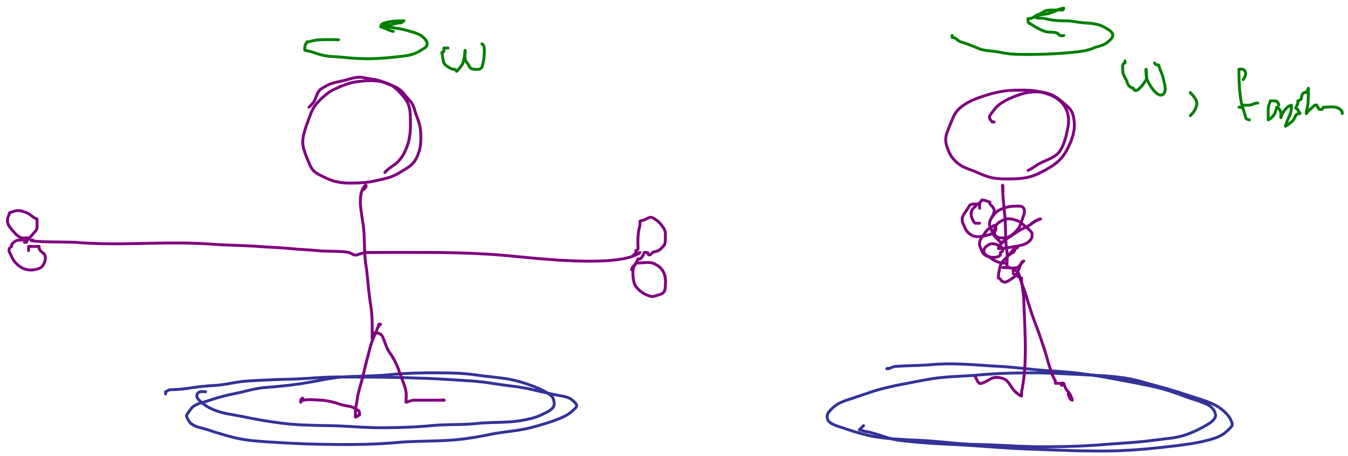
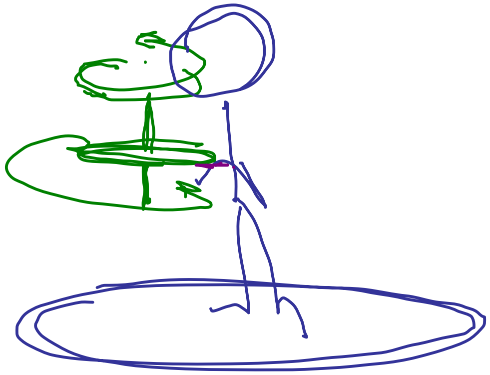
Phys 2110-5 11/14/12

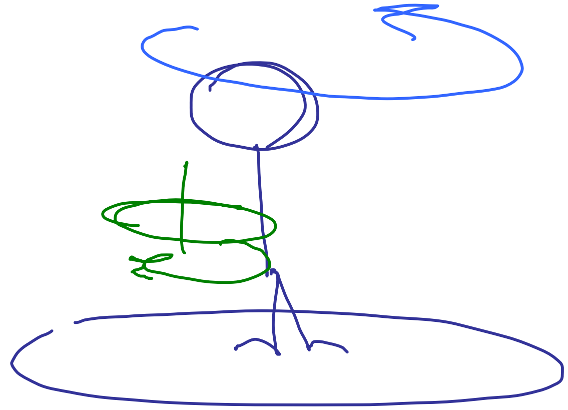
Note Title 11/14/2012

Chap 11 Angular Momentum

No net external torque, L_{Tot} is cons'd.

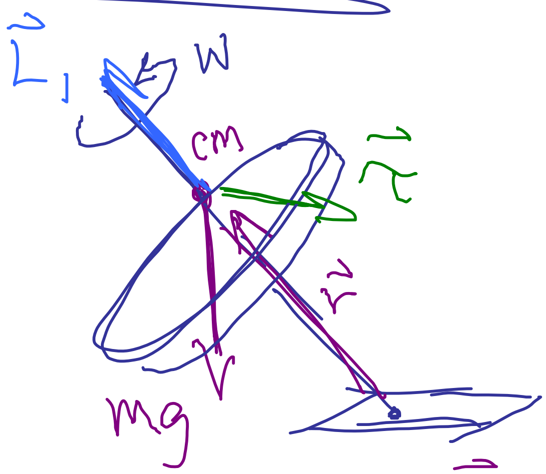




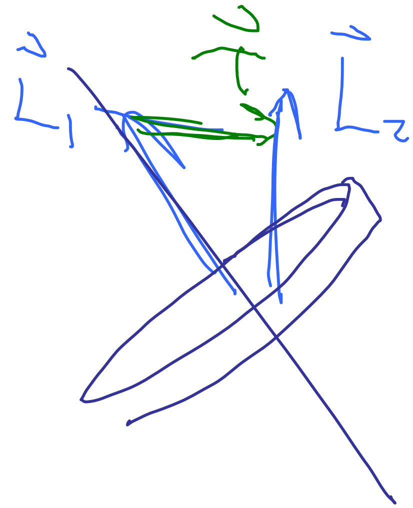


L is conserved.

Gyroscopes



$$\vec{r} \times m\vec{g} = \vec{\tau}$$



p 180.

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

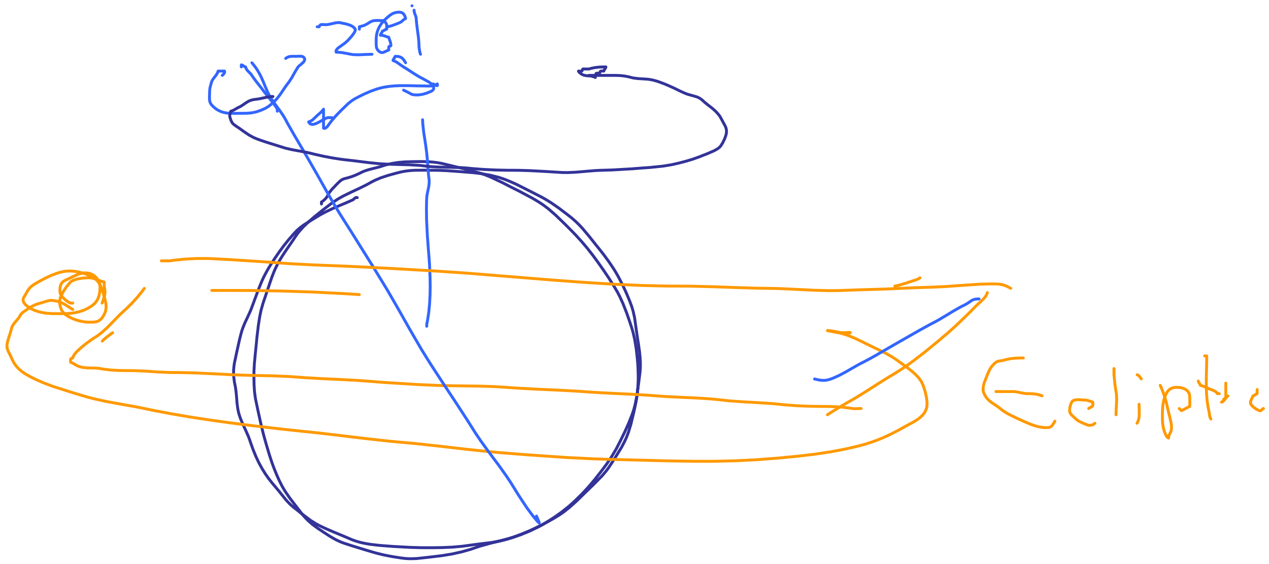
$$\vec{F} = m\vec{a}$$

Fig 11.9

$\vec{L}$ vector cruises around in circle.

$\Longrightarrow$ Precession.

p. 180



Axis of earth precesses

26,000 yrs

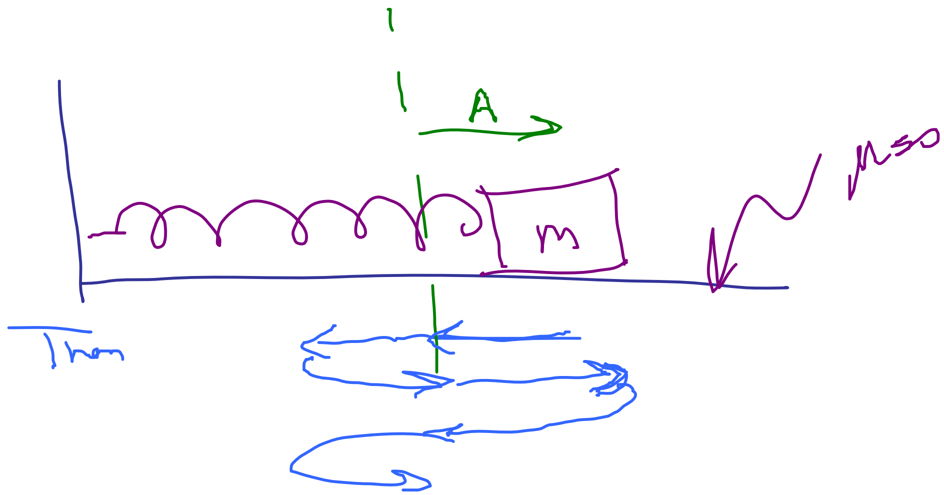
for full precession

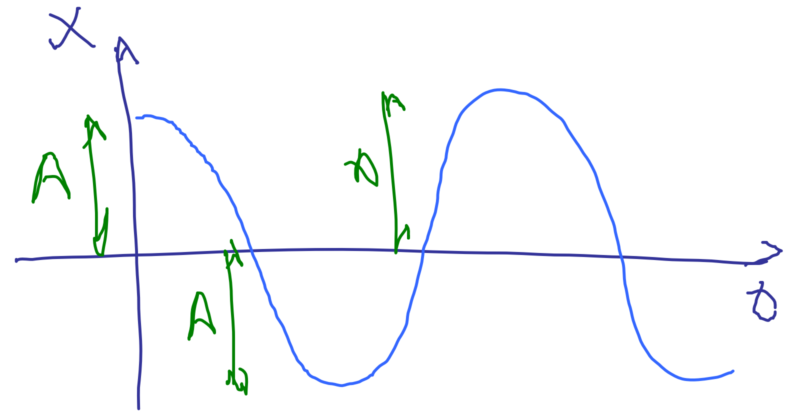
Chap 12 Equilibrium . . . . Statics

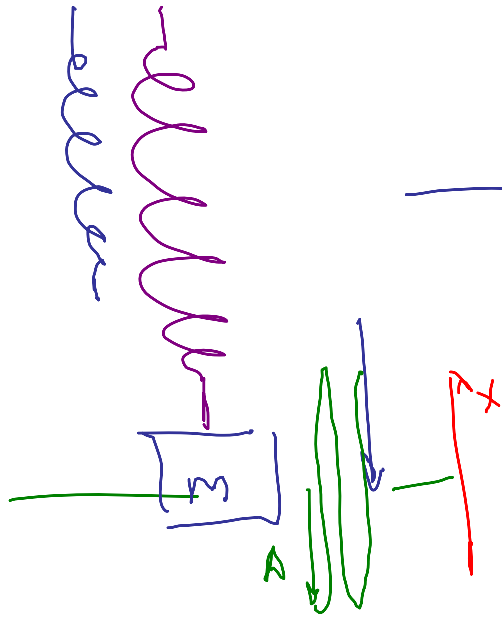
Chap 13 Oscillatory Motion

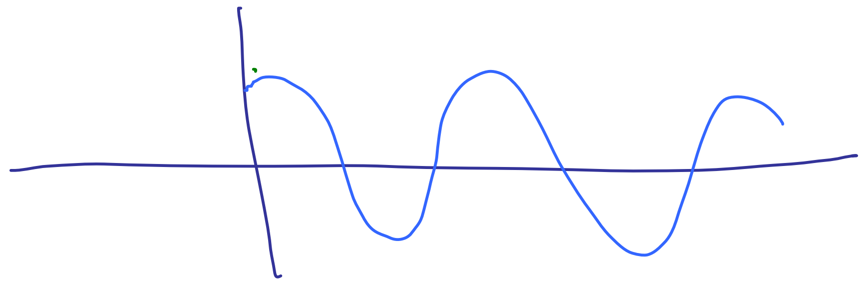
Simple Harmonic Motion.

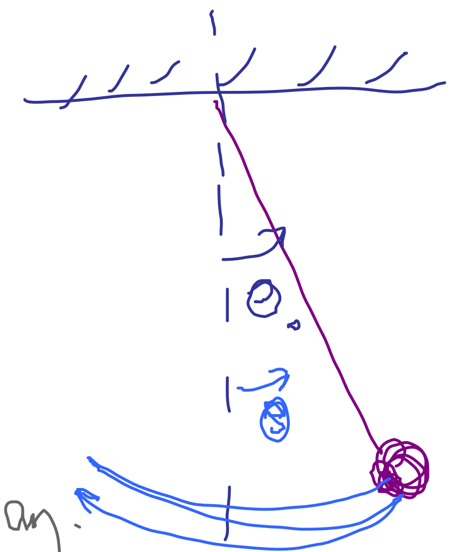
Motion which repeats itself !

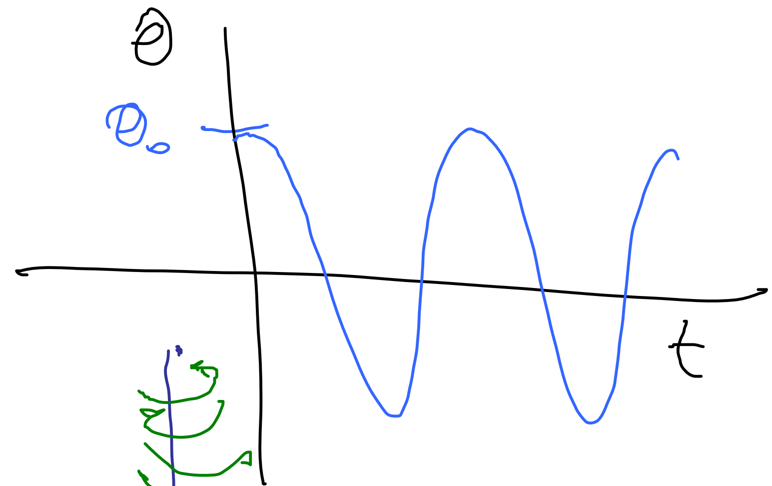






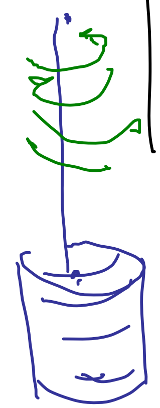






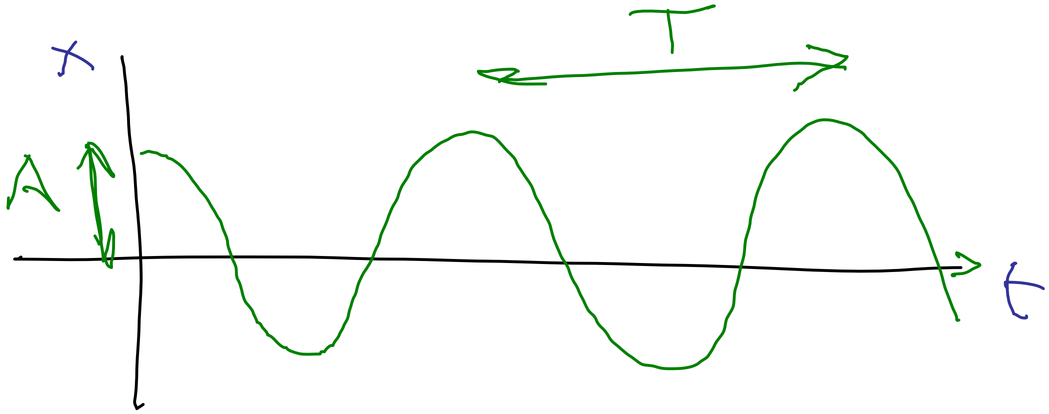
For a system to behave this way.

Linear restoring force



Simplest possible systems.

Periodic motion.



A = Amplitude of motion.

T = period of motion.

$$\text{frequency} = \frac{\#\ \text{osc's}}{\text{time}}$$

Units: osc's/sec

(can erase "osc")

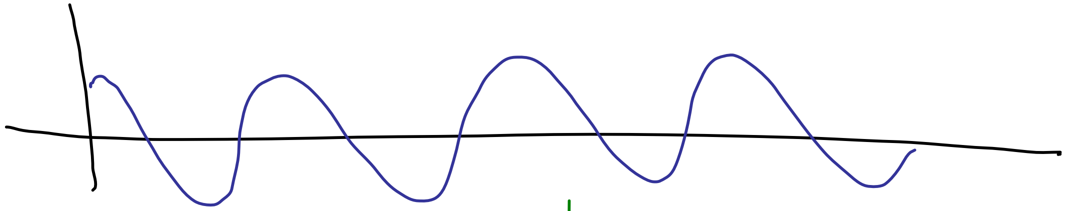
$$f = 1/T \qquad T = \frac{1}{f}$$

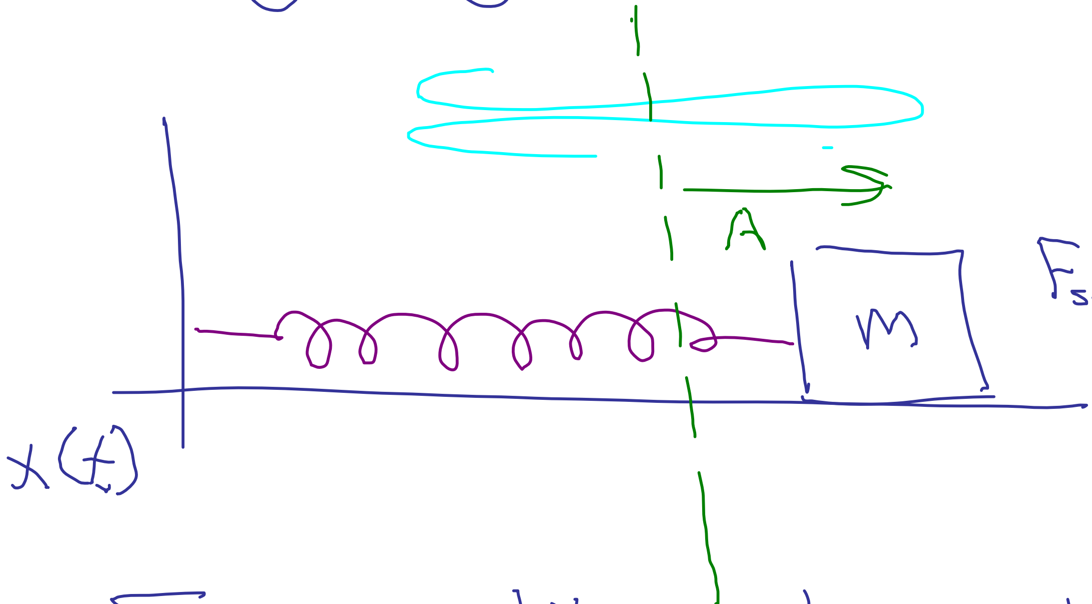
Later angular frequency

$$\underline{\underline{\omega}} = \frac{\#\ \text{radians}}{\text{sec}} = \underline{\underline{2\pi f}}$$

$$\omega = \text{rad}/\text{sec} = 1/\text{sec}$$

$$f = \frac{\text{osc}}{s} = \frac{\text{cycle}}{s} = \text{Hz}$$





<u>Derive</u> the motion of the mass

on mass

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

So: $$m\frac{d^2x}{dt^2} = -kx$$

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

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

$x(t)$ Differential Equation.

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

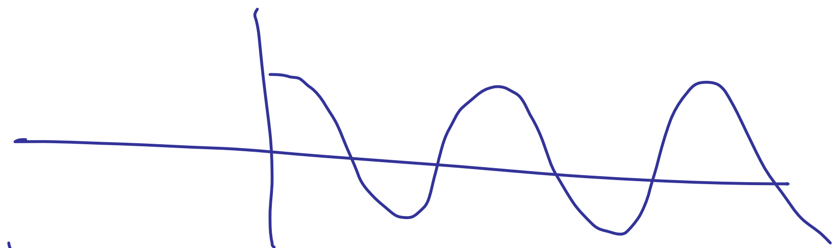
$$x(t) = C_1 \sin(\omega t) + C_2 \cos(\omega t)$$

$\sin(\omega t)$
$\cos(\omega t)$

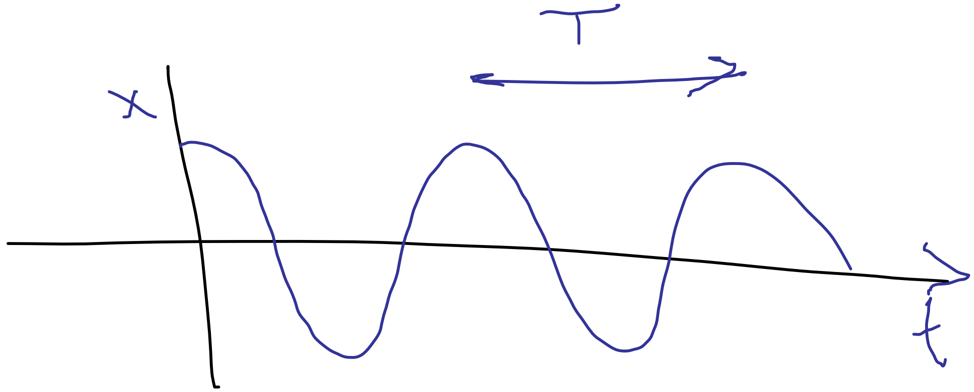
$$= A\cos(\omega t + \phi) \quad \Leftarrow \quad \phi = 0$$

Solution is

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



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



$A\cos(\omega t)$

$A\cos(2\pi f\, t)$

Suppose t incr's by T. Same values
period

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

$$= \cos(\omega t + 2\pi)$$

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

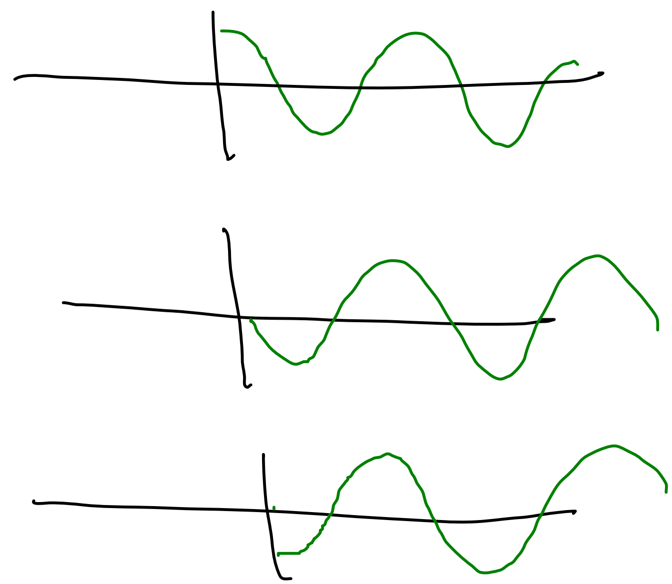
$$\omega = \frac{2\pi}{T} = 2\pi f$$

$$\underline{\underline{\omega = 2\pi f}}$$

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

$$v(t) = \frac{dx}{dt} = -\omega A \sin(\omega t)$$

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

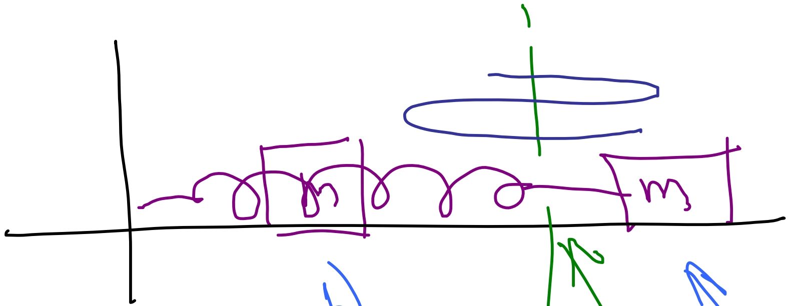


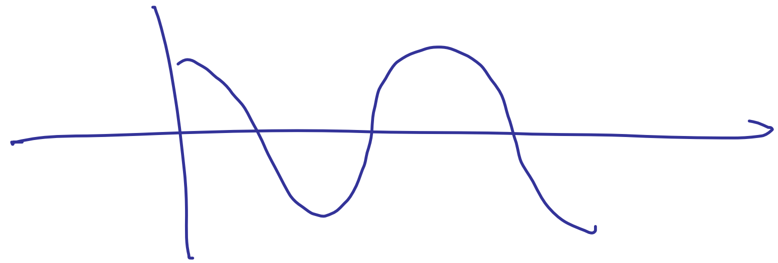
$$a = -\omega^2 x$$

Maximum values

$x_{max} = A$ $\quad v_{max} = \omega A$

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





$|x|$ is max

$|a|$ is max

$|x|$ is max $= A$

$|a|$ is max $= \omega^2 A$

$|v|$ is max $= \omega A$

$U =$ is conserved! $= K + U = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$