Simple Harmonic Motion

Fun With Fiziks

What is SHM?

Basically when something oscillates back and forth

Acceleration is proportional to the negative of displacement

$F = -kx \Rightarrow ma = -kx \Rightarrow a \propto x$

Why? Because when a particle moves from its equilibrium position, the force will try to pull the opposite direction to move the particle back, which results in SHM

Particles will move according to $x(t) = A\cos(\omega t) \rightarrow \omega$ is called angular frequency, don't get it confused with rotational motion! Basically how frequently the particle oscillates back and forth

SHM quantities

Angular frequency (ω) - formula depends on whatever SHM system you are talking about

Frequency (f): $2\pi f = \omega \Rightarrow f = \omega/2\pi$

Period (T): $T = 1/f = 2\pi/\omega$

Amplitude (A): max displacement from the equilibrium position, it’s usually given in the problem, no specific equation to solve it

Example with springs

Springs are a classic example of SHM

F = -kx is hooke's law → a is proportional to -x, so a block on a spring undergoes SHM

$\omega = \sqrt{k/m}$ (kinda because $a = -(k/m) * x$)

$f = 1/2\pi * \sqrt{k/m}$

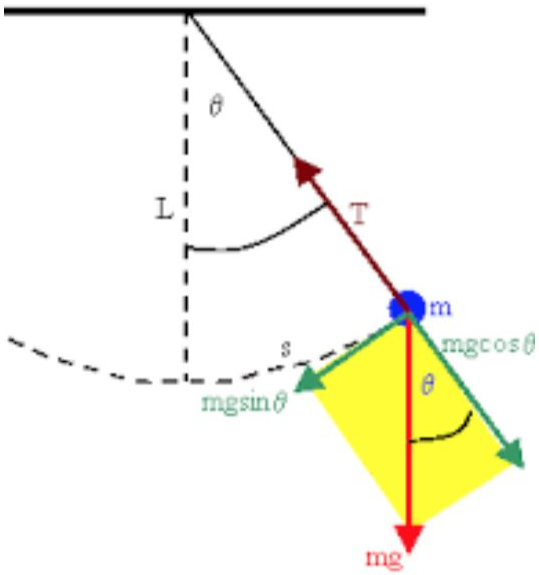
$T = 2\pi * \sqrt{m/k}$

Springs cont.

Draw displacement v time, velocity v time, and acceleration v time graphs

Show how its all trigonometric equations

Pendulums are sorta SHM



Draw the forces on a pendulum to see if it is SHM

$F = ma = -mg\sin\theta$

$a = -g\sin\theta$

$L\alpha = -g\sin\theta$

$\alpha = -(g/L)\sin\theta \rightarrow$ it's not SHM! But what if we approximate?

$\alpha = -(g/L)\theta \rightarrow$ now it is! Except we are talking about angular displacement and acceleration since the pendulum is swinging

Pendulums cont.

$\alpha = -(g/L)\theta$

$a = -(k/m)x$

Similar form

$\omega = \sqrt{g/L}$

$f = 1/2\pi * \sqrt{g/L}$

$T = 2\pi * \sqrt{L/g}$