Test 1

- Solutions, grading guide
  linked from syllabus
- Grade quesn's to me
  How " " " or TA or PLA
  But can't before Fri.
  OH Thurs 3-5 cancelled (sorry)
- 70% if able to crank
  More if understand
  Scores < 40 - concerning

Oscillating Systems

Spring - mass, pendulum, RLC, ...

Spring force $\overset{k}{\sim}$ extension, opposes extension

$$F_s = \pm k \overset{z}{z}$$

m	mg		z
0			0
100 gm	100g = .1N	4	4 cm.
200	200g = .2N	3	7 cm.
300	300g = .2N	3	10 cm.

$$\left.\begin{array}{l}\text{Extension of } 3\text{ cm} = .03\text{ m} \\ \text{Force " } .1\text{ N}\end{array}\right\} \Rightarrow$$

$$k = \frac{F}{\text{extension}} = \frac{.1}{.03} \text{ N/m}$$

Spring-mass system

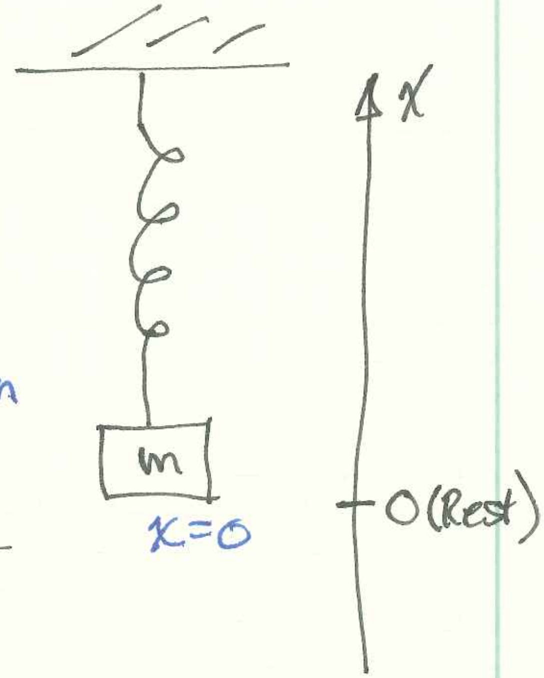
$$F_{total} = ma = mx''$$

p. 204 - 206

$$F_{Spring} = -kx + \cdots$$

x=0 sol'n

$$F_T = F_S \Rightarrow \boxed{mx'' + kx = 0}$$



<u>Analysis:</u> $x'' = -\frac{k}{m}x$

Educated guess: $x(t) = \cos \underline{r}\, t$, r=const

$x' = -r \sin rt$, $x'' = -r^2 \cos rt$

$r^2 = k/m \Rightarrow x(t) = -10 \cos \sqrt{\frac{k}{m}}\, t$

$x(0) = -10$

<u>Period</u> = time for 1 cycle

cos has period = 2π

$\cos \sqrt{\frac{k}{m}}\, t$ repeats when $\sqrt{\frac{k}{m}}\, t = 2\pi$

$$t^{①}_{period} = 2\pi / \sqrt{k/m} = 2\pi \sqrt{\frac{m}{k}}$$

$m \times 4 \Rightarrow$

$$t^{②}_{period} = 2\pi \sqrt{\frac{4m}{k}} = 2 \times$$

Damped spring-mass

Friction $\sim x'$, opposes motion

$$F_d = -px'$$

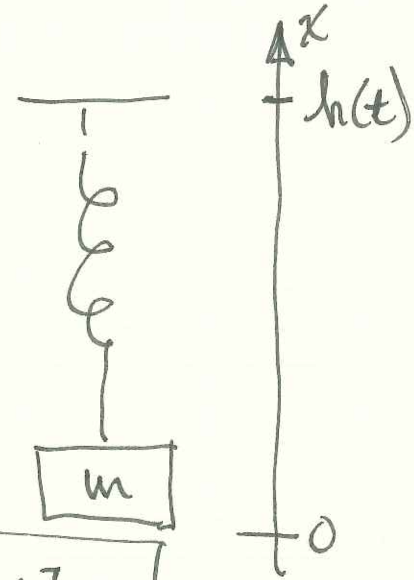
$$F_T = F_s + F_d + \cdots \Rightarrow \boxed{mx'' + px' + kx = 0}$$

$$x(t) \stackrel{?}{=} \sin\sqrt{\frac{k}{m}}\,t \quad ?$$

Forced spring-mass

p. 209 -210

Wiggle top



$$\boxed{mx'' + kx = \underbrace{k[h(t) - h(0)]}_{\text{Forcing term}}}$$

Period, amplitude of mass
vs. period of forcing ?

Terms:

- Period: time for cycle
  - period of $\cos t$ is
  - " " $\cos \omega t$ is
- (Cyclic) frequency
  - Cycles per second = Hertz, 2π radians/cycle
  - $\cos \omega t$

p.278

- (Circular) frequency
  - Radians per second
  - $\cos \omega t$

    $t = 0 \to t = 1 \Rightarrow \omega \cdot 1$ radians

    $\Rightarrow \cos \omega t$ has circular frequency ω rad/sec

    OR $\omega/2\pi$ cycles/sec $= \frac{\omega}{2\pi}$ Hz