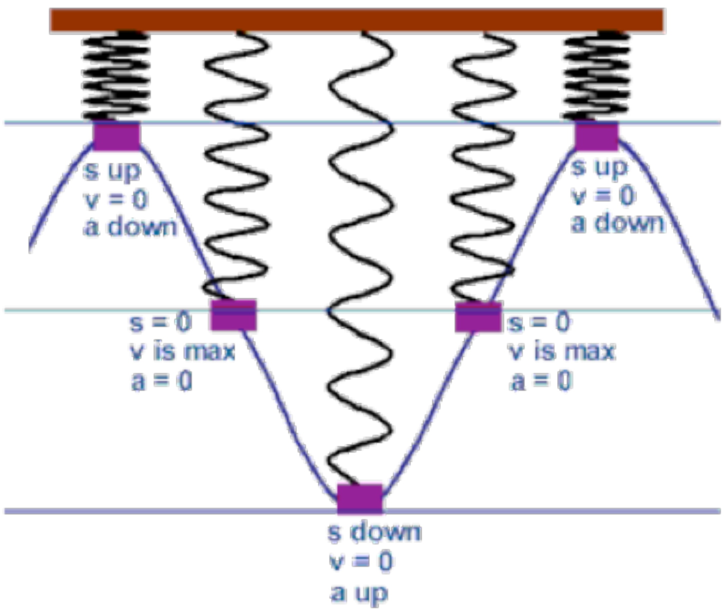
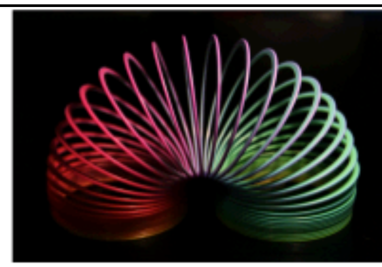
Simple Harmonic Motion

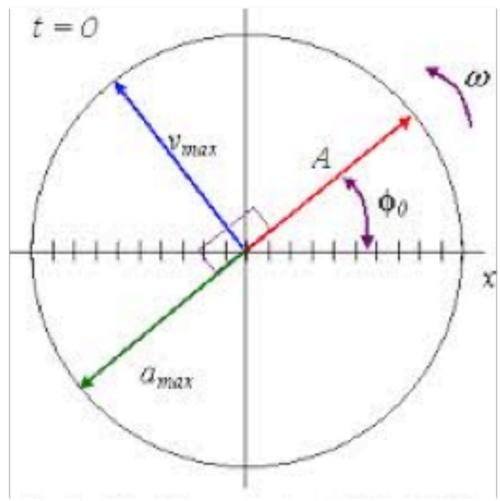
- SHM can also be related to rotational motion.



Circular Review



- Instead of x or y ➔ θ
  radians



- Instead of v ➔ ω
  rad/s

- Instead of a ➔ α
  rad/s2

February 28, 2017

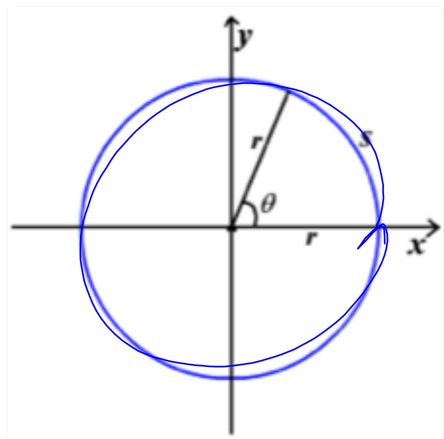
Rotational Formulas

- Omega, *Angular Frequency

$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T}$$

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

$$T = \frac{2\pi}{\omega} = \frac{1}{f}$$

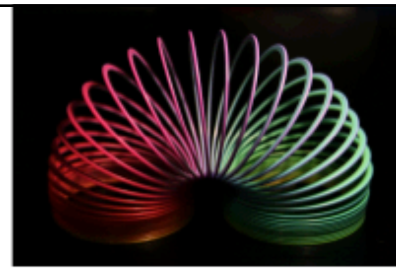


$$\omega = \frac{2\pi}{T} \qquad T = \frac{1}{f}$$

$$\omega = \frac{2\pi}{\frac{1}{f}} = \frac{2\pi f}{1} = 2\pi f$$

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

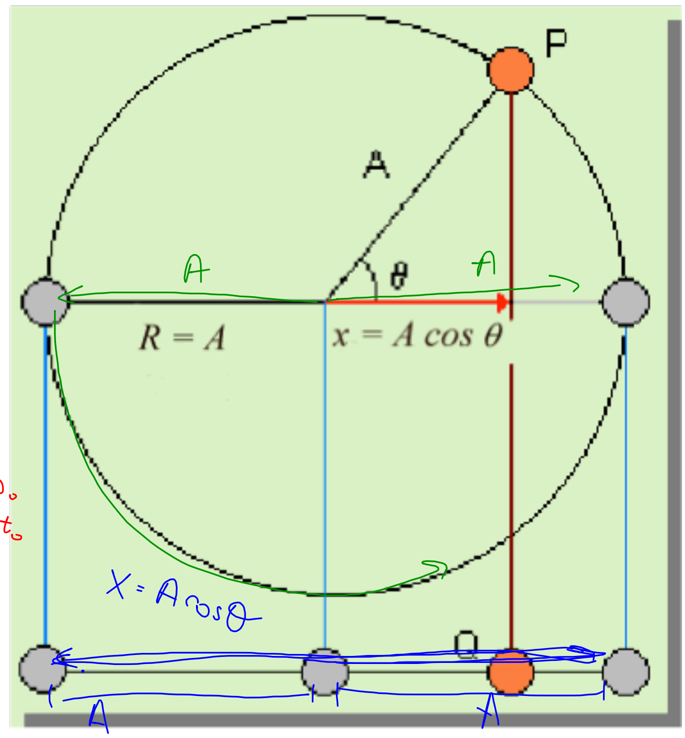
Another Circular Visualization of SHM



- Video

Another Circular Visualization of SHM

- Horizontal Motion:
- Object in horizontal SHM can be 'projected' on to the unit circle.
- The x-component of the circular motion can be used to describe the position of the of the SHM as a function of time



$$x = A\cos\theta$$

$$X = A \cdot \cos(\omega \cdot t)$$

$$X = A\cos(2\pi f \cdot t)$$

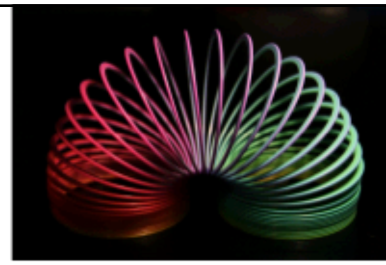
$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{\theta_f - \theta_0}{t_f - t_0}$$

$$\omega = \frac{\theta}{t}$$

$$\theta = \omega \cdot t$$

$$\omega = 2\pi f$$

Sinusoidal Nature of SHM - Horizontal



- Position (x):

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

A = max. amplitude

- Velocity (v):

$$v = -A \cdot \omega \sin(\omega t)$$

- Max. velocity (v_{max}):

$v_{max} = A \cdot \omega$

- Acceleration (a):

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

- Max. acceleration (a_{max}):

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