Critical damping: $c^2 = 4km$

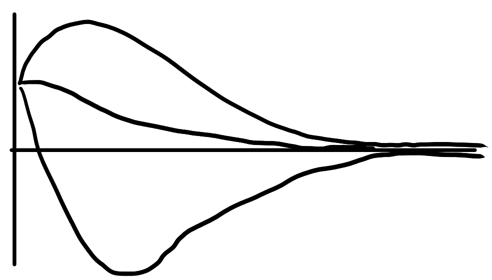
$$mx'' + cx' + kx = 0 \qquad r = \frac{-c + \sqrt{c^2 - 4km}}{2m} = \frac{-c}{2m}$$

$$r = -\gamma \quad \text{repeated root!}$$

So basic solutions are $e^{-\gamma t}, \ te^{-\gamma t}$

General solution $x(t) = e^{-\gamma t}(c_1 + c_2 t)$

Plot



No actual oscillation!

Overdamped $c^2 > 4km$

$$r = \frac{-c \pm \sqrt{c^2 - 4km}}{2m}$$

$$r = -\gamma \pm \sqrt{\gamma^2 - \omega_0^2}$$

Basic solutions $e^{(-\gamma + \sqrt{\gamma^2 - \omega_0^2})t}, \ e^{(-\gamma - \sqrt{\gamma^2 - \omega_0^2})t}$

General solution $x(t) = e^{-\gamma t}\left(c_1 e^{\sqrt{\gamma^2 - \omega_0^2}\, t} + c_2 e^{-\sqrt{\gamma^2 - \omega_0^2}\, t}\right)$

Could also be written $x(t) = e^{-\gamma t}\left(A\cosh(\sqrt{\gamma^2 - \omega_0^2}\, t) + B\sinh(\sqrt{\gamma^2 - \omega_0^2}\, t)\right)$

Plot