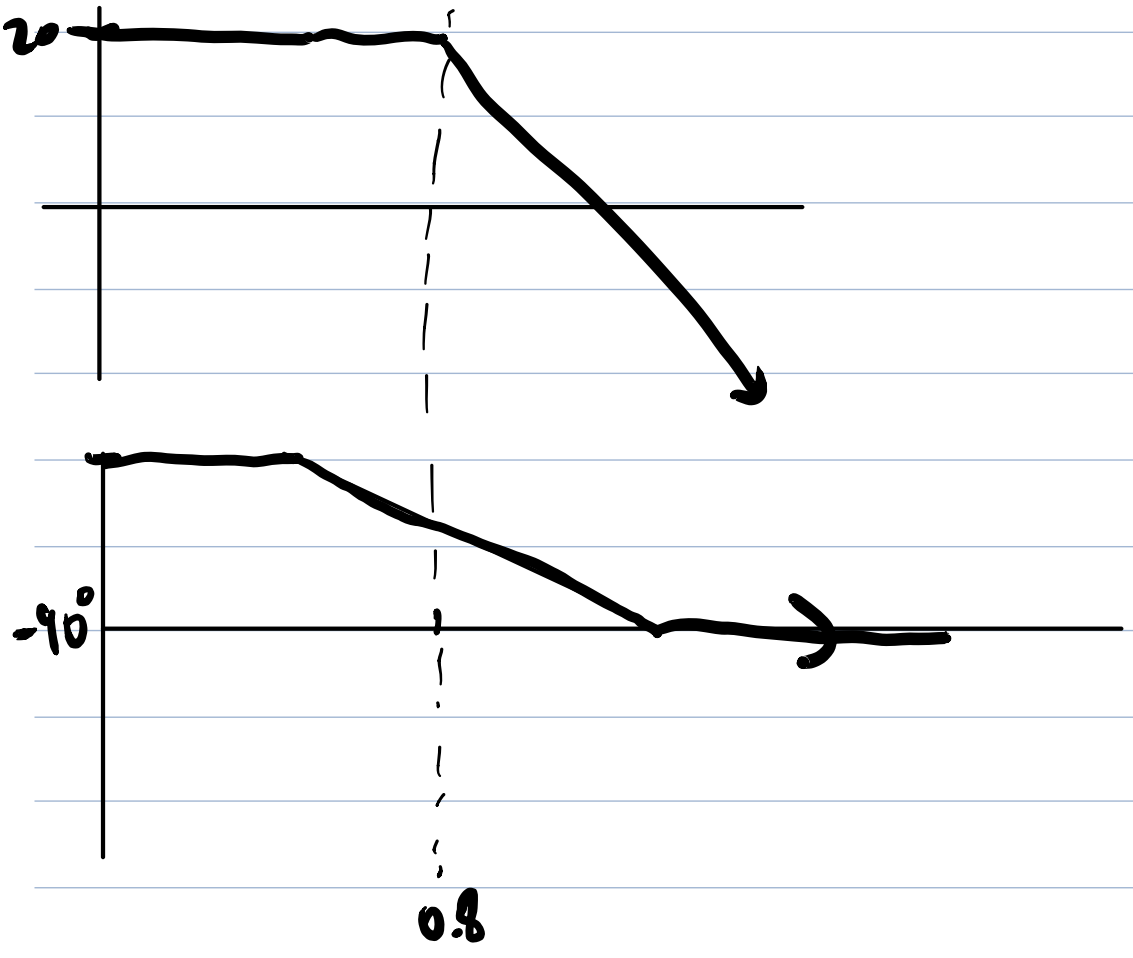
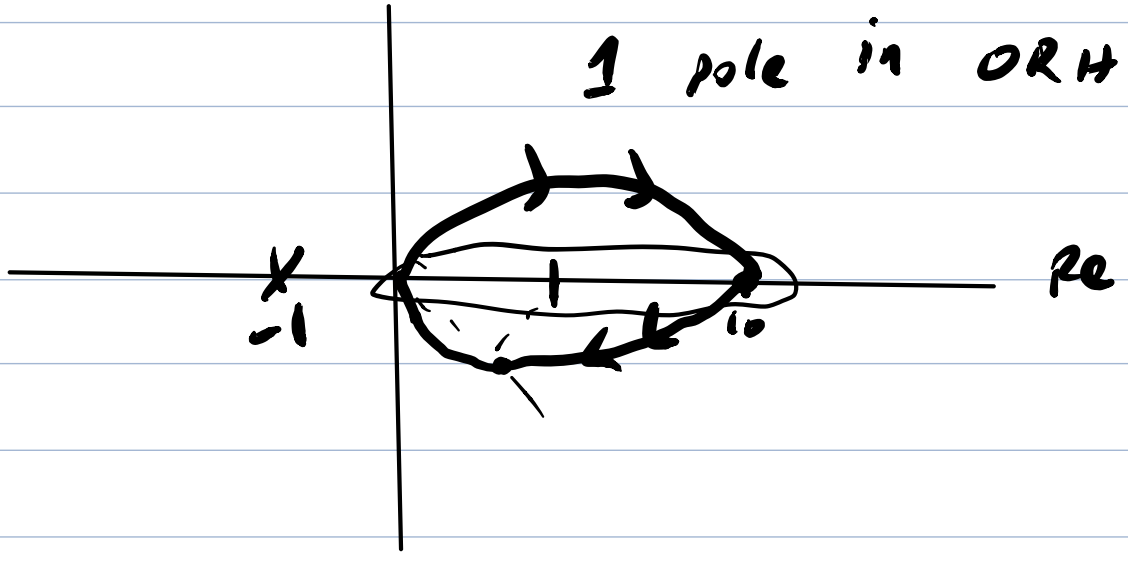
Problem 7



Initial $\omega = 0$ $\quad$ At $\omega = 0.8$

$P(0)C(0) = 10$ $\quad$ $P(0.8j)C(0.8j) = \frac{5}{\sqrt{1}} - \frac{5}{\sqrt{2}}j$



Look for ω_{gc} where $|PC|_{dB} = 0$ $\quad$ $\omega_{gc} \approx 3$

$OL = -\frac{1}{K}$ ~~< 10~~ 2 CW enc. (-1 CCW enc.) Need 1

PS

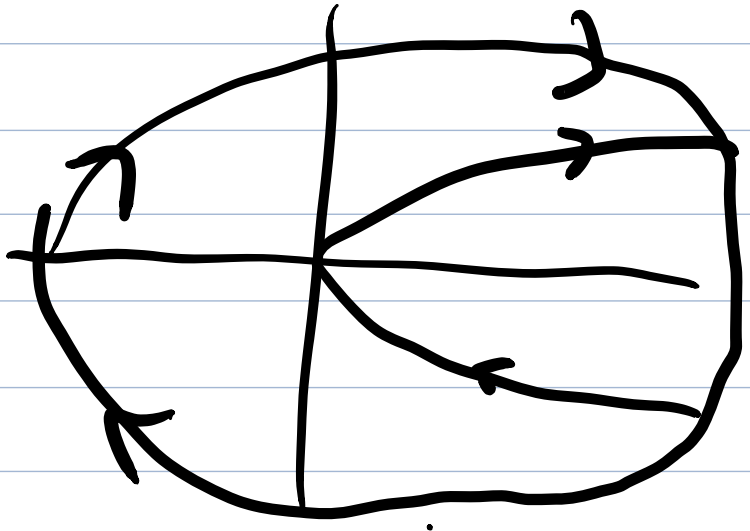
$P(s) = \frac{s-1}{s^2}$ $\quad C(s) = K$

Find K for feedback stability

Note: No ORHP poles in PC.

desire no CCW encirclements!

$$P(j\omega)C(j\omega) = \frac{1}{\omega^2} - \frac{1}{\omega^3}j$$



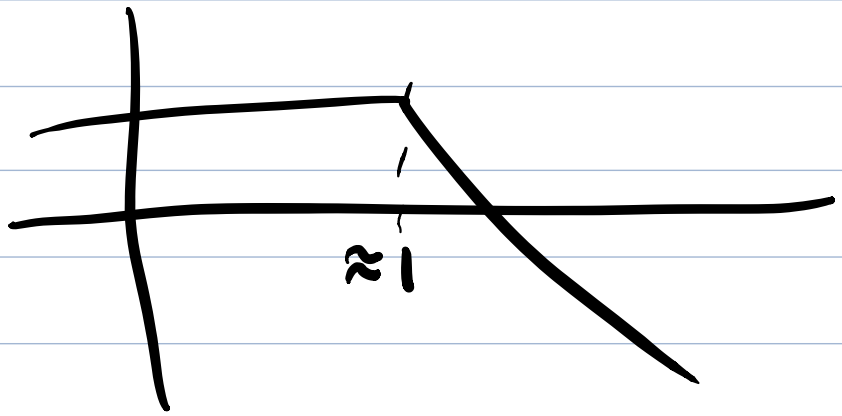
$$P(\varepsilon e^{j\omega}) = \frac{\varepsilon e^{-j\omega} - e^{-2j\omega}}{\varepsilon^2}$$

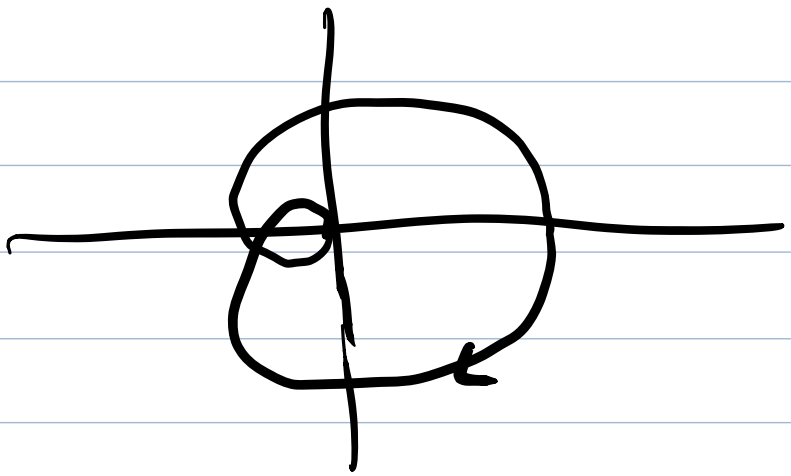
game over!

$$\approx \frac{-e^{-2j\omega}}{\varepsilon^2}$$

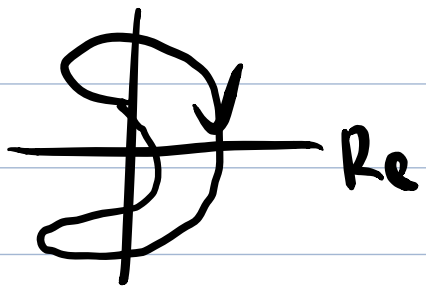
e.g. final 2017

$P(s) = \frac{1}{(s+1)(s+2)}$ $\quad C(s) = \frac{K}{s+3}$





delay



$P(s) = \cdots e^{-j0.25}$

$C(s) =$

$$T_{max} = \frac{\phi_{pm}}{\omega_{gc}}$$

$$s^5 + 2s^4 + 25s^3 + 50s^2 + 144s + 288$$

s^5	1	25	144	
s^4	2	50	288	
s^3	0 (1)	0 (100)	0*	row of zeros
s^2				
s^1				
s^0				

$$A(s) = 2s^4 + 50s^2 + 288$$

$$s^2 = \frac{-50 \pm 14}{4}$$

$$s^2 = \{-9, -16\}$$

$$s = \{3j, -3j, 4j, -4j\}$$