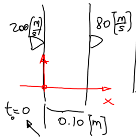
PROBLEMA DE LA BALA.

$t = ?$



material

$$\boxed{\frac{dV}{dt} = -kV^2}$$

$V_0 = 200 \,;\, t_0 = 0$

$X_0 = 0$

$$V = \frac{1}{kt - C}$$

$$200 = \frac{1}{-C}$$

$$C = -\frac{1}{200}$$

$$\boxed{V = \frac{1}{kt + \frac{1}{200}}} \quad SP$$

$V_f = 80 \left[\frac{m}{s}\right] \,;\, t_f = ?$

$$\frac{dx}{dt} = \frac{1}{kt + \frac{1}{200}} \quad \text{EDO(1)NL}$$

$$dx = \frac{dt}{kt + \frac{1}{200}}$$

VARIABLES SEPARABLES.

$$\longrightarrow \int dx = \int \frac{dt}{kt + \frac{1}{200}}$$

$$\frac{dV}{V^2} = -k\,dt$$

VARIABLES SEPARABLES

$$SG \rightarrow \int \frac{dV}{V^2} = -k \int dt + C$$

$$\int V^{-2} dV = -kt + C$$

$$\frac{V^{-1}}{-1} = -kt + C$$

$$\frac{1}{V} = kt - C$$

$$\boxed{V = \frac{1}{kt - C}} \quad SG$$

SG

$$X = \frac{1}{k} \int \frac{k\,dt}{kt + \frac{1}{200}} + C_2$$

$$X = \frac{1}{k} \ln\left(kt + \frac{1}{200}\right) + C_2$$

$$0 = \frac{1}{k} \ln\left(\frac{1}{200}\right) + C_2$$

$$C_2 = -\frac{1}{k} \ln\left(\frac{1}{200}\right)$$

$$X = \frac{1}{k} \ln\left(kt + \frac{1}{200}\right) - \frac{1}{k} \ln\left(\frac{1}{200}\right)$$

$$kX = \ln\left(\frac{kt + \frac{1}{200}}{\frac{1}{200}}\right)$$

$$\frac{kt + \frac{1}{200}}{\frac{1}{200}} = e^{kX}$$

$$kt + \frac{1}{200} = \frac{e^{kX}}{200}$$

$$200kt = e^{kX} - 1$$

$$t = \frac{e^{kX} - 1}{200k}$$

$$t_f = \frac{e^{\frac{k}{10}} - 1}{200k}$$

$$t_f = \frac{e^{\frac{k}{10}} - 1}{200k}$$

$$V = \frac{1}{kt + \frac{1}{200}}$$

$$kt + \frac{1}{200} = \frac{1}{V}$$

$$kt = \frac{1}{V} - \frac{1}{200}$$

$$k = \frac{\frac{1}{V} - \frac{1}{200}}{t}$$

$$t_f = \frac{e^{\left(\frac{\frac{1}{80} - \frac{1}{200}}{10 t_f}\right)} - 1}{200\left(\frac{\frac{1}{80} - \frac{1}{200}}{t_f}\right)}$$

$$t_f\left(200\left(\frac{\frac{1}{80} - \frac{1}{200}}{t_f}\right)\right) = e^{\left(\frac{\frac{1}{80} - \frac{1}{200}}{10 t_f}\right)} - 1$$

$$200\left(\frac{1}{80} - \frac{1}{200}\right) + 1 = e^{\left(\frac{\frac{1}{80} - \frac{1}{200}}{10 t_f}\right)}$$

$$\frac{5}{2} = e^{\left(\frac{\frac{1}{80} - \frac{1}{200}}{10 t_f}\right)}$$

$$\frac{\frac{1}{80} - \frac{1}{200}}{10 t_f} = \ln\left(\frac{5}{2}\right)$$

$$a = e^b$$

$$b = \ln(a)$$

$$10 t_f = \frac{\frac{1}{80} - \frac{1}{200}}{\ln\left(\frac{5}{2}\right)}$$

$$t_f = \frac{\frac{1}{80} - \frac{1}{200}}{10 \ln\left(\frac{5}{2}\right)}$$

$$t_f = 8.1852 \times 10^{-4}$$

$$t = 0.00081852\ [s]$$

$$k = \frac{\frac{1}{80} - \frac{1}{200}}{t_f} \Rightarrow k = 9.16$$

$$\boxed{V = \frac{1}{9.16t + \frac{1}{200}}} \qquad \boxed{X = \frac{\ln\left(\frac{9.16t + \frac{1}{200}}{\frac{1}{200}}\right)}{9.16}}$$

$$t_f = \frac{e^{\frac{9.16}{5}} - 1}{200(9.16)} = 2.86 \times 10^{-3}$$

$$V = 32 \left[\frac{m}{s}\right]$$

CAPÍTULO 2. EDO(n) LINEAL

$$\frac{dy}{dx} + p(x)y = q(x) \quad \text{EDO(1)L.c.v.NH}$$

$$y(x) = Ce^{-\int p(x)dx} + e^{-\int p(x)dx}\int e^{\int p(x)dx} q(x)dx$$

$$y_{g/NH} = y_{g/H} + y_{p/q}.$$

EDO(2)LCCH.

$$\frac{d^2y}{dx^2}+a_1\frac{dy}{dx}+a_2y=0$$

H_0: $y_p=e^{mx}$ $\quad \frac{dy}{dx}=me^{mx}$ $\quad \frac{d^2y}{dx^2}=m^2e^{mx}$

$$\left[m^2e^{mx}\right]+a_1\left[me^{mx}\right]+a_2\left[e^{mx}\right]=0$$

$$\left(m^2+a_1m+a_2\right)e^{mx}=0$$

$\boxed{H_1: y=0 \quad \text{trivial}}$

$$\begin{matrix} m_1 \\ m_2 \end{matrix}\left\{ \begin{cases} e^{mx}=0 \\ m^2+a_1m+a_2=0 \end{cases} \right.$$

ECUACIÓN CARACTERÍSTICA

$$\frac{d^2y}{dx^2}+a_1\frac{dy}{dx}+a_2y=0 \quad \text{EDO(2)LCCH.}$$

$y_g=c_1y_1+c_2y_2$ $\quad$ $\left.\begin{matrix} y_1 \\ y_2 \end{matrix}\right\}$ SOLUCIONES PARTICULARES FUNDAMENTALES.

$$y=e^{mx}$$

$$y_1=e^{m_1x} \qquad y_2=e^{m_2x}$$

$$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$$

$H_0 \quad y = e^{mx} \longrightarrow m^2 - 5m + 6 = 0$

$(m-3)(m-2) = 0$

$y_g = c_1 e^{2x} + c_2 e^{3x}$

$\left.\begin{matrix} m_1 = 2 \\ m_2 = 3 \end{matrix}\right\} m_1 \neq m_2 \in \mathbb{R}$

✓ $y_1 = e^{2x} \quad \frac{dy}{dx} = 2e^{2x} \quad \frac{d^2y}{dx^2} = 4e^{2x}$

$$[4e^{2x}] - 5[2e^{2x}] + 6[e^{2x}] = 0$$

$$(10e^{2x} - 10e^{2x}) = 0$$

$$0 \equiv 0$$

✓ $y_2 = e^{3x} \quad \frac{dy}{dy} = 3e^{3x} \quad \frac{d^2y}{dx^2} = 9e^{3x}$

$$[9e^{3x}] - 5[3e^{3x}] + 6[e^{3x}] = 0$$

$$(15e^{3x} - 15e^{3x}] = 0$$

$$0 \equiv 0$$

Sol gral $y = C_1 e^{x} + C_2 e^{-x}$ EDO(2)L∴H

$m_1 = 1 \qquad m_2 = -1$

$(m-1)(m+1) = 0$

$m^2 - 1 = 0$ ECUACIÓN CARACTERÍSTICA.

$$\frac{d^2y}{dx^2} - y = 0$$

$$\boxed{\text{EDO}(n)L} \rightleftarrows \boxed{SG}$$