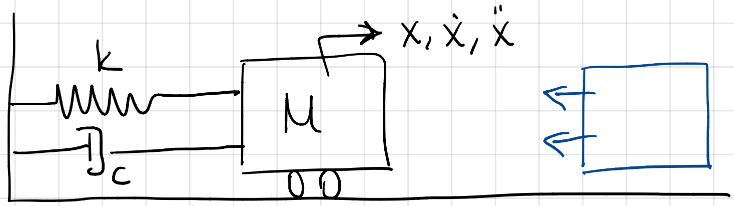
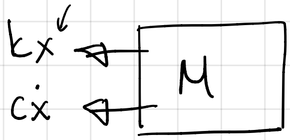
Finding Damping Constant Using Experimental Data





$$\Sigma \vec{F} = M\vec{\ddot{x}}$$

$$-kx - c\dot{x} = M\ddot{x} \Rightarrow M\ddot{x} + c\dot{x} + kx = 0 \Rightarrow 2^{nd}, \text{ Hom., Linear Diff. Eqn.}$$

$$M\ddot{x}(t) + c\dot{x}(t) + k\,x(t) = 0 \Rightarrow x(t) = ?$$

$$\ddot{x}(t) + \frac{c}{M}\dot{x}(t) + \frac{k}{M}x(t) = 0$$

$$\ddot{x}(t) + 2\xi\omega_n\dot{x}(t) + \omega_n^2 x(t) = 0$$

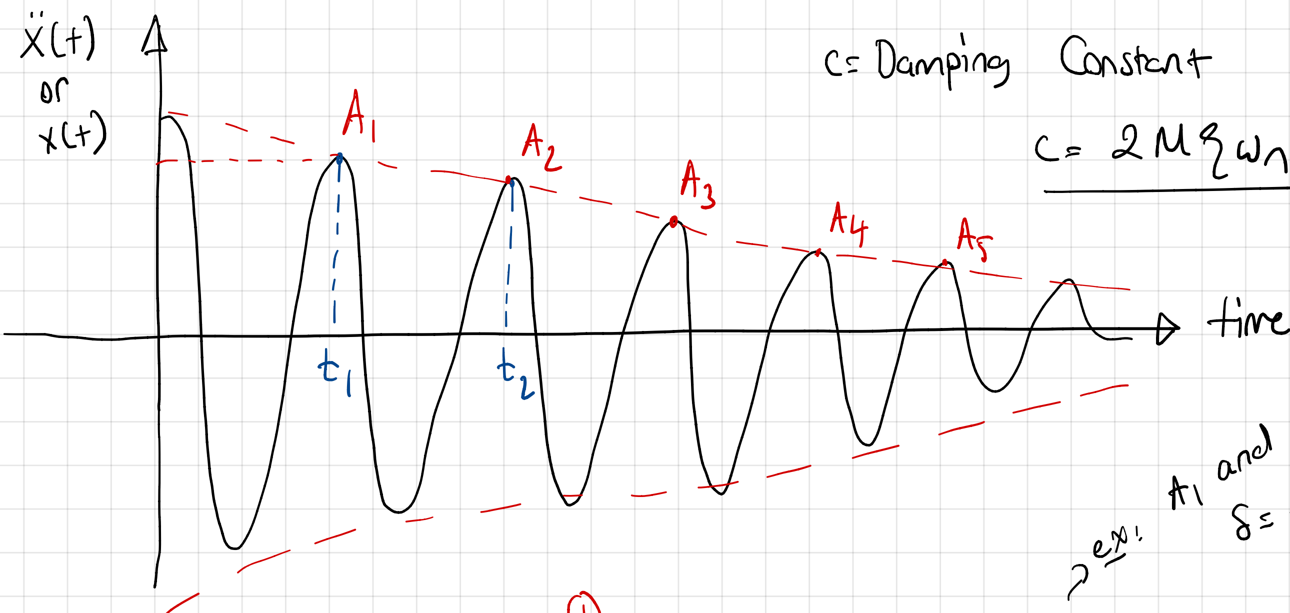
1) $\omega_n^2 = \dfrac{k}{M}$

2) $2\xi\omega_n = \dfrac{c}{M}$

c = Damping Constant

$\Downarrow$

$\underline{c = 2M\xi\omega_n}$ 6



ex: A_1 and A_4 $\quad \delta = \frac{1}{3}\ln\left|\frac{A_1}{A_4}\right|$

Logarithmic Decrement = 1 $\delta = \ln\left|\dfrac{A_1}{A_2}\right|$, $\delta = \dfrac{1}{n}\ln\left|\dfrac{A_1}{A_{n+1}}\right|$

2 $\xi = \dfrac{\delta}{\sqrt{4\pi^2 + \delta^2}}$: Damping Ratio

3 $T_d = t_2 - t_1$

4 $f_d = \dfrac{1}{T_d} \Rightarrow \omega_d = 2\pi f_d$

ω_d = Damped Freq. $\Rightarrow$ 5 $\omega_d = \omega_n\sqrt{1-\xi^2}$