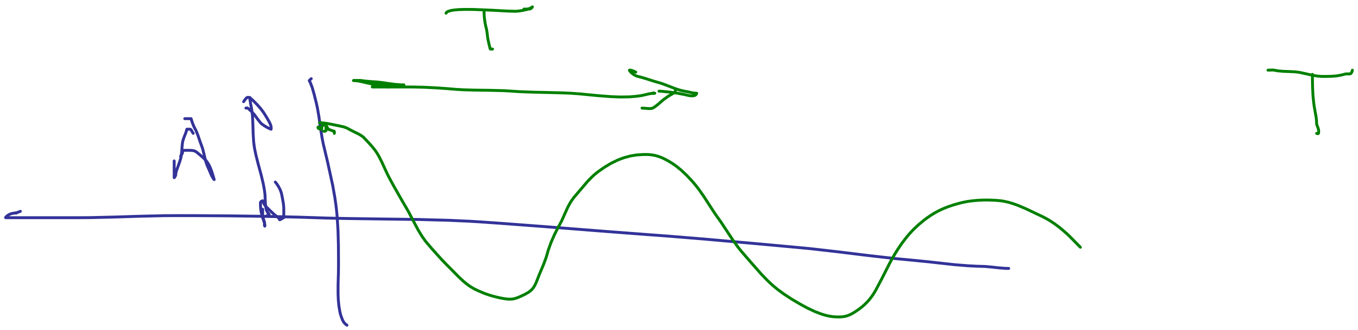






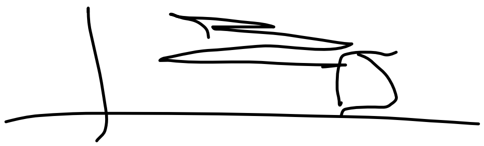
T = period of motion.

A = amplitude.



How many complete osc's per time does mass make?

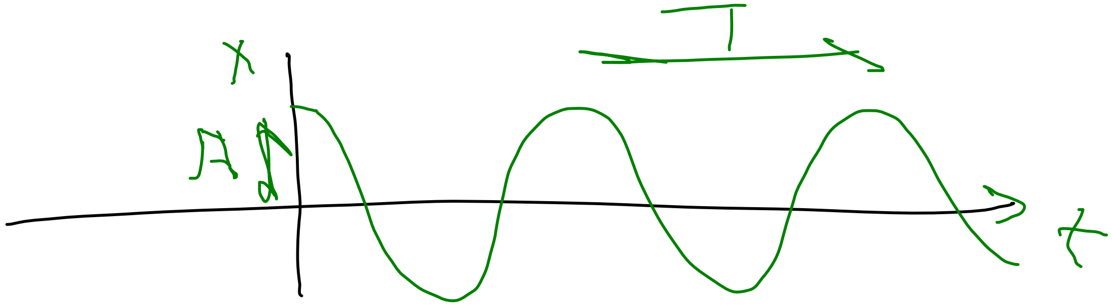
f, frequency. $\frac{\text{osc's}}{\text{sec}} = \frac{\text{cycle}}{\text{sec}} = \text{Hz}$ = Hertz



Angular frequency, $\omega = \frac{\text{rad}}{\text{sec}} = 1/s$

$$\boxed{f = 1/T}$$

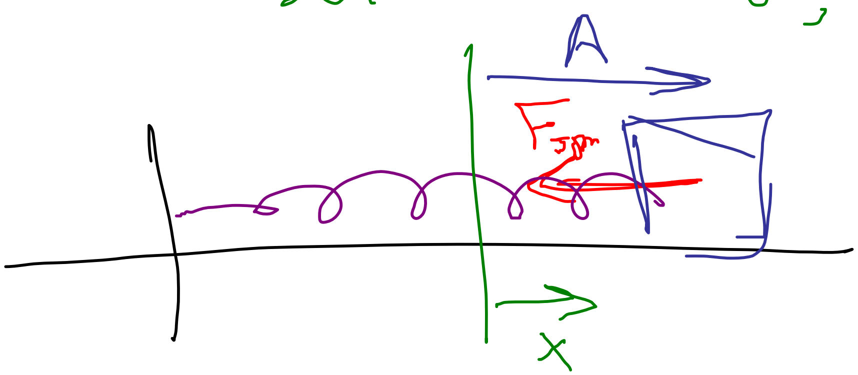
$$\boxed{\omega = \underbrace{2\pi}_{\text{rad/osc}} f}$$



Mathematical description.

cos curve.

Prove that this is the case find relation between f, T, and k, m



$$F_{spr} = -kx = ma = m\frac{d^2x}{dt^2}$$

$$\frac{d^2x}{dt^2} = -\frac{k}{m}x = -\omega^2 x$$

$$k/m = \omega^2$$

$$\boxed{\frac{d^2x}{dt^2} = -w^2 x}$$

$x(t)$

$f(x) + \frac{1}{f(x)} = 7 -$

Differential equation.

Algebraic

Try

$\cos(wt)$ $\sin(wt)$

$-w\sin(wt)$

$-w^2\cos(wt)$ $-w^2 \sin$

$C_1 \cos(wt$

General solution:

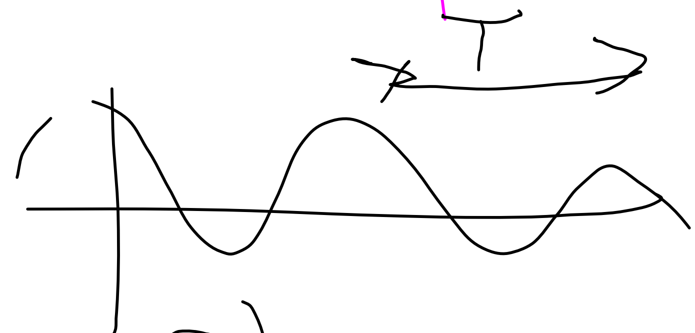
$x(t) = C_1 \cos(wt) + \cancel{C_2 \sin(wt)}$

Use

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

In general, $x(t) = A\cos(\omega t + \cancel{\phi})$

Significance of ω:



$$A\cos(\omega t) = A\cos(\omega[t+T])$$

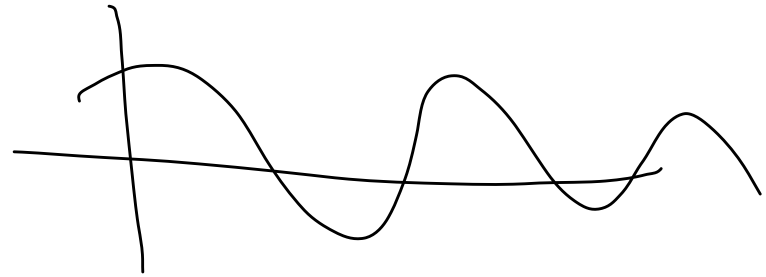
$$= A\cos(\omega t + \omega T)$$

$$= 2\pi$$

$$\omega T = 2\pi$$

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

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



$$\omega = 2\pi/T = 2\pi f$$

$$f = \#\ \text{osc/sec}$$

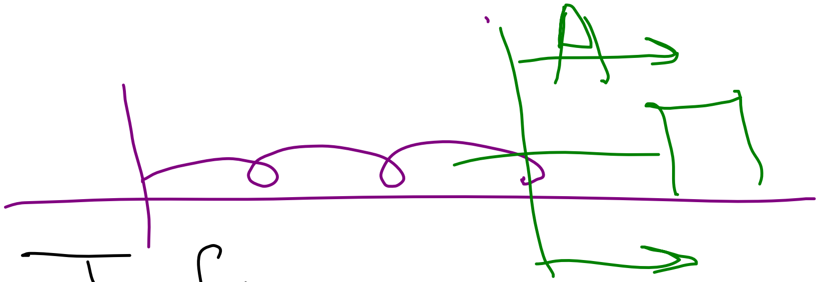
$\omega = 2\pi$ times this

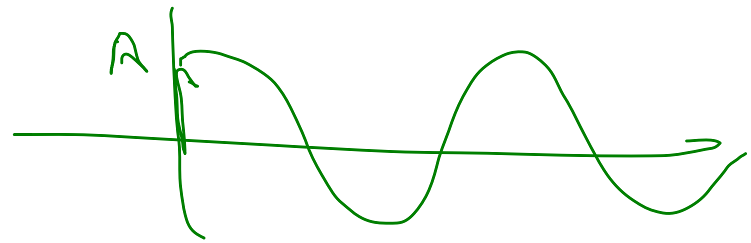
ω = angular freq.

$$\omega^2 = \frac{k}{m} \qquad \omega = \sqrt{\frac{k}{m}} = 2\pi f$$

Depends on spr. const.

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{T} \qquad T = 2\pi\sqrt{\frac{m}{k}}$$

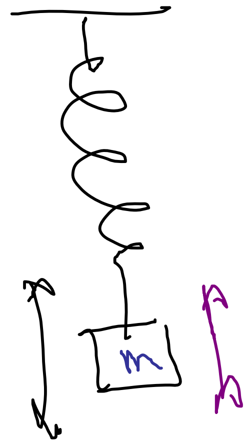




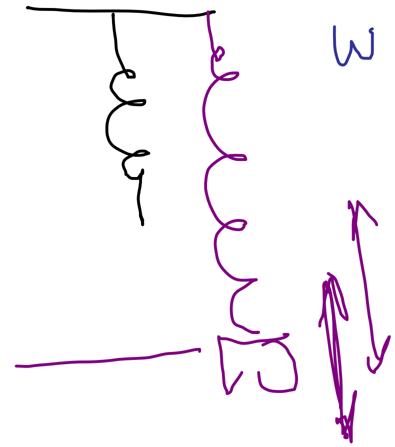
T, f

Indep't of amplitude.

Works same as

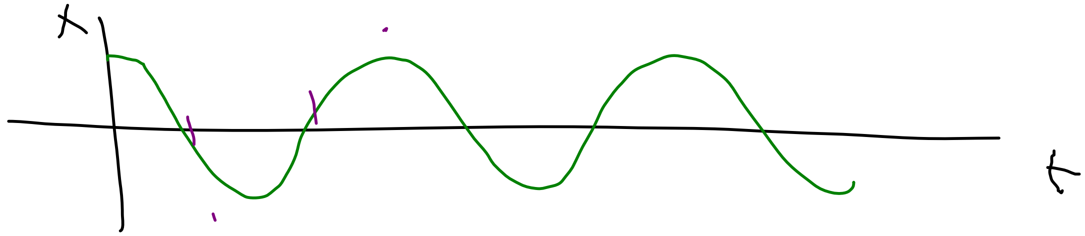


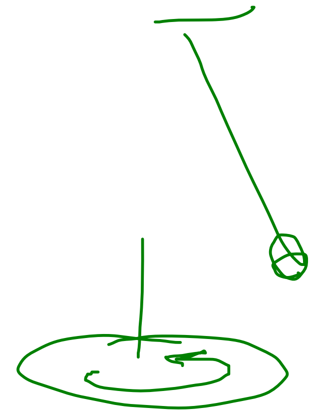
$\omega = \sqrt{\frac{k}{m}}$ No g!



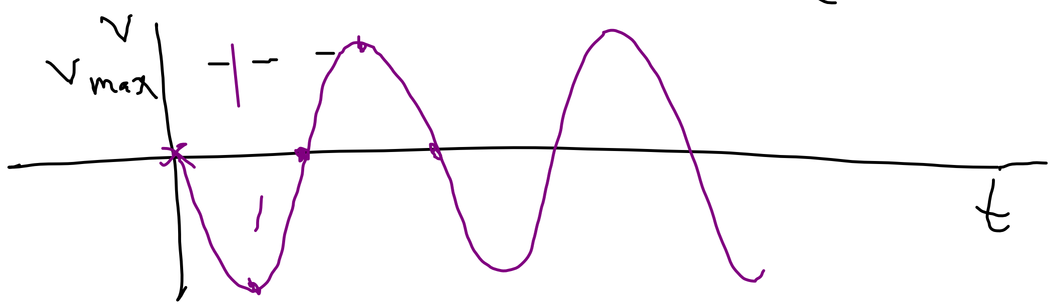
$\omega = \sqrt{\frac{k}{m + m_{spr}/3}}$

gravity is "cancelled out"



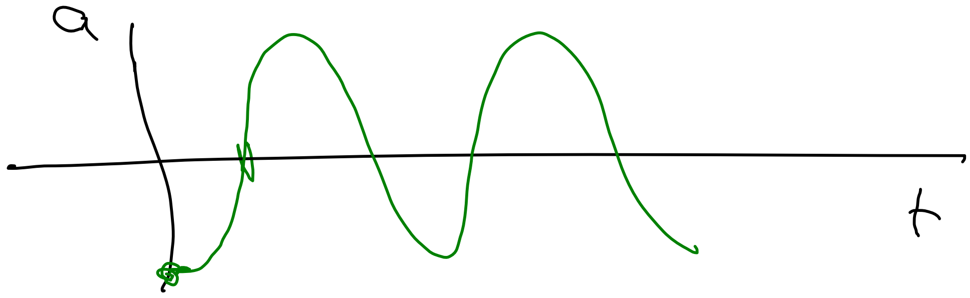


$$x(t) = A\cos(\omega t)$$
$$= A\cos(2\pi f t)$$



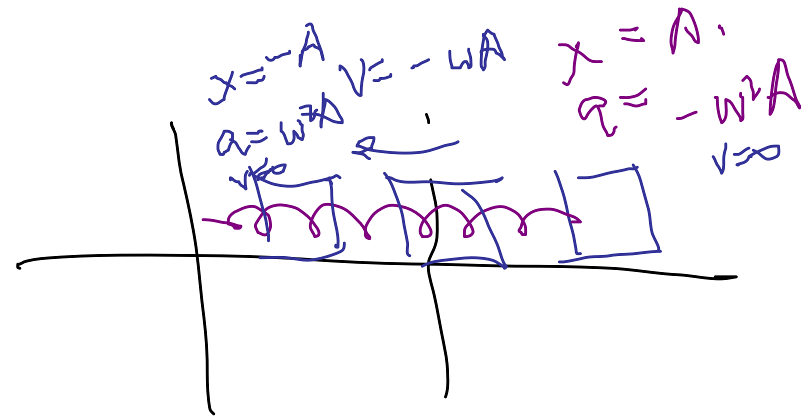
$$v(t) = x'(t) = -\underline{\omega A}\sin(\omega t)$$

$$v_{max} = \omega A \quad \text{Occurs at } x = 0$$



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

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



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