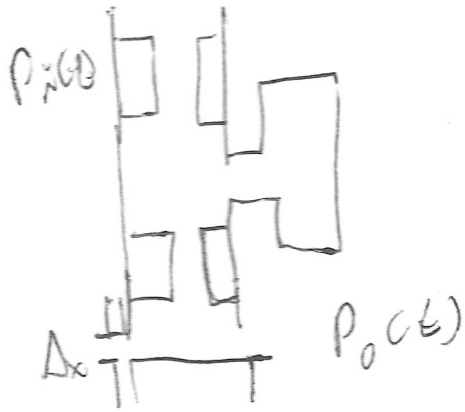
Problema no 1



Nota:
Problema 3
$M = 0.5\ Kg$

$R_v = 2.2\ K$

$C = 4.7\ uF$

$$V_i(t) = R_f i_1(t) + R_v(i_1(t) - i_2(t)) \ldots (1)$$

$$0 = R_v(i_2(t) - i_1(t)) + \frac{1}{C}\int i_2(t)\,dt \ldots (2)$$

$$V_o(t) = \frac{1}{C}\int i_2(t)\,dt \ldots (3)$$

Aplicando la transformada de laplace

$$V_i(s) = R_f I_1(s) + R_v I_1(s) - R_v I_2(s) \ldots (4)$$

$$0 = R_v I_2(s) - R_v I_1(s) + \frac{1}{sC} I_2(s) \ldots (5)$$

$$V_o(s) = \frac{1}{sC} I_2(s) \ldots (6)$$

$\uparrow$ V. S

$\uparrow$ V. E

Despejando variables dependientes

$$V_i(s) = I_1(s)(R_f + R_v) - R_v I_2(s)$$

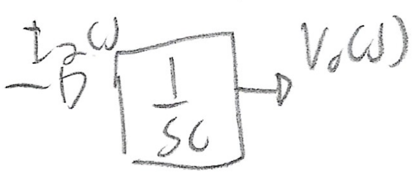
$$V_i(s) + R_v I_2(s) = I_1(s)(R_f + R_v)$$

$$\underset{\text{V.E}}{\frac{V_i(s)}{R_f+R_v}} + \frac{R_v}{R_f+R_v} \underset{\text{V.E}}{I_2(s)} = \underset{\text{V.S}}{I_1(s)} \ldots (7)$$

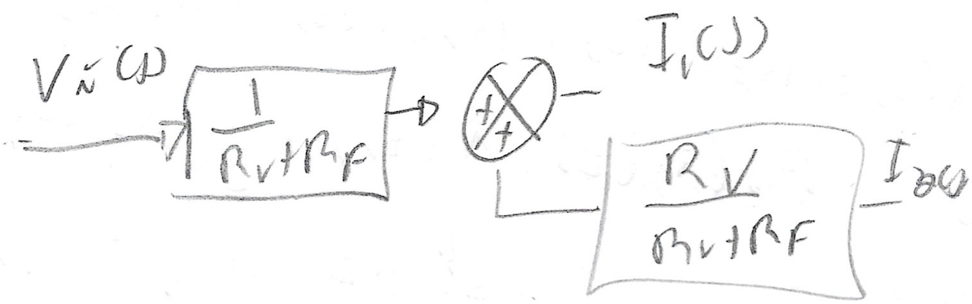
$$R_v I_1(s) = I_2(s)\left(R_v + \frac{1}{sC}\right) = I_2(s)\left(\frac{sCR_v+1}{sC}\right)$$

$$\frac{sCR_v}{sCR_v+1} I_1(s) = I_2(s) \ldots (8)$$

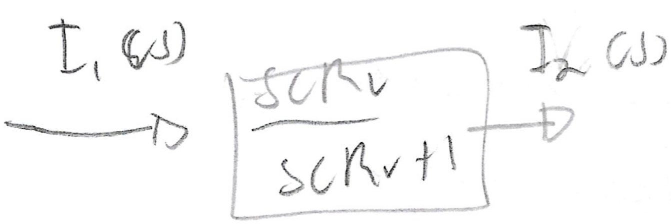
Para (6)



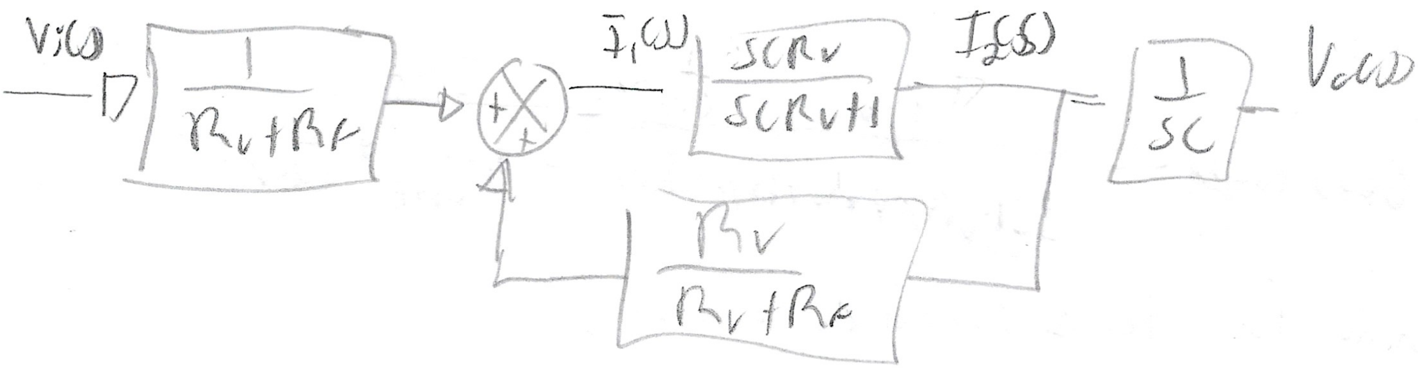
Para (7)



Para (8)



Unimos los diagramas



$$V_i(s) \longrightarrow \boxed{\left(\frac{1}{R_v+R_f}\right)\left(\frac{\frac{sCR_v}{sCR_v+1}}{1-\left(\frac{R_v}{R_v+R_f}\right)\left(\frac{sCR_v}{sCR_v+1}\right)}\right)\left(\frac{1}{sC}\right)} \longrightarrow V_o(s)$$

$$\frac{V_o(s)}{V_i(s)} = \left(\frac{1}{\cancel{R_v+R_f}}\right)\left(\frac{\cancel{sC}R_v\cdot\cancel{(R_v+R_f)}}{(R_v+R_f)(sCR_v+1)-sCR_v^2}\right)\frac{1}{\cancel{sC}}$$

$$\frac{V_o(s)}{V_i(s)} = \frac{R_v}{\cancel{sCR_v^2}+R_v+sCR_vR_f+R_f-\cancel{sCR_v^2}}$$

$$\boxed{\frac{V_o(s)}{V_i(s)} = \frac{R_v}{sCR_vR_f+R_v+R_f}}$$

Para una entrada impulso

$R(s)=1$

$$C(s)=G(s)\cdot R(s) = \frac{\frac{1}{\tau}}{s+\frac{1}{\tau}} = \frac{\frac{1}{\tau}}{s+\frac{1}{\tau}}$$

Aplicando la transformada inversa

$$\cancel{c(t) = \frac{1}{\tau} e^{-\frac{t}{\tau}}}$$

Para su constante en el tiempo

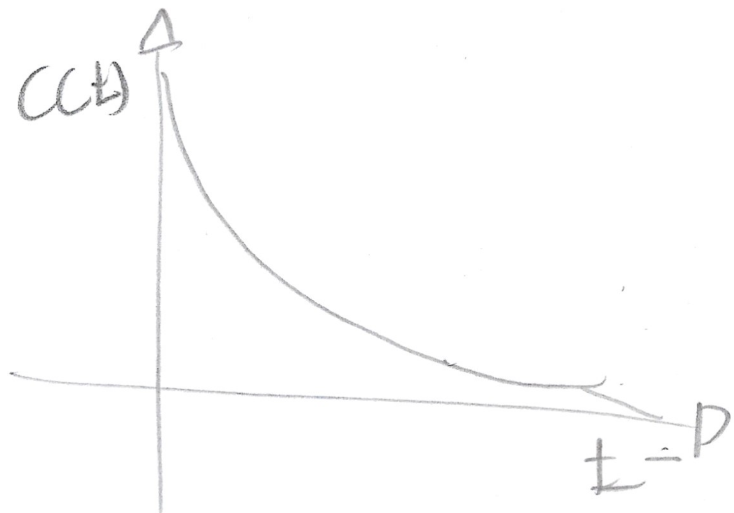
$$\frac{V_o(s)}{V_i(s)} = \frac{R_v}{sCR_vR_f+R_v+R_f}\cdot\frac{\frac{1}{CR_vR_f}}{\frac{1}{CR_vR_f}} = \frac{\frac{1}{CR_f}}{s+\frac{1}{CR_f}+\frac{1}{CR_v}}$$

$$= \frac{\frac{R_f+R_v}{CR_fR_v}\underbrace{\left(\frac{R_v}{R_f+R_v}\right)}_{\text{Ganancia}}}{s+\frac{R_f+R_v}{CR_fR_v}} \Rightarrow \frac{1}{\tau}=\frac{R_f+R_v}{CR_vR_f}$$

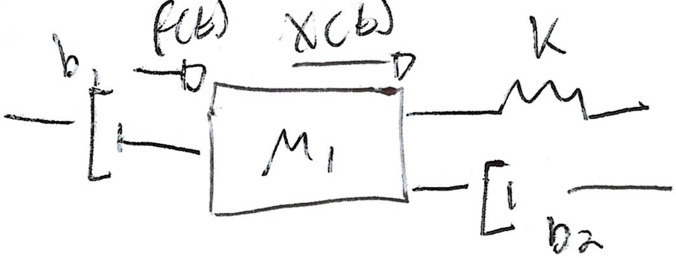
$$\Rightarrow \tau = \frac{CR_vR_f}{R_f+R_v}=0.00323$$

$$c(t)=\left(\frac{1}{0.00323}e^{-\frac{t}{0.00323}}\right)\cdot 5\cdot 0.3125 \leftarrow \text{Ganancia}$$

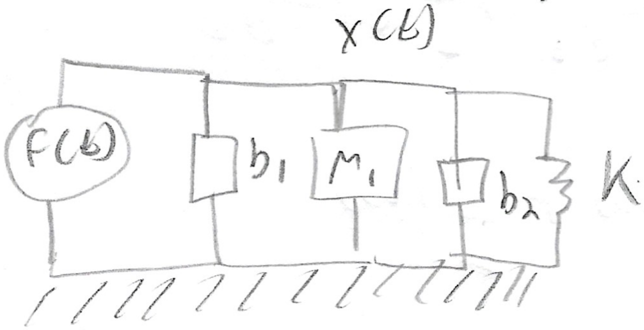
t	$c(t)$
0	483.55
T/2	293.24
T	177.89
2T	65.44
3T	24.07
4T	8.85
5T	3.25
6T	1.19



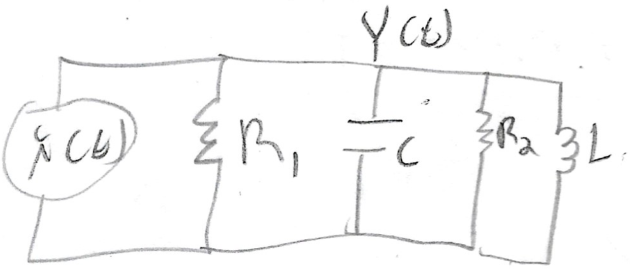
Problema no3



Establecemos tierra y conectamos las masas



Sustituimos los componentes con la analogía Fuerza-corriente



El número de ecuaciones es igual al número de nodos o desplazamientos

$$i(t) = R_1\, i(t) + C\, i(t) + R_2\, i(t) + L\, i(t)$$

Encontramos el valor de las corrientes

$$i(t) = \frac{V(t)}{R_1} + C\frac{dV(t)}{dt} + \frac{V(t)}{R_2} + \frac{1}{L}\int v(t)\,dt$$

Sustituimos por su definición formal del voltaje

como el voltaje   Fza - corriente

$$v(t) = \frac{d\,y(t)}{dt}$$

$$i(t) = \frac{1}{R_1}\frac{d\,y(t)}{dt} + C_1\frac{d^2 y(t)}{dt} + \frac{1}{R_2}\frac{d\,y(t)}{dt} + \frac{1}{L}\int \frac{d(y(t))}{dt}dt$$

$$I(s) = \frac{s}{R_1}\,y(s) + s^2 C_1\,Y(s) + \frac{s}{R_2}\,y(s) + \frac{1}{L}\,Y(s)$$

$$I(s) = Y(s)\left(\frac{s}{R_1} + s^2 C_1 + \frac{s}{R_2} + \frac{1}{L}\right)$$

$$= Y(s)\left(\frac{sLR_2 + s^2 R_1 R_2 L + sLR_1 + R_1 R_2}{R_1 R_2 L}\right)$$

$$\frac{R_1 R_2 L}{s^2 R_1 R_2 L + s(LR_2 + LR_1) + R_1 R_2 L} = \frac{Y(s)}{I(s)}$$

Para determinar la cte de amortiguamiento

$$\frac{Y(s)}{I(s)} = \frac{R_1 R_2 L}{s^2 R_1 R_2 L + s(LR_2 + LR_1) + R_1 R_2} \qquad \frac{\frac{1}{LR_1R_2}}{\frac{1}{LR_1R_2}}$$

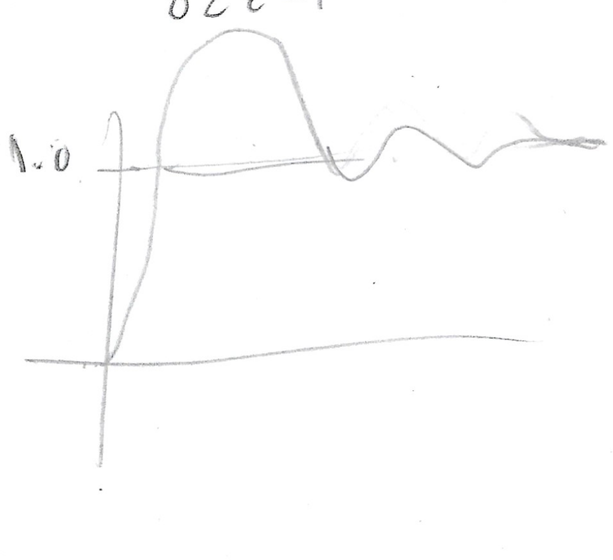
$$\frac{Y(s)}{I(s)} = \frac{4\left(\frac{1}{L}\right)}{s^2 + s\left(\frac{1}{R_1} + \frac{1}{R_2}\right) + \frac{1}{L}}$$

$$\Rightarrow w_n^2 = \frac{1}{L} = \sqrt{\frac{1}{L}} = \sqrt{K} = 3.49$$

$$2 \varepsilon W_n = b_1 + b_2$$

$$\varepsilon = \frac{b_1 + b_2}{2 W_n} = \frac{1.2 + 4.7}{2(3.49)} = \underline{0.844}$$

$0 < \varepsilon < 1$



sub amortiguada

Para Resolver la ecuación diferencial, utilizando AOP

$$F(S) = S^2 M X(s) + s X(s)(B_1 + B_2) + X(s) K$$

$$f(t) = m \frac{d^2 x(t)}{dt} + (b_1 + b_2) \frac{d x(t)}{dt} + K x(t)$$

$$\boxed{f(t) = m\ddot{x} + (b_1 + b_2)\dot{x} + Kx}$$

$$\ddot{x} = \frac{f(t)}{m} + \frac{(b_1 + b_2)}{m}\dot{x} - \frac{K}{m}x$$