(1) $$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$ lens equation

(2) $$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$ magnification eqn

$P > 0$ for conv.

< 0 div.

(3) $$P = \frac{1}{f}$$ power of the lens

$[m^{-1}]$ [D] diopter

(*) $$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

lensmaker's formula

$R_{1,2}$ are radiuses of the lens curvature

n index of refraction

(*) mirrors

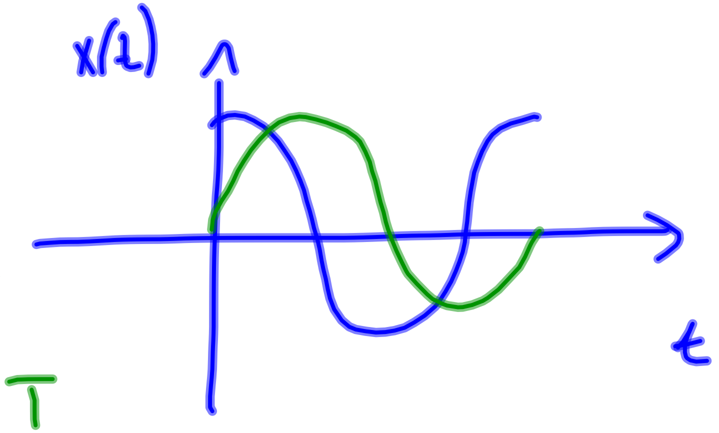
Oscillations

- overview

- if you displace a system from equilibrium it will try to go back. while it's trying it is oscillating
  - swing, spring, bungie jumping

Simple harmonic motion (SHM)

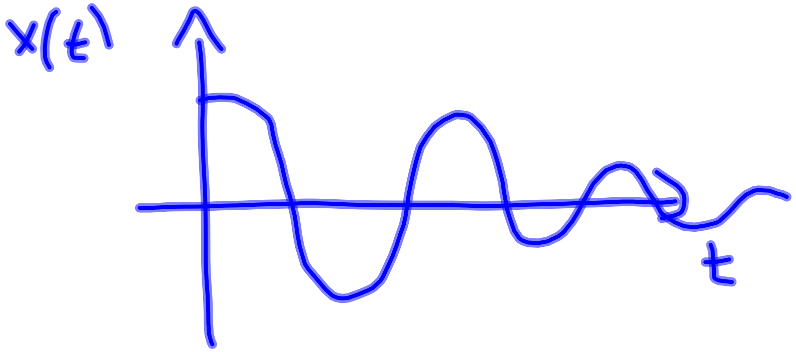
$x(t) = A\cos\omega t$



- amplitude of oscillation A
- period of oscillation T
  - frequency (number of oscillations per unit time) $f = \frac{1}{T}$ [Hz] [s^{-1}]

- angular frequency $\omega = \frac{2\pi}{T}$ [rad/s]

- if the motion is damped amplitude A decreases



If a system is driven at a frequency near its natural frequency ω_0 $\Rightarrow$

large amplitudes = resonance

WAVES

- disturbances that propagate through space

In oscillatory motion an object oscillated.

Is the same true for the wave?

NO

What propagates in a wave?

Energy ; information

The particles oscillate as in SHM, do not travel with the wave.

- slinky
- stadium wave
  - gym

Phet

Waves - mechanical - require a medium such as air, water ...

- electromagnetic - share many properties with mechanical waves but they don't require medium
  - visible
  - infrared light
  - radio waves
  - x rays

Waves

- longitudinal – the particle oscillates in the same direction as wave (sound)
- transverse – the particle oscillates $\perp$ to the wave

As with oscillatory motion waves have

- A - amplitude (for water it is a crest of the wave, for sound it is max pressure)

- shape - waves come in many shapes that we call wavefronts

- wavelength λ - the distance over which the wave pattern repeats

- period T - time for one complete wave oscillation

- frequency $f = \frac{1}{T}$ number of wave cycles per unit time

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