Soluzione sviluppata da uno studente durante lo svolgimento del compito d'esame.

$$W(s) = \frac{K(s-8)}{s(s+0.5)}$$

$K = 1$

$$W_1(s) = \frac{s-8}{s(s+0.5)}$$

- $s - 8 = -8\left(1 - \frac{s}{8}\right)$ termine binomio al numeratore

  $\omega_t = 8$ rad/s

  + 20 dB/dec $[8, +\infty]$

  - $\frac{\pi}{4}$ rad/dec $[0.8, 80]$

- s termine monomio al denominatore

  - 20 dB/dec $[0, +\infty]$

  - $\frac{\pi}{2}$ rad sfasamento globale

- $s + 0.5 = 0.5\left(1 + \frac{s}{0.5}\right)$ termine binomio al denominatore

  $\omega_t = 0.5$

  - 20 dB/dec $[0.5, +\infty]$

  - $\frac{\pi}{4}$ rad/dec $[0.05; 5]$

$$\tilde{W}(s) = \frac{-8\left(1 - \frac{s}{8}\right)}{0.5 \cdot s\left(1 + \frac{s}{0.5}\right)} = -\frac{8}{0.5} \frac{\left(1 - \frac{s}{8}\right)}{s\left(1 + \frac{s}{0.5}\right)} = -16 \frac{\left(1 - \frac{s}{8}\right)}{s\left(1 + \frac{s}{0.5}\right)}$$

$K_W = -16$

$|K_W|_{dB} = 20\log(16) \simeq 24$ dB

$\angle K_W = \pm\pi$

il diagramma delle fasi parte da $-\frac{\pi}{2}$ per il termine monomio ma c'è uno sfasamento di $\pm\pi$

$\Rightarrow +\pi - \frac{\pi}{2} = \frac{\pi}{2}$

il diagramma dei moduli passa per il punto (1, 24 dB)

Attenzione: vero se non ci fossero i due termini binomi

$[0, 0.5) = -20$ dB/dec

$[0.5, 8) = -20$ dB/dec $- 20$ dB/dec $= -40$ dB/dec

$[8, +\infty) = -20$ dB/dec $- 20$ dB/dec $+ 20$ dB/dec $= -20$ dB/dec

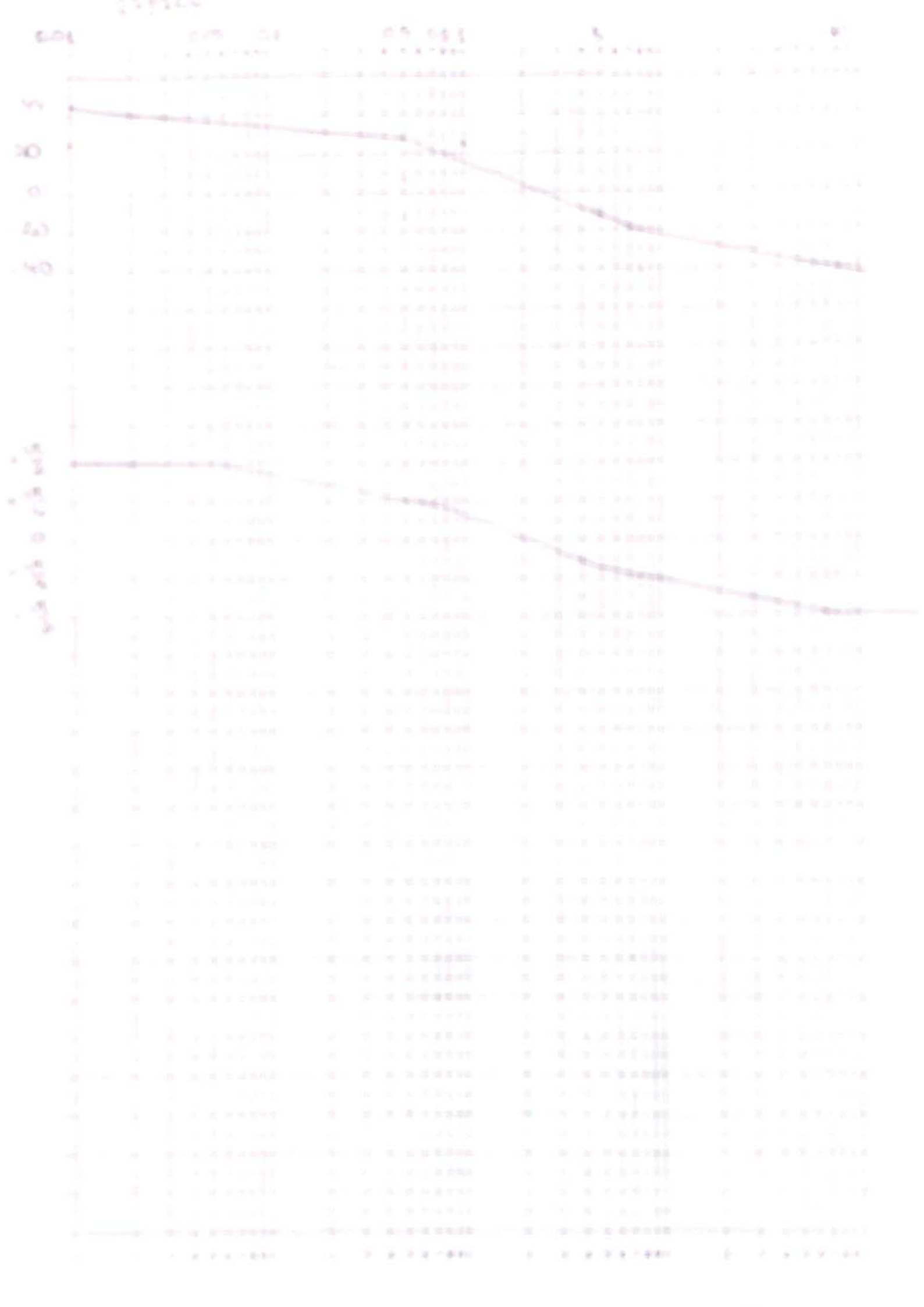
$[0, 0.05) = 0$ rad/dec

$[0.05, 0.8) = -\frac{\pi}{4}$ rad/dec

$[0.8, 5) = -\frac{\pi}{4}$ rad/dec $- \frac{\pi}{4}$ rad/dec $= -\frac{\pi}{2}$ rad/dec

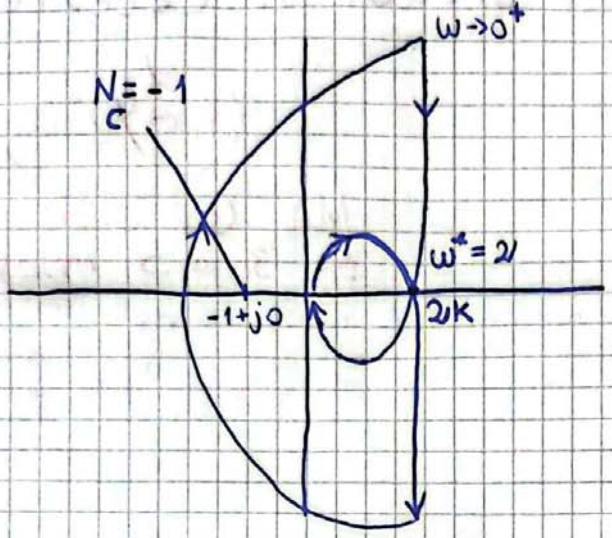
$[5, 80] = -\frac{\pi}{4}$ rad/dec

$[80, +\infty) = 0$ rad/dec



diogramma polare

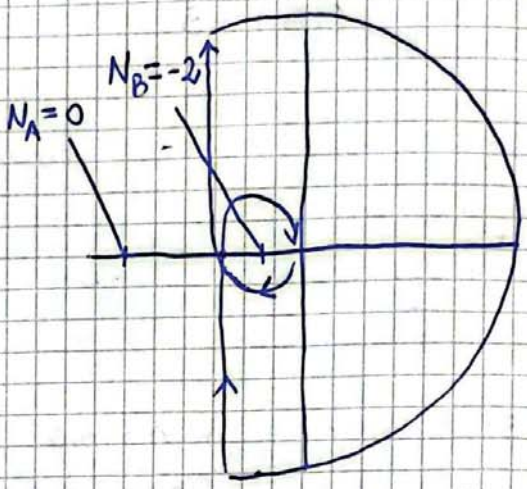
$K>0$



$$W(j\omega) = \frac{-8}{j\omega(j\omega+0.5)}$$

$$W(0) = \frac{-8}{0} \to \infty$$

$K<0$



$$W_{CH}(s) = \frac{KW(s)}{1+KW(s)}$$

$$d_{CH}(s) = KN(s) + D(s) = K(s-8) + s(s+0.5) = Ks - 8K + s^2 + 0.5s$$
$$= s^2 + s(K+0.5) - 8K$$

ROUTH

2	1	$-8K$
1	$K+0.5$	0
0	$-8K$	

$K+0.5>0 \to K>-0.5$

$-8K \to -K>0 \to K<0$

		-0.5	0	
1	+	+	+	
$K+0.5$	-	+	+	
$-8K$	+	+	-	
	2V	0V	1V	

$K<-0.5$ ho 2 variazioni

$\Rightarrow$ instabilità

$-0.5<K<0$ ho 0 variazioni

$\Rightarrow$ stabilità

$K>0$ ho 1 variazione

$\Rightarrow$ instabilità

$$P_{AP} = s(s+0.5) = 0 \begin{cases} s=0 \\ s=-0.5 \end{cases} \to Re(s)^+ = 0$$

Nyquist

$$m_{CH}^+ = m_{AP} - N$$

- $K>0$

$$m_{CH}^+ = 0 - (-1) = 1$$

- $K<0$
  - è in (A) se $-2>-1$ $\quad m_{CH}^+ = 0-0=0$
  - è in (B) se $-2<-1$ $\quad m_{CH}^+ = 0-(-2)=2$