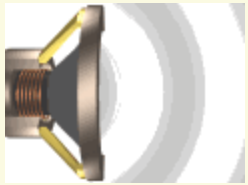
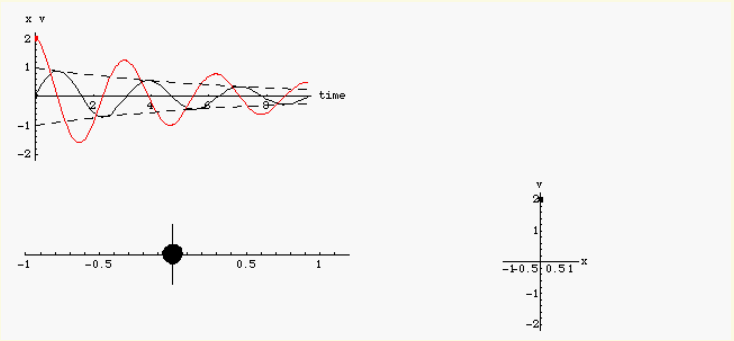


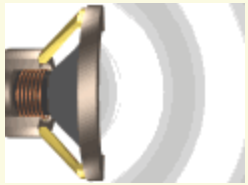
Aula 14: Movimento oscilatório

1. Movimento com atrito viscoso
2. Movimento oscilatório amortecido
3. Movimento oscilatório forçado
4. Ressonância

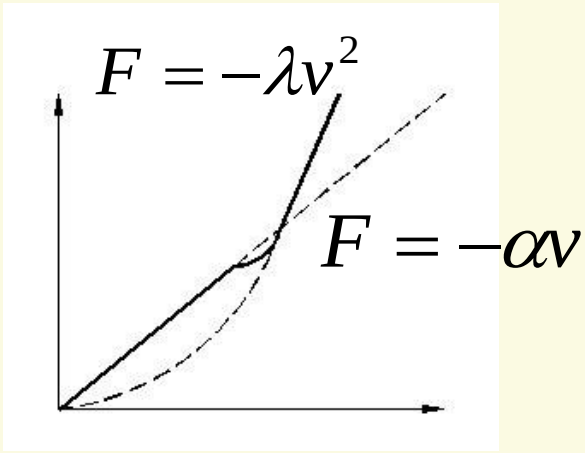


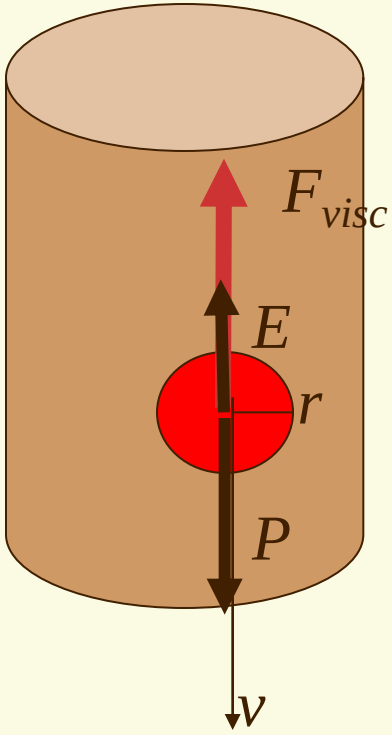
Simulação: movimento com atrito viscoso

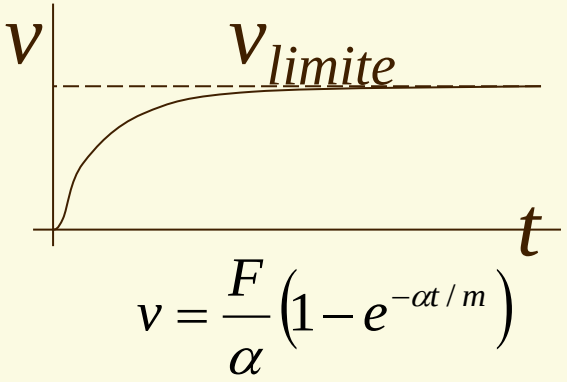
Movimento com atrito viscoso: animação



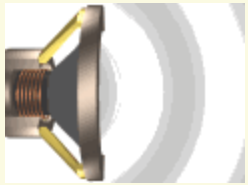
1. Movimento com atrito viscoso



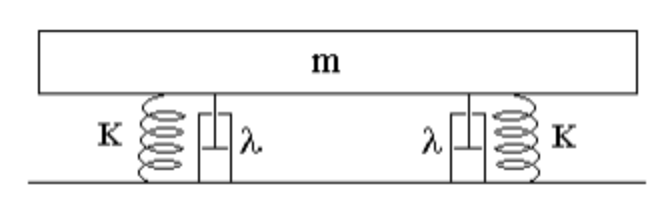




Simulação: movimento harmónico amortecido



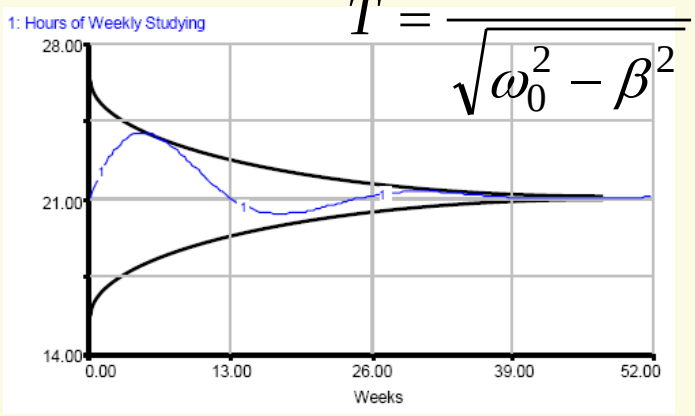
2. Movimento oscilatório amortecido



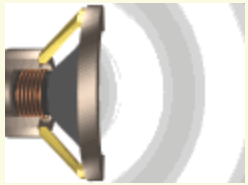
$$m\frac{d^2x}{dt^2} = -kx - \alpha\frac{dx}{dt} \Rightarrow \frac{d^2x}{dt^2} + 2\beta\frac{dx}{dt} + \omega_0^2 x = 0$$

$$x = A_0 e^{-\beta t}\,\mathrm{sen}\left(\omega t + \varphi_0\right)$$

$$T = \frac{2\pi}{\sqrt{\omega_0^2 - \beta^2}}$$



Movimento harmónico forçado: animação



3. Movimento oscilatório forçado

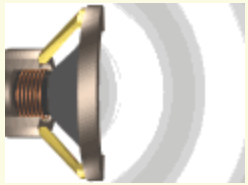
$$\frac{d^2x}{dt^2} + 2\beta\frac{dx}{dt} + \omega_0^2 x = f_0 \cos\omega t$$

$$A = \frac{f_0}{\sqrt{(\omega_0^2 - \omega^2)^2 + (2\beta\omega)^2}}$$

Simulação: amplitude da oscilação forçada

Simulação: fenómeno de ressonância

Documento (1940): efeitos da ressonância



4. Ressonância

$$\omega_{res} = \sqrt{\omega_0^2 - 2\beta^2}$$

$$A_{res} = \frac{F_0 / m}{2\beta\sqrt{\omega_0^2 - \beta^2}} \rightarrow \infty, \quad \beta \rightarrow 0$$