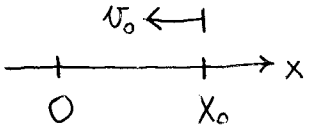
27.) $m = 10g$ $D = 0{,}03 \frac{N}{m}$ $b = 0{,}04 \frac{kg}{s}$ $x_0 = 10cm$ $t = ?$ $x = 0$

$F_1 = -Dx$ $F_2 = -b\dot{x}$ $v_0 = -40 \frac{cm}{s}$



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

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

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

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

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

$$\lambda^2 + 2\alpha\lambda + \omega^2 = 0 \longrightarrow \lambda_{1,2} = \frac{-2\alpha \pm \sqrt{4\alpha^2 - 4\omega^2}}{2} = -\alpha \pm \sqrt{\alpha^2 - \omega^2}$$

$\alpha > \omega$ aperiodikus

$$x(t) = Ae^{\lambda_1 t} + Be^{\lambda_2 t}$$

$$x(0) = A + B = x_0 \quad \bullet\ B = x_0 - A$$

$$\dot{x}(t) = A\lambda_1 e^{\lambda_1 t} + B\lambda_2 e^{\lambda_2 t}$$

$$\dot{x}(0) = A\lambda_1 + B\lambda_2 = v_0$$

$$A\lambda_1 + (x_0 - A)\lambda_2 = v_0 \Longrightarrow \underline{A} \text{ és } \underline{B}$$

$$0 = Ae^{\lambda_1 t} + Be^{\lambda_2 t}$$

$$0 = e^{\lambda_1 t}\left(1 + \frac{B}{A}e^{(\lambda_2 - \lambda_1)t}\right)$$

$$-1 = \frac{B}{A}e^{(\lambda_2 - \lambda_1)t} = \frac{B}{A}e^{-2\sqrt{\alpha^2 - \omega^2}\,t}$$

$$-\frac{A}{B} = e^{-2\sqrt{\alpha^2 - \omega^2}\,t}$$

$$\ln\left(-\frac{A}{B}\right) = -2\sqrt{\alpha^2 - \omega^2}\,t$$

$$t = \frac{\ln\left(-\frac{B}{A}\right)}{2\sqrt{\alpha^2 - \omega^2}}$$