SMH maths

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There is some learning to do here. It is helpful to be familiar with the s, v and a graphs for shm

Defined as restoring force $\propto -x$

$\frac{dx}{dt} = v$ .... 1 ie gradient of displacement

$\frac{dv}{dt} = a$ .... 2 ie gradient of velocity

$\therefore \frac{d^2x}{dt^2} = a$ ....

$\omega = 2\pi f$

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

Learn $a = -\omega^2 x$
which can be written
as $\frac{d^2x}{dt^2} = -\omega^2 x$

This is another differential equation.
It has 2 possible, very similar solutions.

Which of these solutions you use depends on where you decide to start timing from - - - in other words where is t=0.

So t=0 is at max displacement:

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

So t=0 is at the midpoint - where x=0.

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

you can easily put $\omega = 2\pi f$ in

Don't forget this eqn too...
$v = \pm \omega\sqrt{A^2 - x^2}$

With reference to the x, v and a graphs.

- Max displacement is A (ie the amplitude)
- Max v is ωA
- Max a is $\omega^2 A$

In all three cases you can have both negative and positive maxima

Linking to Force

We tend to think of this in terms of a spring where F=-Kx
As ever we know F=ma so we can combine these two to get that

=> ma=-kx

Linking to the fact that $\frac{d^2x}{dt^2}$ = accel we can....

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

Try & get to a place where you see $\frac{d^2x}{dt^2}$ and think acceleration.

The OCR B syllabus models this....