$\boxed{1}$ a) $G(s) = \dfrac{s+10}{(s+4)(s+2)^2}$

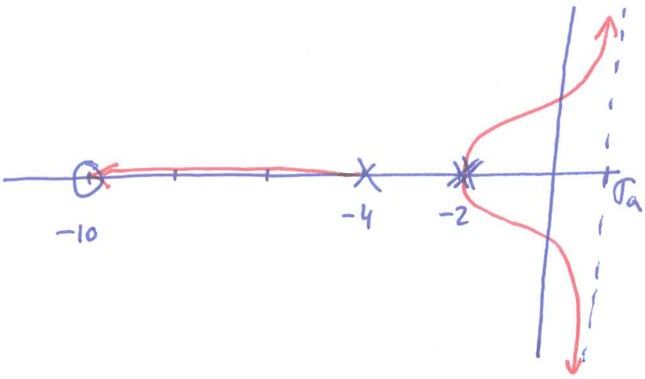
ceros: $s = -10$

polos: $s = -2, -2, -4$

Grado rel. $2 \Rightarrow$ 2 asíntotas verticales

$$\sigma_a = \frac{-4-2-2-(-10)}{2} = 1$$

Punto de ruptura en el polo doble: $\sigma_r = -2$



b) $$G_{BC} = \frac{1}{1+KG(s)} = \frac{K(s+10)}{(s+4)(s^2+4+4s)+Ks+10K} = \frac{K(s+10)}{s^3+4s+4s^2+4s^2+16+16s+Ks+10K}$$

$$= \frac{K(s+10)}{s^3+8s^2\ (20+K)s+(16+10K)s^0}$$

Rango de estabilidad por Routh:

s^3	1	$20+K$
s^2	8	$16+10K$
s^1	a_{11}	0
s^0	$16+10K$	0

$$a_{11} = \frac{(20+K)8-16-10K}{8} = \frac{160-16+8K-10K}{8} = \frac{144-2K}{8}$$

Estabilidad: 1ª columna positiva:

$$\frac{144-2K}{8} > 0 \Rightarrow 72-K > 0 \Rightarrow K < 72$$

$$16+10K > 0 \Rightarrow K > \frac{-16}{10}$$

Como $K > 0 \Rightarrow K \in (0, 72)$

c) $T_s = 4s \Rightarrow \dfrac{4}{\xi\omega_n} = 4 \Rightarrow \xi\omega_n = 1$. Cuando los polos complejos conjugados estén en $-1 \pm ?j$. Para calcular la K, usaré el polo de la recta real. Calculo su posición por la regla del baricentro:

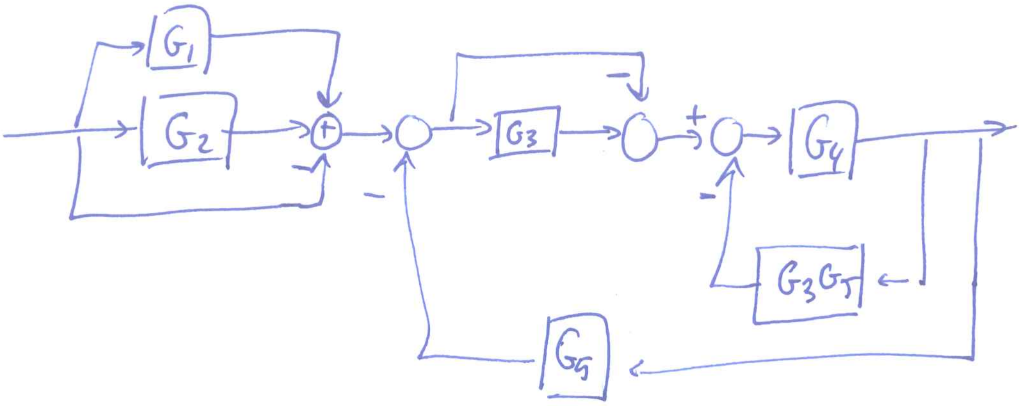
$\Sigma p_i = -4-2-2 = -8$. Luego $2\cdot(-1)+p = -8 \Rightarrow p = -6 \Rightarrow s^* = -6$

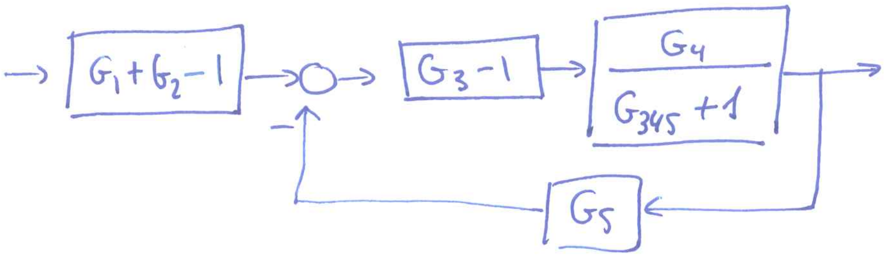
$$K = \frac{|D(s)|}{|N(s)|} = \frac{2\cdot4\cdot4}{4} = 8$$

d) como $\dfrac{|-6|}{|-1|} \geq 5$, la aprox a 2º orden es buena

13'

1





$$\boxed{(G_1+G_2-1)\,\frac{(G_3-1)\,G_4}{G_{45}(G_3-1)+G_{345}+1}} \longrightarrow$$

b) $$\underbrace{\left(2+\frac{1-s}{s}-1\right)}_{\frac{\cancel{2s}+1-\cancel{s}-\cancel{s}}{s}}\frac{(5s-1)s}{2s(5s-1)+10s^2+1}=\frac{1}{\cancel{s}}\,\frac{(5s-1)\cancel{s}}{10s^2-2s+10s^2+1}=$$

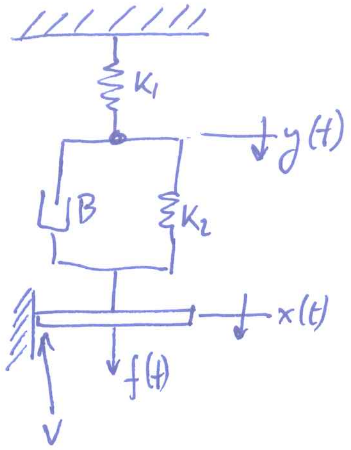
$$=\frac{5s-1}{20s^2-2s+1}\xrightarrow{\text{Rechin}}=\frac{\times}{20s^2-2s+1+5Ks-K}$$

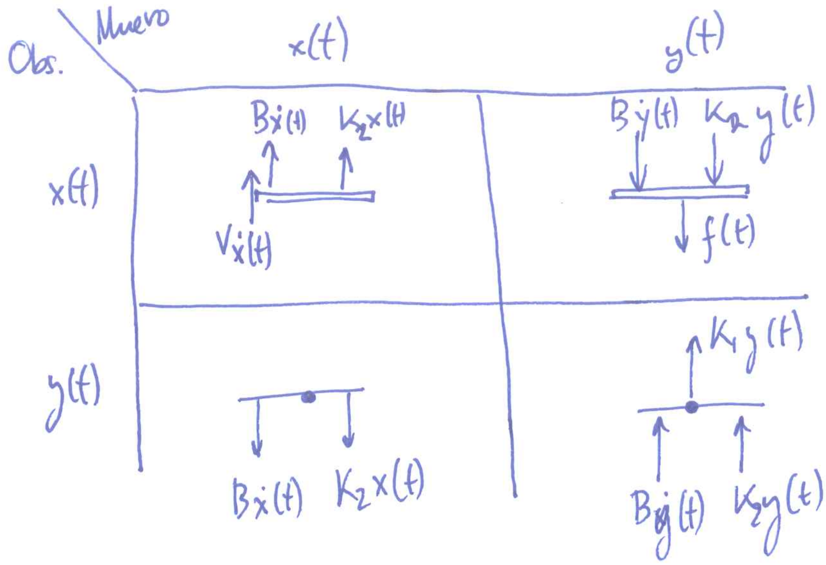
s^2	20	$1-K$
s^1	$5K-2$	$\emptyset$
s^0	$1-K$	$\emptyset$

$$\left.\begin{array}{l}1-K>0 \Rightarrow K<1\\ 5K-2>0\Rightarrow K>\frac{2}{5}\end{array}\right\}\ \underline{K\in\left(\tfrac{2}{5}\,..\,1\right)}$$

2

a)





(1) $f(t) + B\dot{y}(t) + K_2 y(t) = (B+V)\dot{x}(t) + K_2 x(t)$

(2) $B\dot{x}(t) + K_2 x(t) = B\dot{y}(t) + (K_1+K_2)y(t)$

b) (1) $F(s) + BsY(s) + K_2Y(s) = (B+V)sX(s) + K_2X(s)$

(2) $BsX(s) + K_2X(s) = BsY(s) + (K_1+K_2)Y(s)$

c) Sustituyo: (1) $F(s) + Y(s)(K+s) = X(s)(2s+K)$

(2) $X(s)(s+K) = Y(s)(s+2K)$

Despejo $Y(s)$ en (2): $Y(s) = X(s)\dfrac{K+s}{2K+s}$ Sustituyo en (1)

$$F(s) + X(s)\frac{(K+s)^2}{2K+s} = X(s)(2s+K) \Rightarrow F(s) = X(s)\left[(2s+K) - \frac{(K+s)^2}{2K+s}\right]$$

$$= X(s)\left[\frac{(2s+K)(2K+s) - K^2 - s^2 - 2Ks}{2K+s}\right] = \left[\frac{\cancel{4Ks} + \cancel{2}s^2 + \cancel{2}K^2 + 3Ks - \cancel{K^2} - \cancel{s^2} - \cancel{2Ks}}{2K+s}\right]$$

$$\Rightarrow \frac{X(s)}{F(s)} = \frac{2K+s}{K^2+3Ks+s^2}$$

d) $\mu = \dfrac{2K}{K^2} = \dfrac{2}{K}$ $f(t) = 10Kg \cdot 9'8 = 98N \Rightarrow 98 \cdot \dfrac{2}{K} = 0'1 \Rightarrow K = 1960$

15'