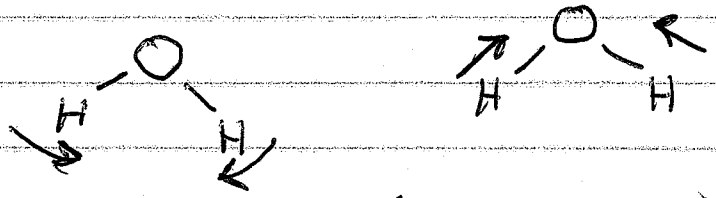
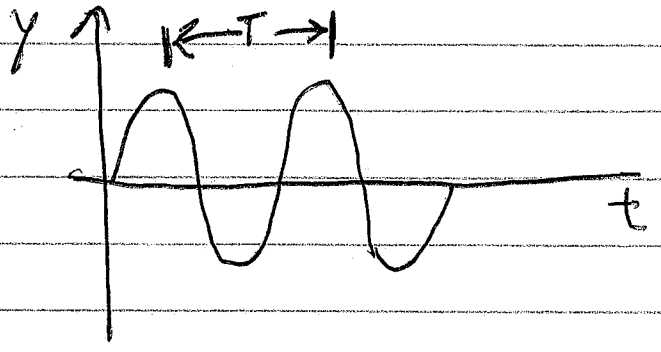
Oscillations - repetitive behavior
- Equilibrium where the value can be naturally constant.
- Restoring force - tendancy back toward equilibrium.
- Inertia - overshoots equilib.

Examples:
- Mass on a spring
- Vibrating diving board
- Pendulum
- Molecules



- Nuclei in magnetic Fields (NMR, MRI)
- AC Voltage, Current
- Pieces of Waves

Language of oscillations



Vertical on the graph:
- Displacement
- Equilibrium
- Amplitude - max displacement
- Energy - proportional to amplitude squared.

Horizontal axis: Timing
- Period (T) - time of repetition.
- Frequency (f) - $f = 1/T$ # repetitions per unit time.

Generic equation: $y = y_0 \sin(2\pi f t + \phi)$

y_0 = amplitude
f = frequency
ϕ = phi = phase shift

Does this repeat every T?
$\sin()$ repeats every 2π
start @ $t=0$ $\quad 2\pi f t = 0$
cycle? $\quad t = T \quad 2\pi f T = 2\pi \left(\frac{1}{T}\right) T = 2\pi$ ✓

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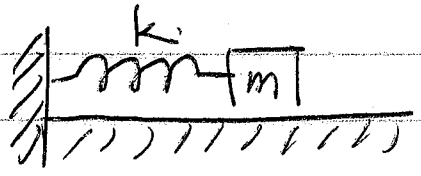
Simple Harmonic Oscillator – mass & spring



no friction
m = mass
k = spring constant or stiffness

Force: $F = -kx$

Newton's 2nd Law: $F = ma$

When x is ⊕ accel is ⊖
x = 0 accel is 0
x is ⊖ accel is ⊕

Frequency: $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

Stiffer ⇒ faster oscillation
more mass ⇒ slower

Ex: Car suspension
$m = 2000$ kg
$f = 2$ Hz

$2\pi f = \sqrt{k/m}$
$(2\pi f)^2 = k/m$

$k = m(2\pi f)^2$
$= (2000)(2\pi(2))^2$
$= 316{,}000$ N/m

x when F = weight of car
$F = mg = (2000)(9.8)$
$= 19600$ N

(4)

Check $|F| = kx$

$(19600\,N) = (316000\,N/m)\,x$

$0.06\,m = x$

$6\,cm$ = spring compression

Pendulum

$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$ ← prop to restoring force

← prop to "inertia"