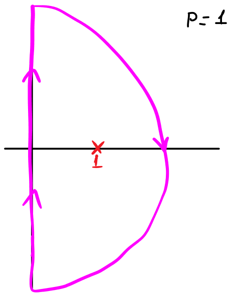
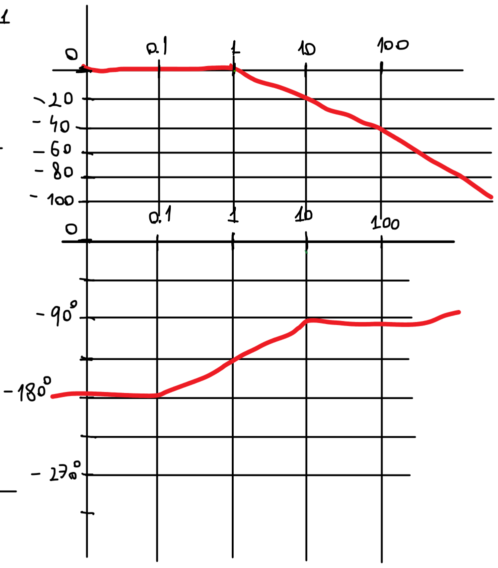
Q1)

Q 1.1)

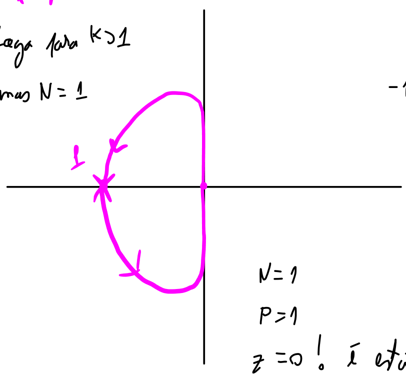
$P(s) = \frac{1}{s-1}$





K=1

Logo para K>1 temos N=1



N=1

P=1

Z=0! é estável

Q 1.2) K=100 ⇒ "subiu" 40dB

$GM^{+} = +\infty$ dado que a fase para ∞ não é 180°

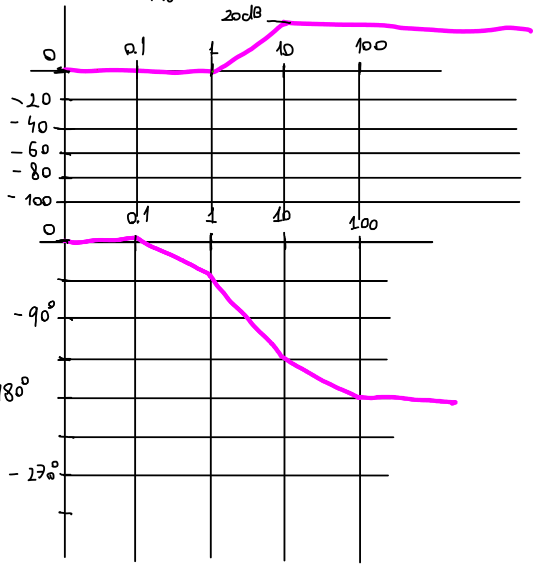
$GM^{-} = -40dB$ que foi o que subimos

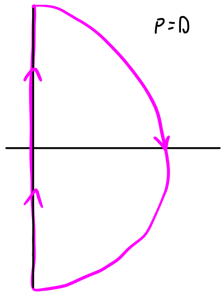
$e(t) = r(t) - y(t)$ $\quad \lim_{t\to\infty} e(t) = \lim_{s\to 0} s\,E(s)$

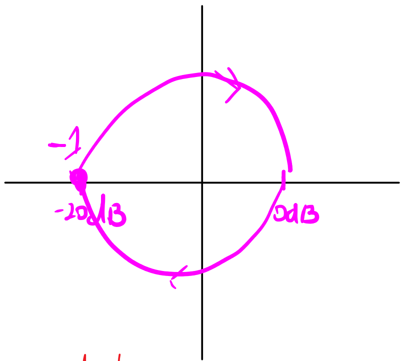
$y(t) = e(t)\cdot C(s)$

$E(s) = \frac{\frac{1}{s}}{1+\frac{100}{s-1}}$ $\quad \lim_{s\to 0} \frac{\cancel{s}\cdot\frac{1}{\cancel{s}}}{1+\frac{100}{s-1}} = \frac{1}{1-100} = \boxed{\frac{1}{99}} \rightarrow < 10\%$ ✓

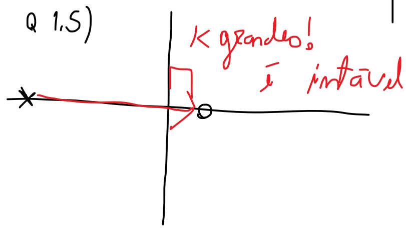
Q 1.4) $P(s) = \frac{10(s-1)}{s+10} = (s-1)\cdot\frac{10}{s+10}$



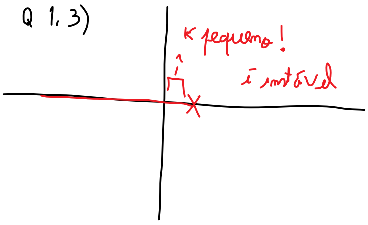




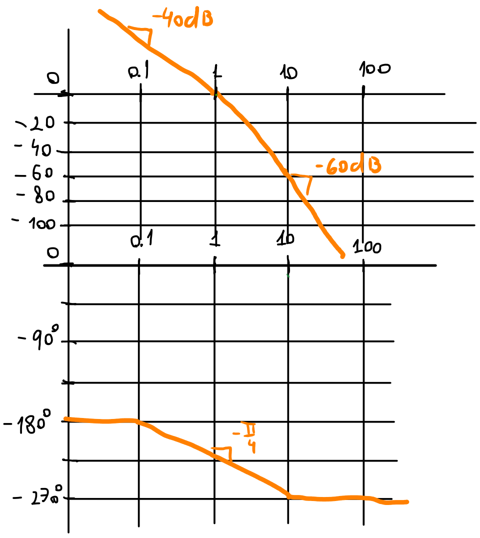
Q 1.5)

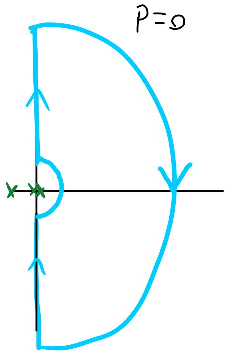


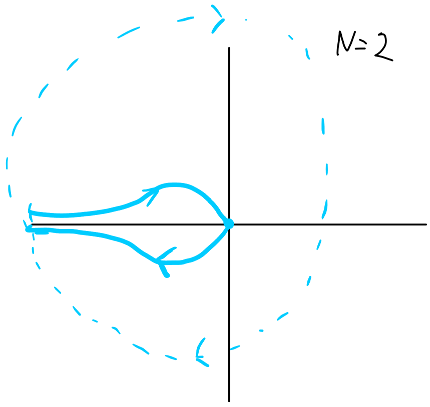
Q 1.3)



Q2) $\frac{1}{s}\cdot\frac{1}{s+1}\cdot\frac{1}{s}$







$\left.\frac{1}{s^2(s+1)}\right|_{s=\varepsilon e^{j\theta}} \rightarrow \frac{1}{\varepsilon^2}e^{-2j\theta}$

P=0

N=2 ⇒ Z≠0 é instável

Q 2.2)

R1) ⇒ 1 integrador (já tem) ✓

R2) ⇒ + 1 integrador $\left(\frac{1}{s}\right)$ ✓

R3) ⇒ $[0 ; 0.01]$ > 60dB ✓

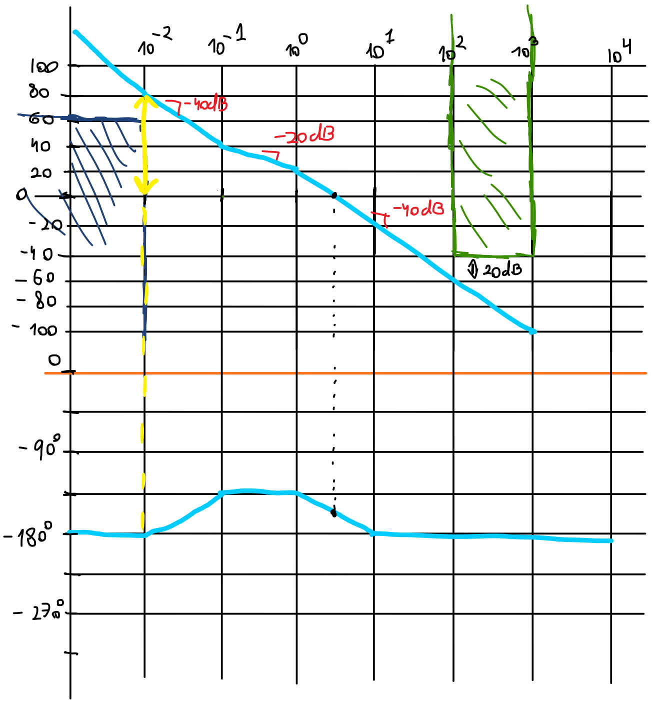
R4) ⇒ $[10^2, 10^3]$ < -40dB ✓

R5) ⇒ $P_M \geq 20^\circ$ ✓

R6) ⇒ $G_M^+ \geq 20dB$ ✓

$K(s) = K \frac{s+a}{sa}$ R1) e R2) ✓

$K \cdot \frac{s+a}{a} \cdot \frac{1}{s} \cdot \frac{1}{s} \cdot \frac{1}{(s+1)}$



$a = 0.1$
$k = 1$

$GM^+ = \infty$ (no entanto a respeitar as restrições é apenas 20dB)

$PM^+ \approx 45^\circ$

Q.2.2) Precisa de diminuir 80 dB's

Atenção

Estes valores são assimptóticos

Q 2 3) $\tau = 1$

fase de $e^{-s\tau} = -\omega\tau$

$\omega = 3.16$ (no meio)

-3.16

$\underbrace{PM_\tau}_{0} = -\omega\tau + PM$

$0 < -\omega\tau + PM \approx -3.16 + \frac{\pi}{4}$? F ⟶ fica instável