"Übungsklausur"

Aufgabe 1

a) weder gerade noch ungerade
(sin- und cos Koeffizienten)

b) Sprünge $\rightarrow \frac{1}{n}$ (auch Knick, aber Sprünge dominieren)

c) - Punktsymmetrisch
- ungerades reelles Zeitsignal
↳ imaginäres, ungerades Frequenzsignal

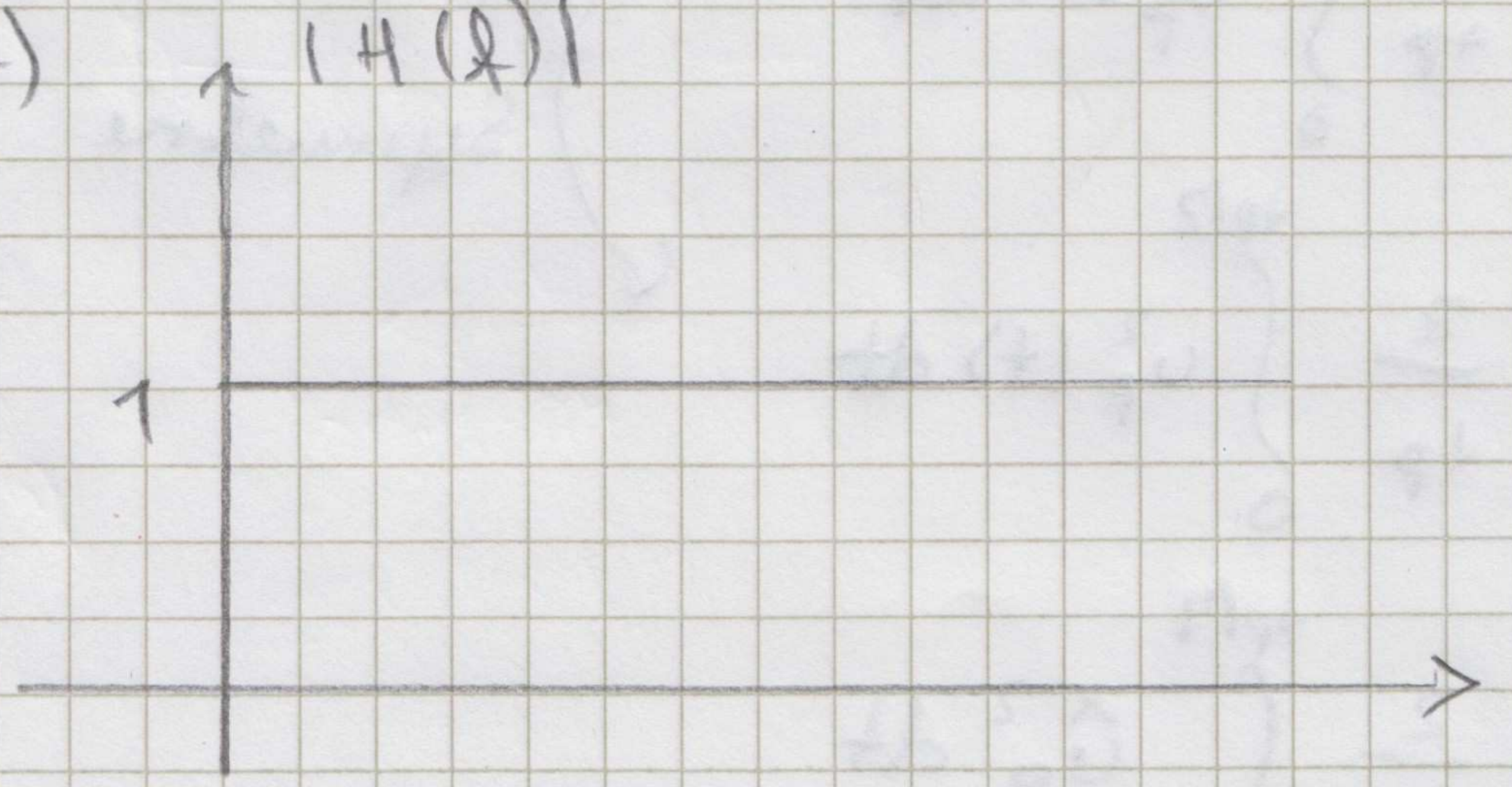
d) Kein Energiesignal $\int_{-\infty}^{\infty} |u(t)|^2 dt = \infty$

↳ nicht fouriertransformierbar

e) nicht stabil, da mit $e^{\frac{t}{1ms}}$ ansteigend

$$\int_{-\infty}^{\infty} |h(t)| dt = \infty$$

f)



Abstände von Pol- und Nullstelle immer gleich

Aufgabe 2

a) Punktsymmetrisch (ungerade)

b) $\underline{c}_\mu = -j \frac{b_\mu}{2}$

$$b_\mu = \frac{4}{t_p} \int_0^{\frac{t_p}{2}} u_p(t) \cdot \sin(2\pi \mu f_0 t)\, dt$$

$$= \frac{4}{t_p} \int_0^{\frac{t_p}{4}} \hat{U}_p \cdot \sin(2\pi \mu f_0 t)\, dt$$

$$= \frac{4 \hat{U}_p}{t_p} \left[\frac{1}{2\pi \mu f_0} \left(-\cos(2\pi \mu f_0 t) \right) \right]_0^{\frac{t_p}{4}}$$

$$= \frac{4 \hat{U}_p}{t_p} \cdot \frac{1}{2\pi \mu f_0} \left[-\cos\left(\mu \frac{\pi}{2}\right) + 1 \right]$$

$$= \frac{2 \hat{U}_p}{\pi \mu} \left(1 - \cos\left(\mu \frac{\pi}{2}\right) \right)$$

$$\underline{c}_\mu = -j \frac{b_\mu}{2} = -j \frac{\hat{U}_p}{\mu \pi} \left(1 - \cos\left(\mu \frac{\pi}{2}\right) \right)$$

c) $$U_{eff}^2 = \frac{1}{t_p} \int_0^{t_p} u_p^2(t)\, dt$$

Symmetrie

$$= \frac{2}{t_p} \int_0^{t_p/2} u_p^2(t)\, dt$$

$$= \frac{2}{t_p} \int_0^{t_p/4} \hat{U}_p^2\, dt$$

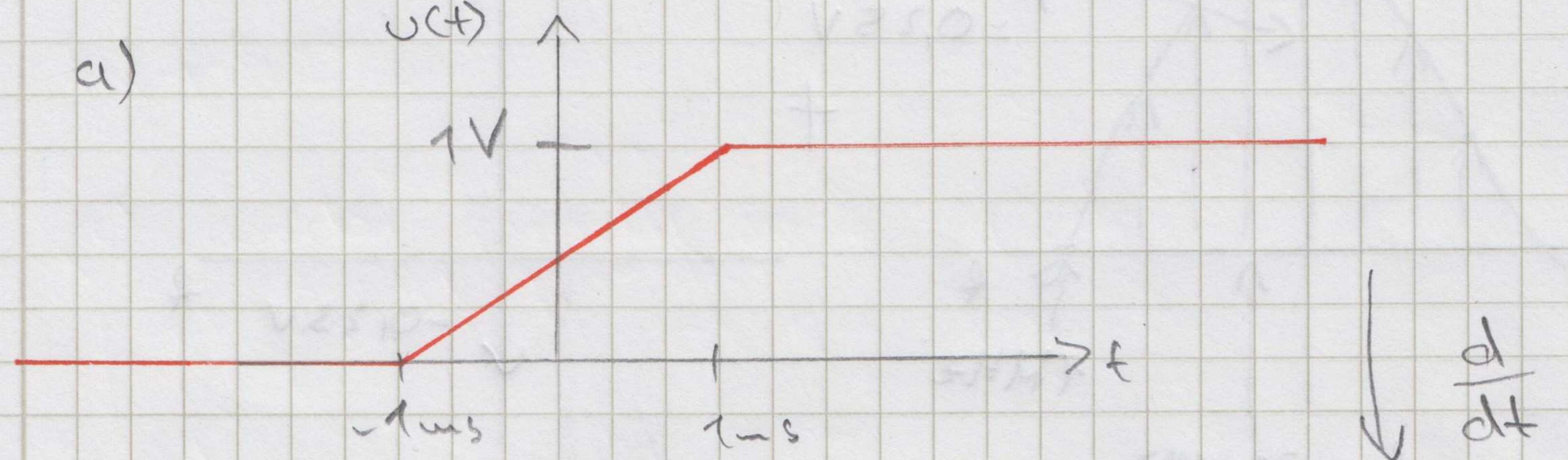
$$= \frac{2 \hat{U}_p}{t_p} \left[t \right]_0^{\frac{t_p}{4}} = \frac{2 \hat{U}_p^2}{t_p} \cdot \frac{t_p}{4} = \frac{\hat{U}_p^2}{2}$$

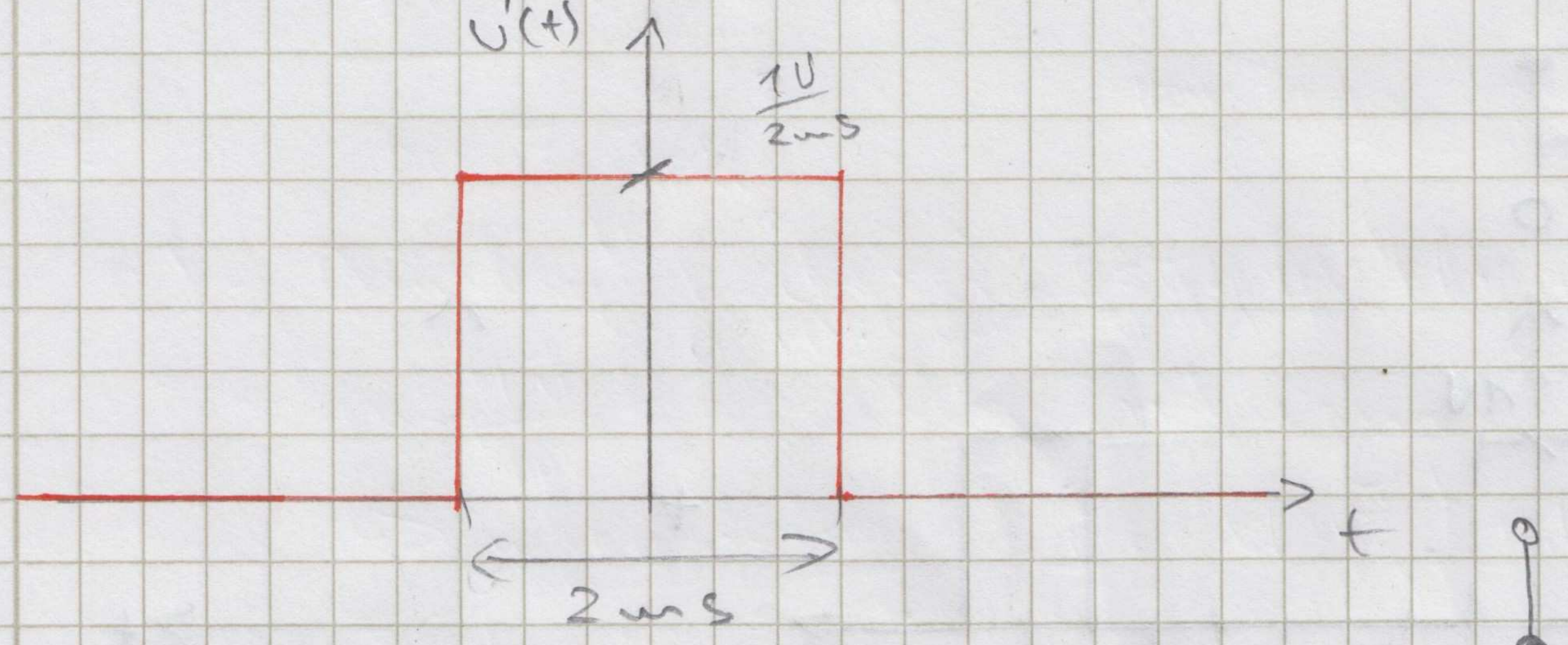
$$U_{eff} = \frac{1}{\sqrt{2}} \hat{U}_p = \underline{1{,}4\,V}$$

d) $$P = \frac{U_{eff}^2}{R} = \frac{2V^2}{2 \cdot 50\Omega} = \underline{0{,}04\,W}$$

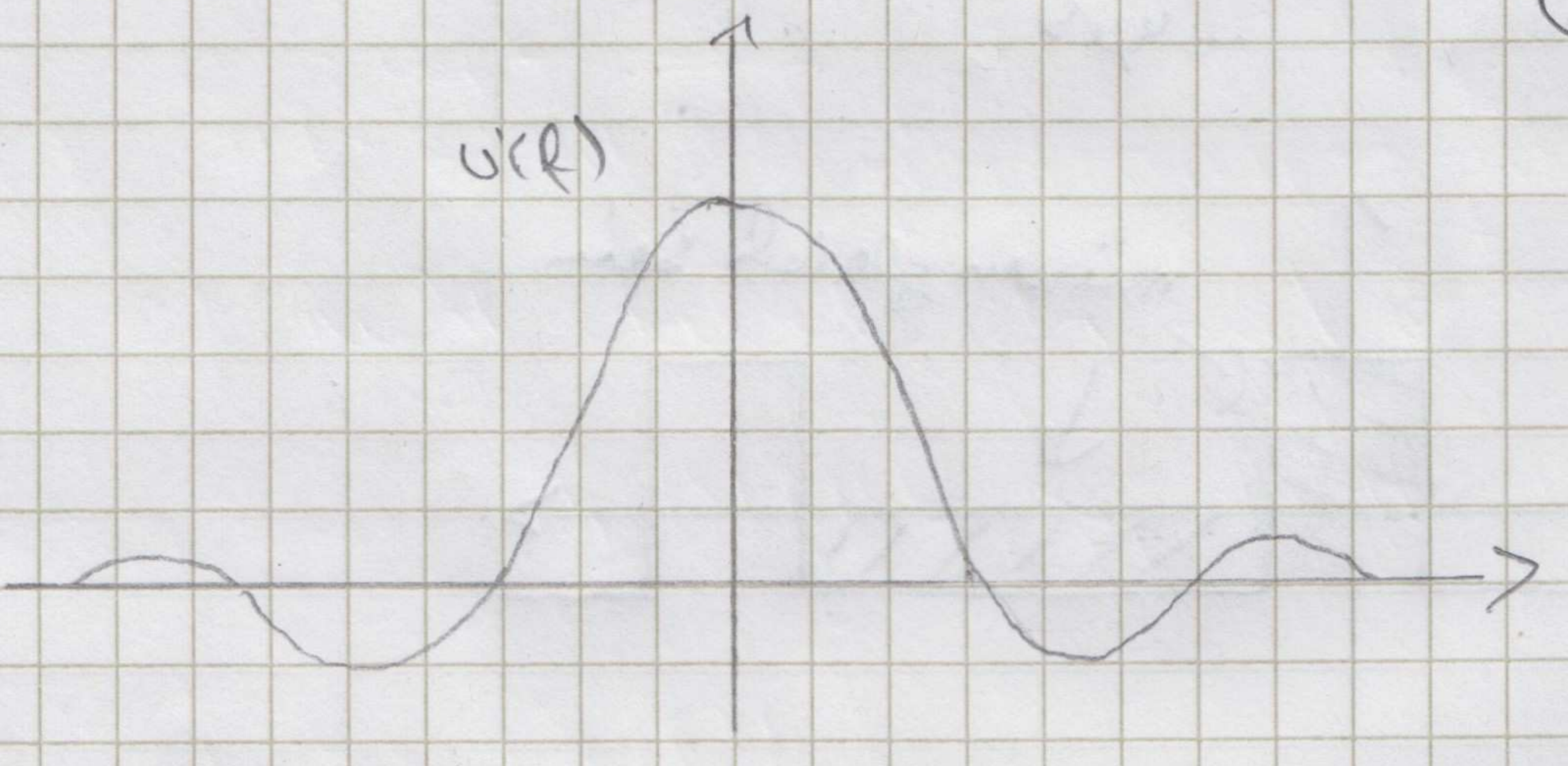
Aufgabe 3

a)





$U'(f) = 1V \, si(\pi 2ms f)$

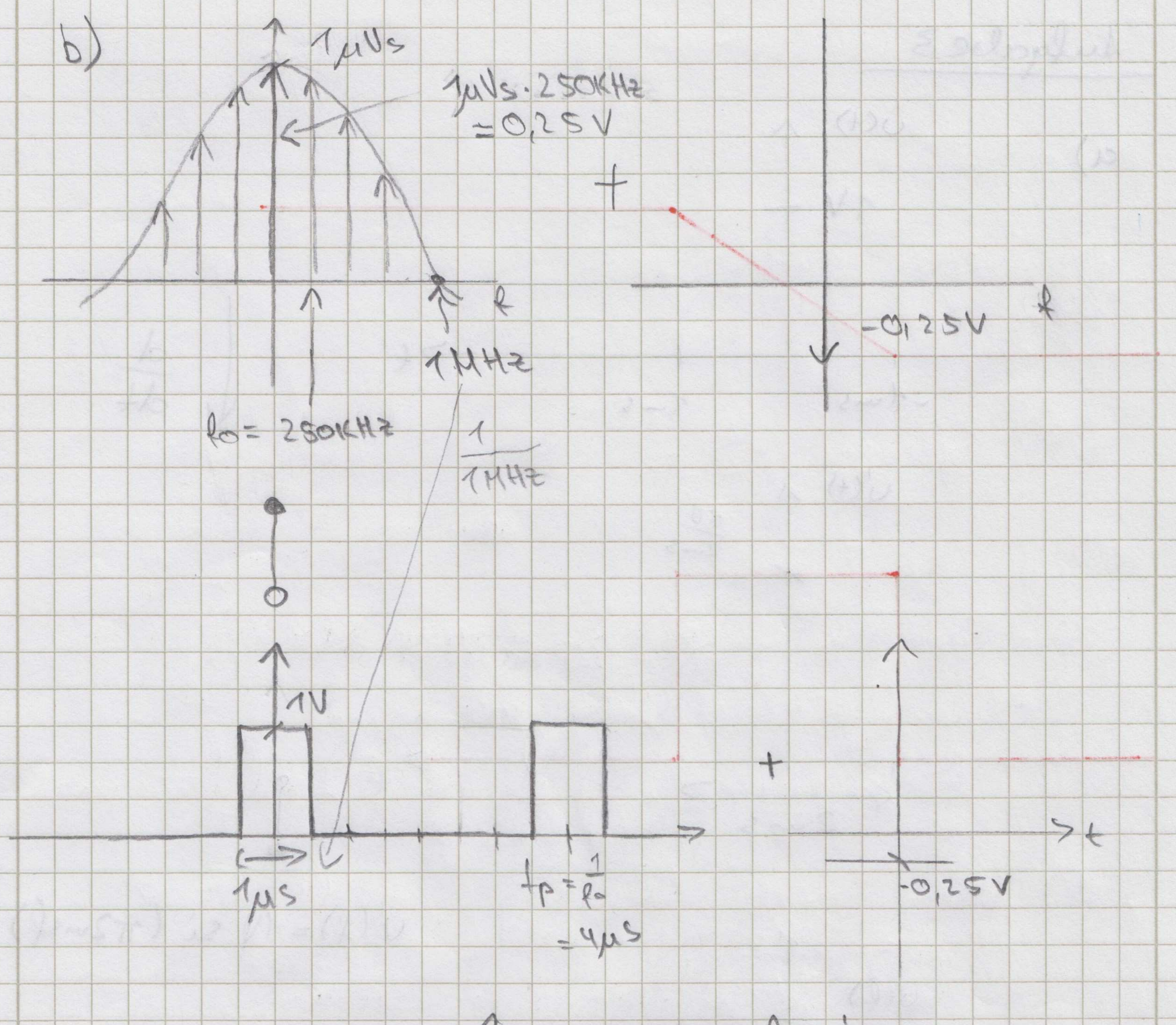


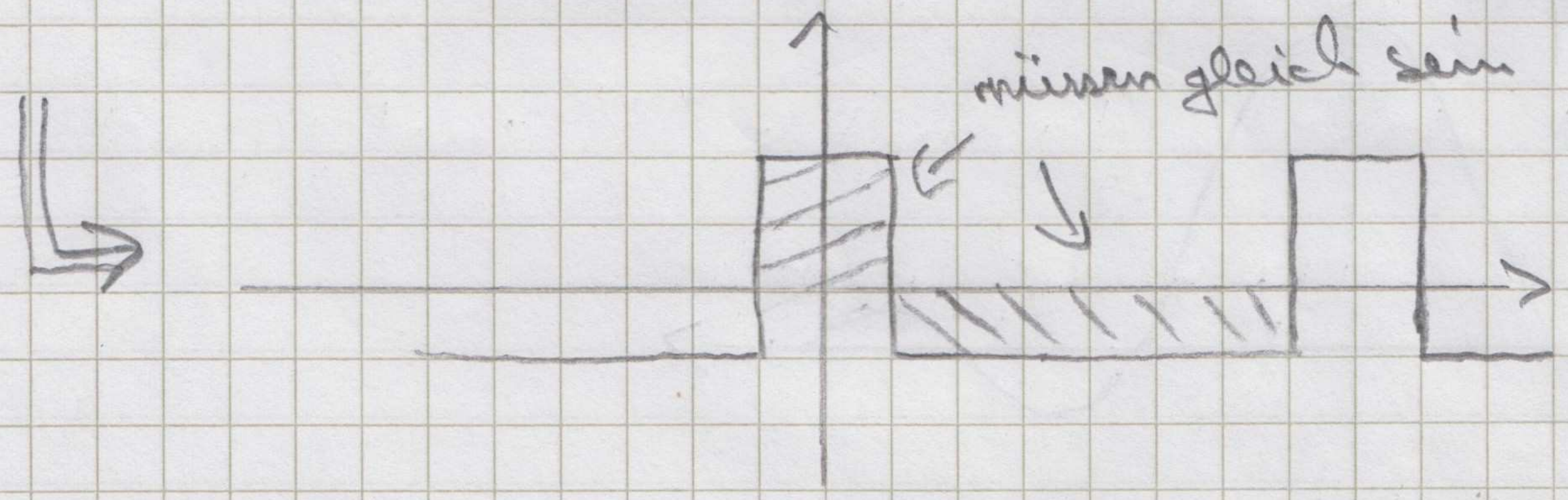
Integrationssatz

$$U(f) = \left[\frac{1}{j2\pi f} + \frac{1}{2}\delta(f)\right] U'(f)$$

$$= \left[\frac{1}{j2\pi f} + \frac{1}{2}\delta(f)\right] 1V \, si(\pi 2ms f)$$

b)





Aufgabe 4

a) $H(p) = \frac{U_2(p)}{U_1(p)} = \frac{R_2 + (R_3 || Z_L)}{R_2 + R_1 + (R_3 || Z_L)}$ $\quad \boxed{Z_L = pL}$

$= \ldots$ bla bla $\ldots$ GTR $\ldots =$

$$\Rightarrow \frac{R_2 + R_3}{R_1 + R_2 + R_3} \cdot \frac{p + \frac{R_2 \cdot R_3}{(R_1 + R_3)L}}{p + \frac{R_3 (R_1 + R_2)}{(R_1 + R_2 + R_3)L}}$$

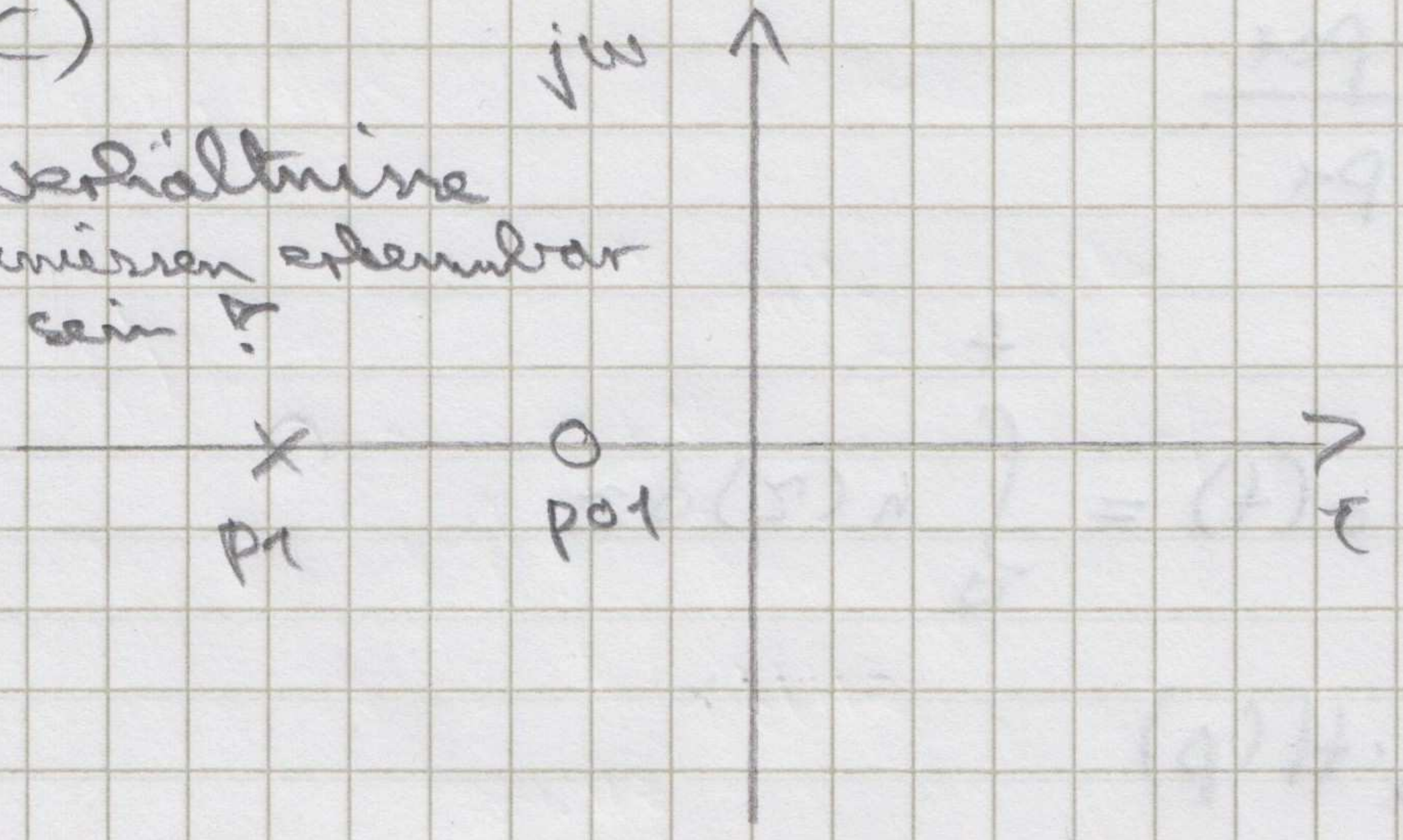
$\rightarrow p_{01} = -0,89 \cdot 10^9 \, s^{-1}$

$\rightarrow p_1 = -1,6 \cdot 10^9 \, s^{-1}$

b) $K_p = 0,9$

c)

Verhältnisse müssen erkennbar sein !

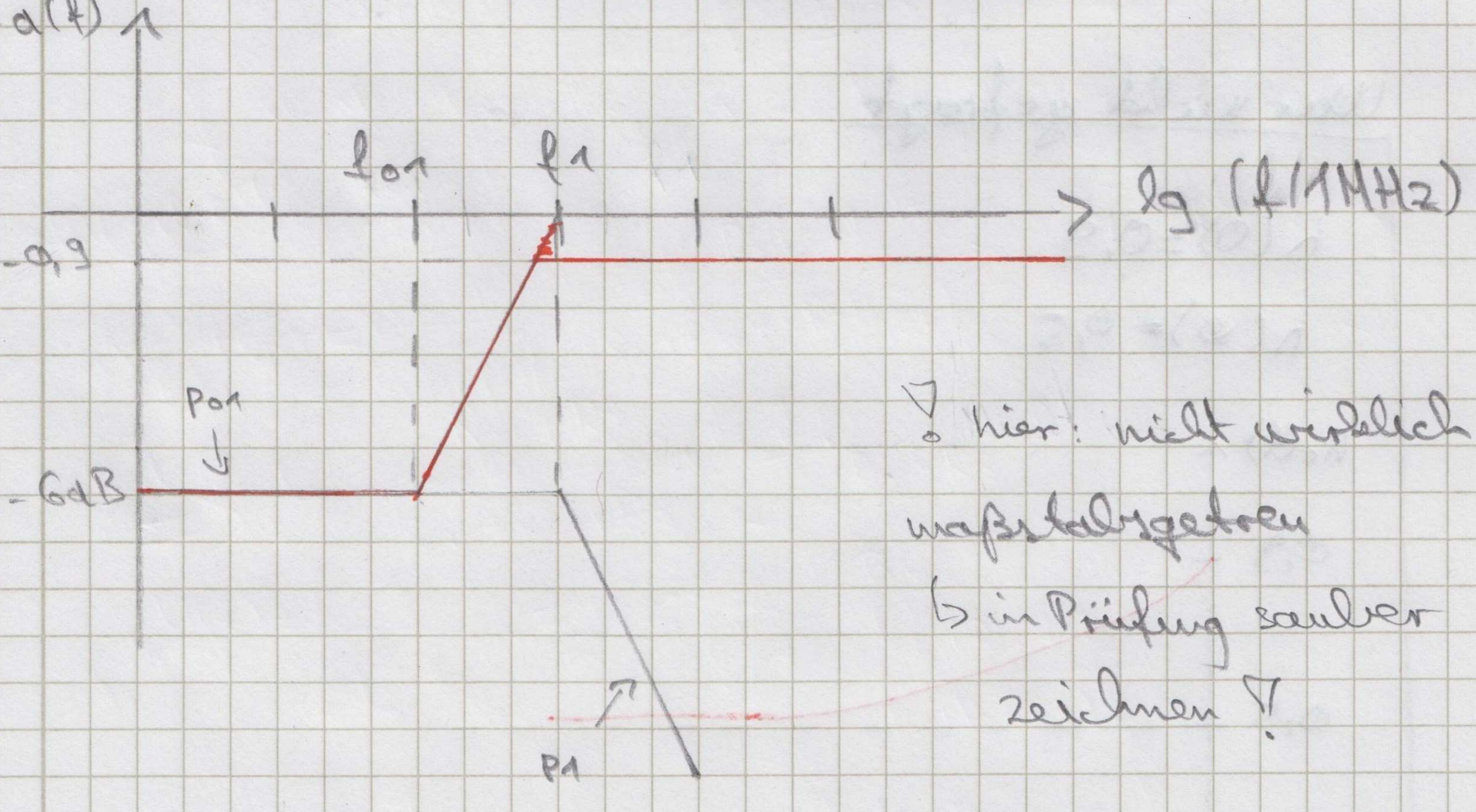


$H(0) = \frac{1}{2}$ $\qquad a(0) = 20 \lg \frac{1}{|H(0)|} dB = 6\,dB$

$H(\infty) = K_p = 0{,}9$ $\qquad a(\infty) = 20 \cdot \lg \frac{1}{|H(\infty)|} = 0{,}9\,dB$

$f_{01} = \frac{-p_{01}}{2\pi} = 141\,MHz$

$f_1 = \frac{-p_1}{2\pi} = 255\,MHz$



! hier: nicht wirklich maßstabsgetreu
↳ in Prüfung sauber zeichnen !

d) $H(p) = K_p \dfrac{p - p_{01}}{p - p_1}$

$$h(t) \xrightarrow{\int} h_\sigma(t) = \int_0^t h(\tau)\,d\tau$$

$$\frac{1}{p} \cdot H(p)$$

$$\frac{1}{p} \cdot H(p) = K_p \cdot \frac{1}{p} \cdot \frac{p - p_{01}}{p - p_1} = K_p \cdot \frac{p - p_{01}}{p(p - p_1)}$$

L

$b = 1$

$c = -p_{01}$

$d = p_1$

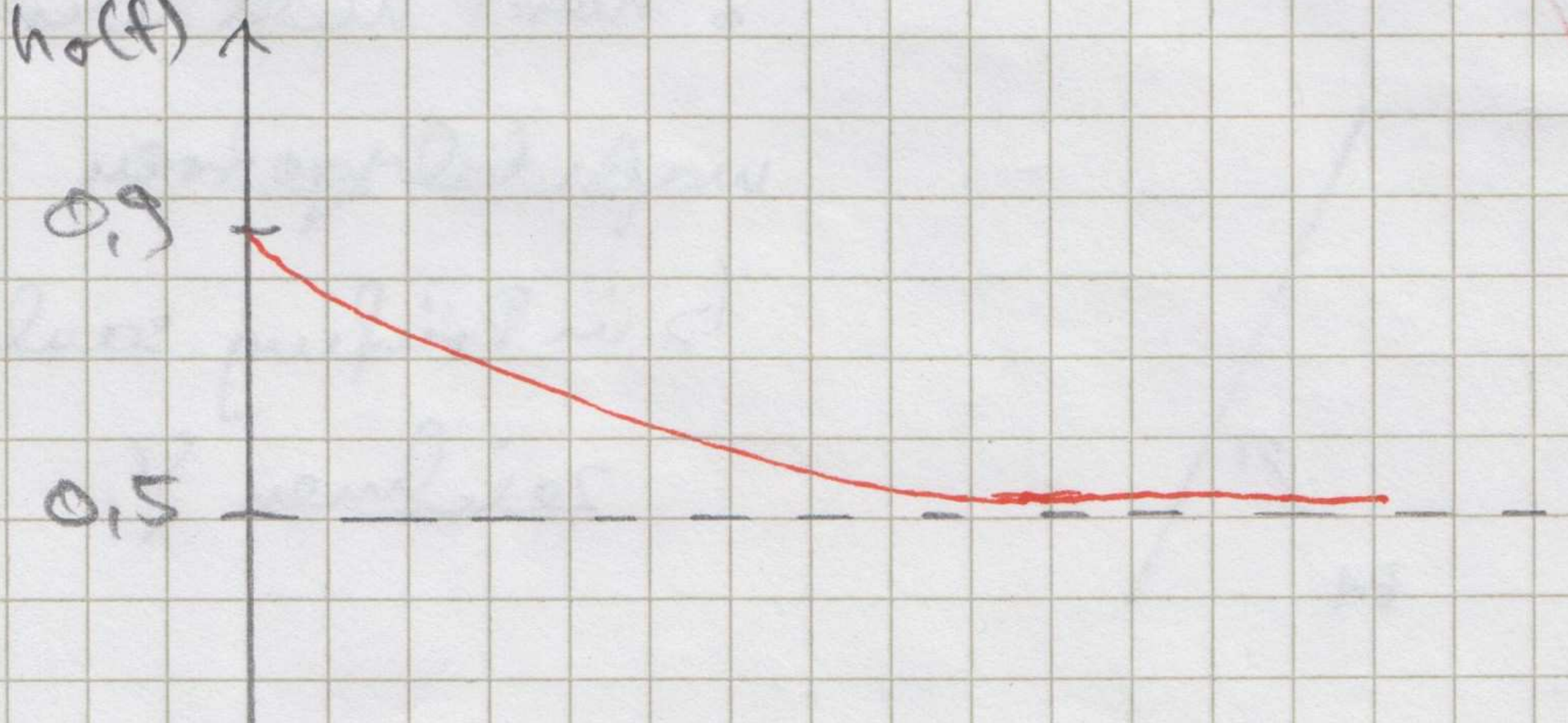
$$h_\sigma(t) = K_p \left[\frac{p_{01}}{p_1} + \left(1 - \frac{p_{01}}{p_1}\right) e^{p_1 t} \right]$$

$$= 0{,}5 + 0{,}4\, e^{-\frac{t}{625\,ps}}$$

<u>War nicht gefragt</u>

$h(0) = 0{,}9$

$h(\infty) = 0{,}5$



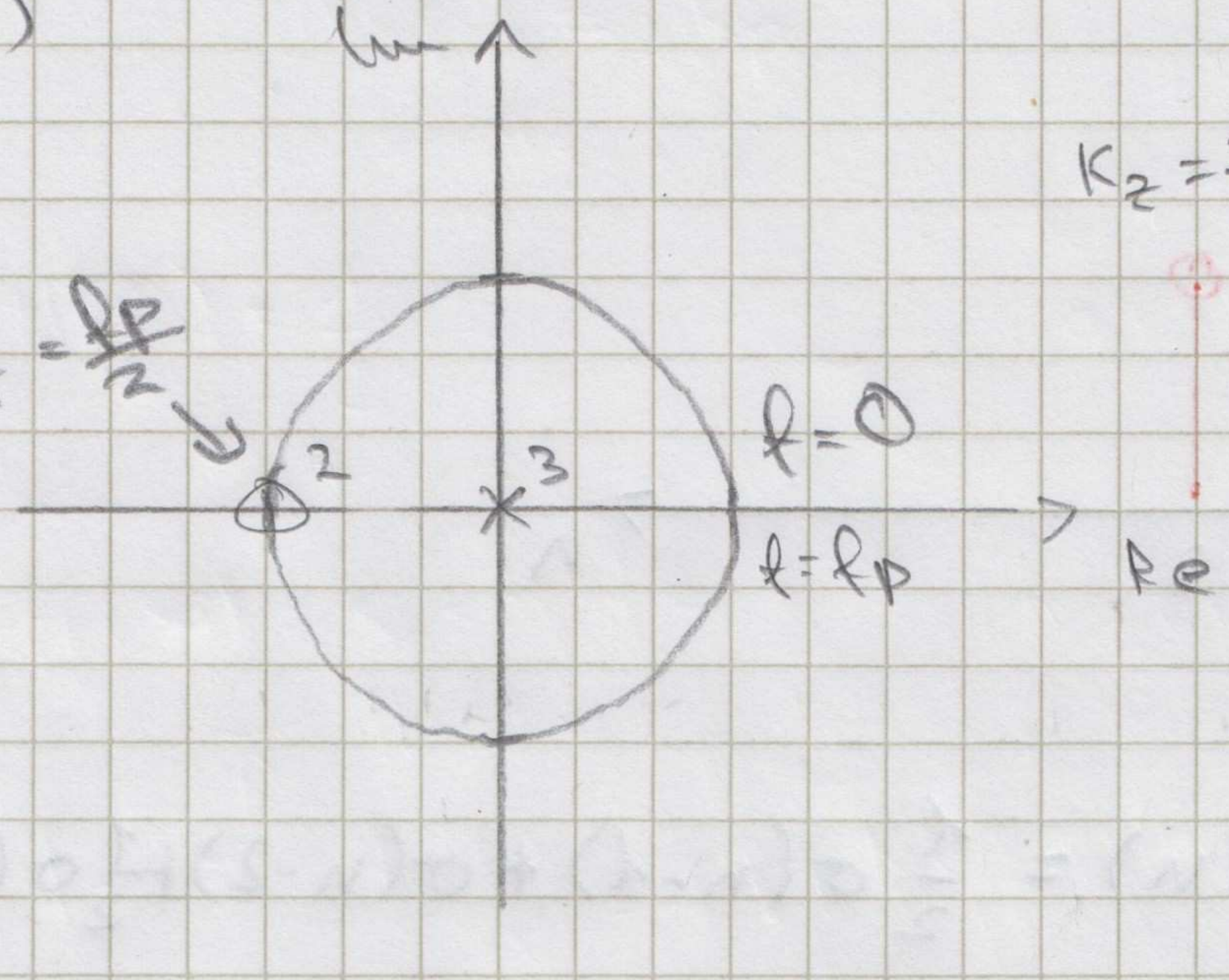
Aufgabe 5

$$H(z) = \frac{1}{2}\,\frac{(z+1)^2}{z^3}$$

NS: $z_{01} = z_{02} = -1$

PS: $z_1 = z_2 = z_3 = z_4 = 0$

a)



$K_z = \frac{1}{2}$

b) Polstelle: kein Einfluss auf Betrag

Nullstelle: - großer Abstand zu $f = 0$

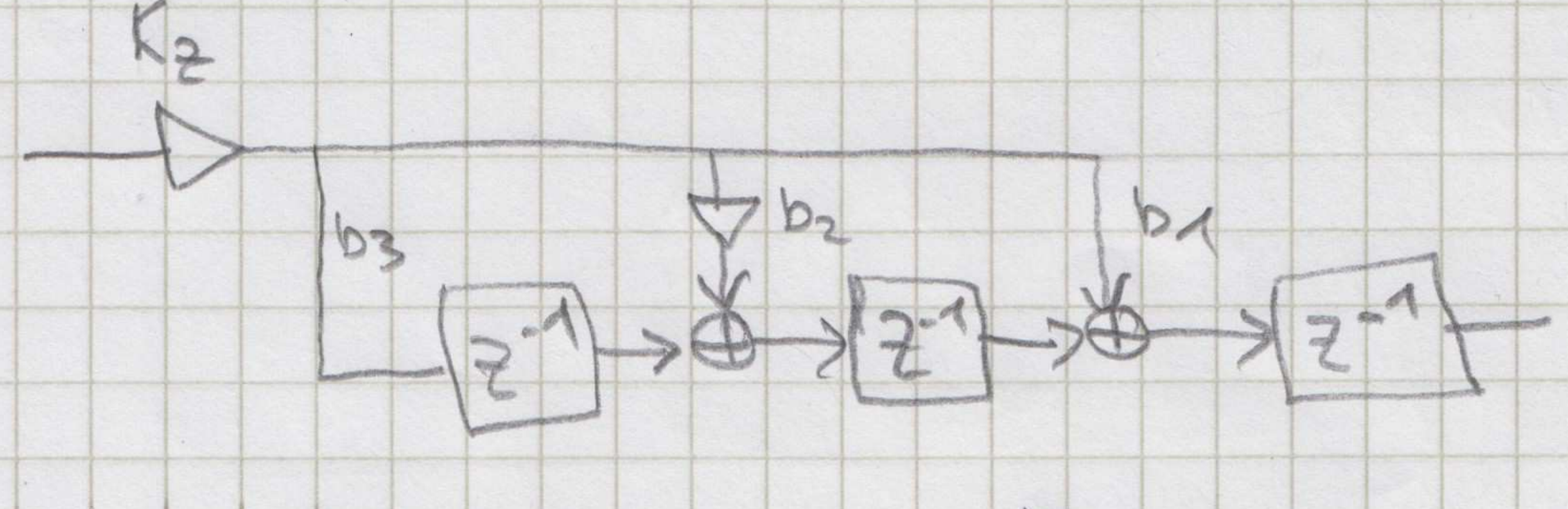
- kleiner Abstand (0) zu $f = \frac{f_p}{2}$

→ Tiefpass

c) $$H(z) = \frac{1}{2}\,\frac{(z-1)^2}{z^3} = \frac{1}{2}\,\frac{z^2+2z+1}{z^3}$$

$$= \frac{1}{2}\left(z^{-1} + 2z^{-2} + z^{-3}\right)$$

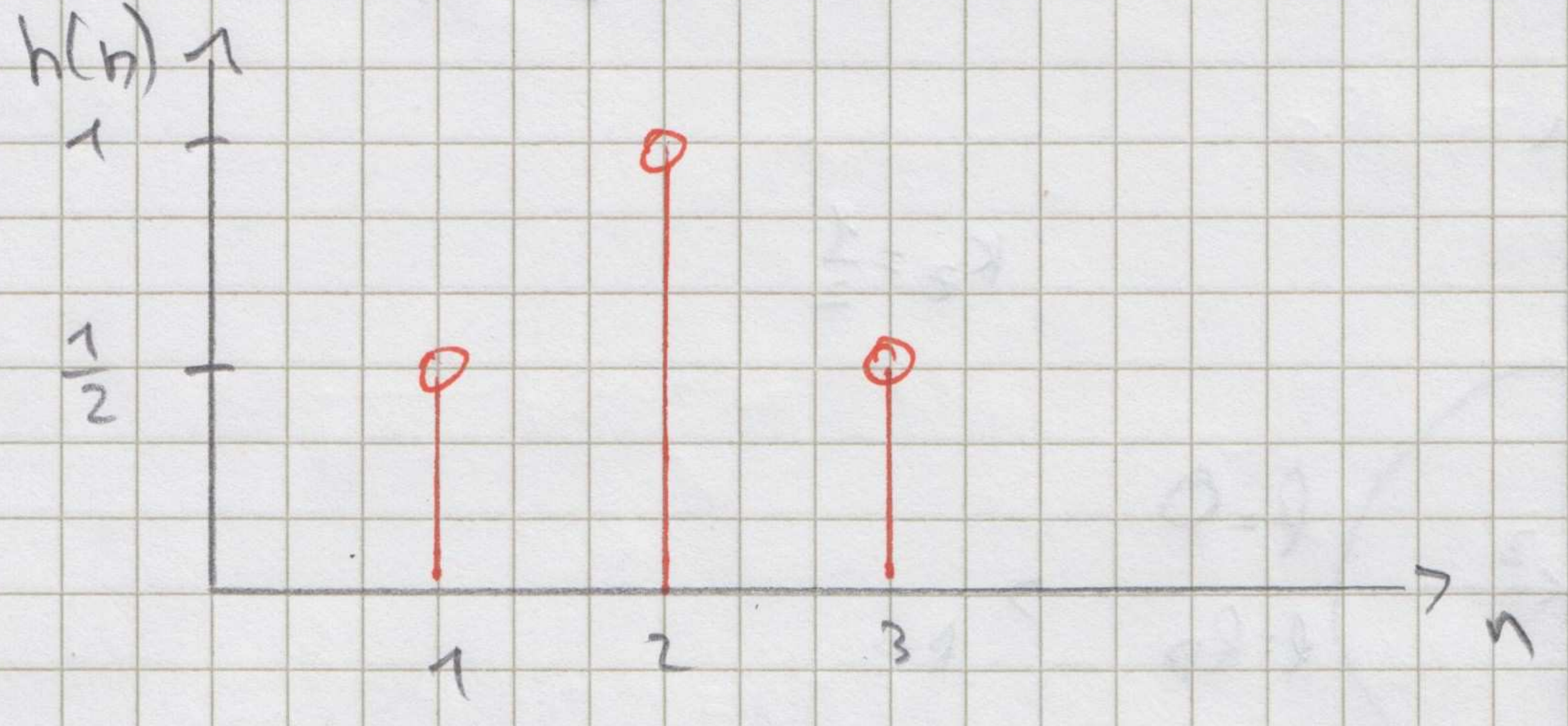
$K_z = \frac{1}{2}$, $b_1 = 1$, $b_2 = 2$, $b_3 = 1$



System 3. Ordnung!

d) $H(z) = \frac{1}{2} z^{-1} + z^{-2} + \frac{1}{2} z^{-3}$

$$h(n) = \frac{1}{2}\delta(n-1) + \delta(n-2) + \frac{1}{2}\delta(n-3)$$



$$h_\sigma(n) = \sum_{k=0}^{n} h(n) = \frac{1}{2}\sigma(n-1) + \sigma(n-2) + \frac{1}{2}\sigma(n-3)$$