

# Unforced Damped Motion

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this lecture will discuss the equation

$$Ay'' + By' + Cy = 0$$

In many applications,  $A$  would be the mass (In a spring, for example,  $A$  would be a mass,  $B$  is the damping, the friction and  $C$  is the spring constant, the force that pulls the mass back Or in electronics,  $B$  would be the resistance, it is giving some friction, giving some heat).

We will substitute  $y = e^{st}$  and get

$$(As^2 + Bs + C)e^{st} = 0$$

So fundamentally, the whole lecture and more is about a quadratic equation. We have to understand how the answers depend on these coefficients  $A, B, C$ .

The quadratic formula tells us that the two solutions -- there are always two, but they could be equal.

$$s = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

$B^2 < 4AC$  means less damping. And it would be called **underdamping**. When  $B^2 = 4AC$  is called **critical damping** and the rest is **overdamping**