

Oscillatory Motion

Glider on airtrack



oscillatory but not simple harmonic motion  
(no net force, except at ends)

Bob on a spring:



Pendulum:



Tube of water:



All examples of simple harmonic motion (SHM)

There is an unbalanced or net force acting on the object when the object is displaced from its equilibrium position.

Hooke's Law:

$$F = -kx$$

The unbalanced force in SHM is proportional to the displacement from the equilibrium position.

Period (T)  $\Rightarrow T = \frac{\text{time}}{\text{cycles}}$

Frequency (f)  $\Rightarrow f = \frac{\text{cycles}}{\text{time}}$

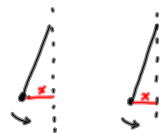
Period & frequency are reciprocals  
 $T = \frac{1}{f}$  and  $f = \frac{1}{T}$

$$\text{kHz} = 10^3 \text{ Hz}$$

$$\text{MHz} = 10^6 \text{ Hz}$$

$$\text{GHz} = 10^9 \text{ Hz}$$

Phase:



in phase.

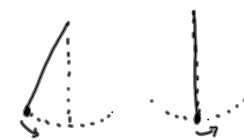
Phase Difference.  
(out of phase)



out of phase



in opposite phase



The second pendulum leads the first and is a quarter of a period ahead

phase difference is  $\frac{T}{4}$

Example

The atoms in an  $O_2$  molecule oscillate with a frequency of  $4.0 \times 10^{14} \text{ Hz}$ . What is the period of oscillation?



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

$$T = \frac{1}{4.0 \times 10^{14} \text{ s}^{-1}}$$

$$T = 2.5 \times 10^{-15} \text{ s}$$