$$\boxed{G(s) = 100\,\frac{0{,}001\,s + 1}{\left(\frac{s}{10} + 1\right)^2}}$$

1) Polstellen: $\boxed{s_{1/2} = -10}$

Nulstelle: $\boxed{n_1 = -10^3}$

2) $|G(j0)| = 100 = 20 \log_{10}(100)$ dB

$= 20 \cdot 2$ dB

$= 40$ dB

A) × $\omega >> s_i$: -20 dB/Dekade | $-90°$

× $\omega << s_i$: 0 dB/Dekade | $0°$

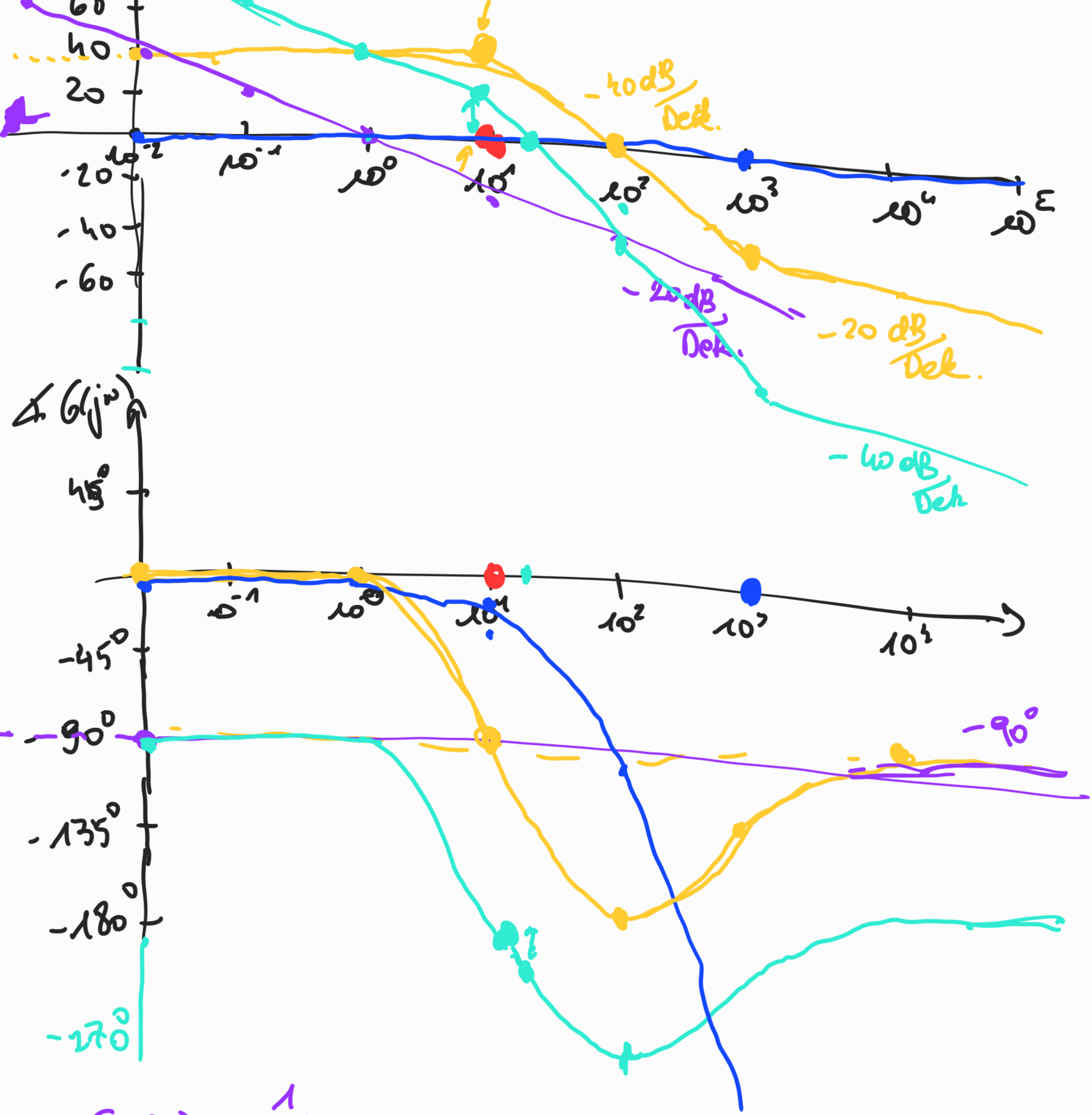
B) × $\omega >> n_i$: $+20$ dB/Dekade | $+90°$

× $\omega << n_i$: 0 dB/Dek. | $0°$

$\Rightarrow$ $\omega \to \infty$: $-20\,\frac{\text{dB}}{\text{dek.}} \cdot (\text{PÜ})$ / $-90° \cdot (\text{PÜ})$

PÜ : $\#s_i - \#n_i$

$|G(j\omega)|$



$$G_1(s) = \frac{1}{s}$$

1) $s_1 = 0$

$\# n_i = 0$

2) $|G(j0)| = \infty$

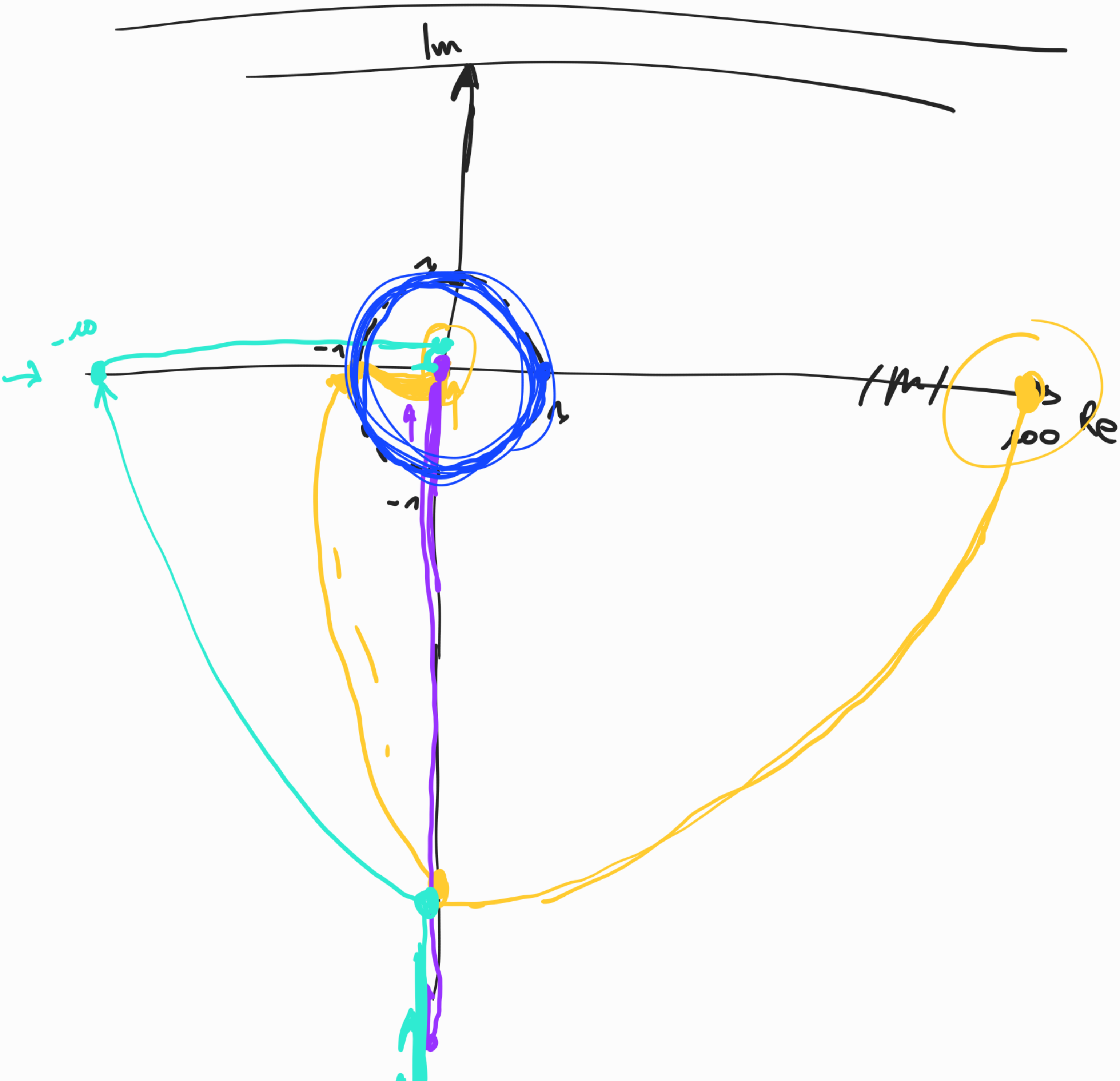
$|G(j1)| = 1 = 20 \log_{10}(1) \text{ dB} = 0 \text{ dB}$

$$|G_2(s)| = |G_1(s)| \cdot |G(s)|$$

$$G_3(s) = e^{-s}$$

$$|G_3(j\omega)| = |e^{-j\omega}| = 1$$

$$\angle G_3(j\omega) = -\omega$$



$$e_{ss} = \frac{1}{1+G(0)} = \frac{1}{1+\infty} = 0$$

$$A_{beobachter} = A - \underbrace{L}_{\text{gain matrix}} C$$

gain matrix → polvorgabe
↳ (Kalman Filter)

$$\ddot{y}(t) \cdot \dot{y}(t) + y(t) = u(t) \cdot \cos(t)$$

$$U_1(s) = \left(\frac{1}{s} + \frac{2}{s}\right) U(s)$$

$$Y(s) = \frac{s}{s+3}\, U_1(s) = \frac{s}{s+3}\left(\frac{1}{s} + \frac{2}{s}\right) U(s)$$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 3 & 1 & 2 \end{bmatrix} \qquad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$[\, s_1 = -1, \quad s_2 = -2, \quad s_3 = -3 \,]$$

$A_K = A - BK \qquad$ wobei $\qquad K = [k_1, k_2, k_3]$

1) $p_K(\lambda) = \det(\lambda - A_K)$

2) $p_w(\lambda) = (s+1)(s+2)(s+3)$

3) $p_K(\lambda) \stackrel{!}{=} p_w(\lambda)$

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1) $BK = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} [k_1 \quad k_2 \quad k_3] = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ k_1 & k_2 & k_3 \end{bmatrix}$

$A_K = A - BK = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 3-k_1 & 1-k_2 & 2-k_3 \end{bmatrix}$

$\det(\lambda - A_K) = \det\left(\begin{bmatrix} \lambda & -1 & 0 \\ 0 & \lambda & -1 \\ k_1-3 & k_2-1 & \lambda+k_3-2 \end{bmatrix}\right)$

$= \lambda(\lambda(\lambda+k_3-2) + k_2-1) +$

$k_1-3\,(1-\lambda)$

$= \lambda(\lambda^2 + (k_3-2)\lambda + k_2-1) +$

$k_1-3 - \lambda(k_1-3)$

$$= \lambda^3 + (k_3 - 2)\lambda^2 + (k_2 - 1)\lambda + k_1 - 3 - \lambda(k_1 - 3)$$

$$p_K(\lambda) = \lambda^3 + (k_3 - 2)\lambda^2 + (k_2 - k_1 + 2)\lambda + k_1 - 3$$

2) $p_W(\lambda) = (s+1)(s+2)(s+3)$

$$= (s^2 + 3s + 2)(s+3)$$

$$= s^3 + 3s^2 + 2s + 3s^2 + 9s + 6$$

$$= s^3 + 6s^2 + 11s + 6$$

3) $p_K(\lambda) \overset{!}{=} p_W(\lambda)$

$k_3 - 2 = 6 \rightarrow k_3 = 8$

$k_2 - k_1 + 2 = 11 \longrightarrow k_2 = 18$

$k_1 - 3 = 6 \longrightarrow k_1 = 9$

$$K = \begin{bmatrix} 9 & 18 & 8 \end{bmatrix}$$