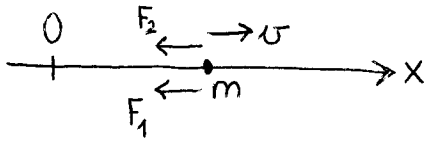
28.) $m = 10\,kg$ $\quad D = 250\frac{N}{m}$ $\quad b = 60\frac{Ns}{m}$ $\quad x_0 = 8m$ $\quad v_0 = 0$ $\quad x(t) = ?$

$F_1 = -Dx \qquad F_2 = -b\dot{x}$



$\vec{a} = \frac{\vec{F_e}}{m}$ $\qquad \vec{v} = \frac{d\vec{r}}{dt}$ $\qquad \vec{a} = \frac{d\vec{v}}{dt}$

$$m\ddot{x} = -Dx - b\dot{x}$$

$$\ddot{x} + \frac{b}{m}\dot{x} + \frac{D}{m}x = 0 \qquad \alpha = \frac{b}{2m} \qquad \omega = \sqrt{\frac{D}{m}}$$

$$\ddot{x} + 2\alpha\dot{x} + \omega^2 x = 0 \qquad x(t) = e^{\lambda t}$$

$$\lambda^2 e^{\lambda t} + 2\alpha\lambda e^{\lambda t} + \omega^2 e^{\lambda t} = 0$$

$$\lambda^2 + 2\alpha\lambda + \omega^2 = 0$$

$$\lambda_{1,2} = \frac{-2\alpha \pm \sqrt{4\alpha^2 - 4\omega^2}}{2} = -\alpha \pm \sqrt{\alpha^2 - \omega^2} = -\alpha \pm i\sqrt{\omega^2 - \alpha^2}$$

$$\lambda_{1,2} = -\alpha \pm i\gamma$$

$\alpha < \omega$
csillapított rezgés

$$\gamma = \sqrt{\omega^2 - \alpha^2}$$

$$x(t) = Ae^{-\alpha t}\cos(\gamma t + \delta)$$

- $x(0) = A\cos\delta = x_0$

$$\dot{x}(t) = -A\alpha e^{-\alpha t}\cos(\gamma t + \delta) - A\gamma e^{-\alpha t}\sin(\gamma t + \delta)$$

$$\dot{x}(0) = -A\alpha\cos\delta - A\gamma\sin\delta = v_0$$

- $v_0 = -A(\alpha\cos\delta + \gamma\sin\delta) = 0$

$$\begin{cases} A\cos\delta = x_0 \\ \alpha\cos\delta + \gamma\sin\delta = 0 \end{cases} \longrightarrow A \text{ és } \delta$$

$$x(t) = Ae^{-\alpha t}\cos(\gamma t + \delta)$$