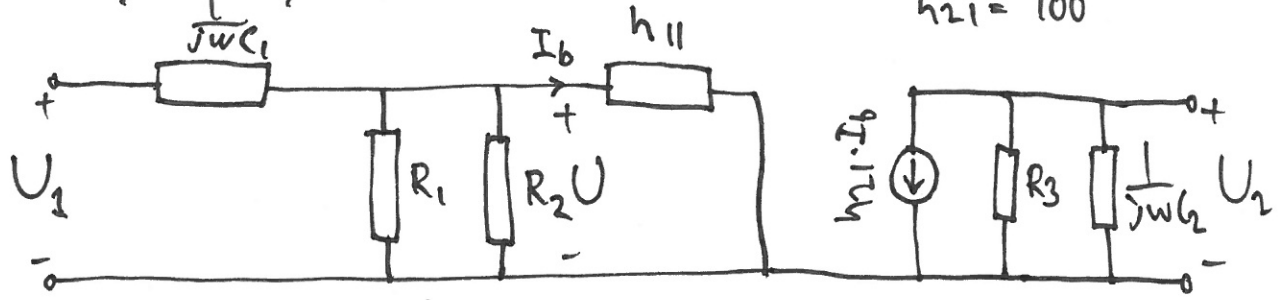
E-29) a)

$h_{11} = 1.0\,k\Omega$

$h_{21} = 100$




$$U_2 = -h_{21}\cdot I_b \cdot \frac{R_3 \cdot \frac{1}{j\omega C_2}}{R_3 + \frac{1}{j\omega C_2}} =$$

$$= -h_{21}\cdot R_3 \cdot I_b \cdot \frac{1}{1 + j\cdot\omega C_2 \cdot R_2}$$

$E = 12\ V$

$R_1 = 20\,k\Omega,\ R_2 = 10\,k\Omega$

$R_3 = 2.0\,k\Omega,\ R_4 = 1.3\,k\Omega$

$C_1 = 12.2\,\mu F,\ C_2 = 5.3\,nF$

$$U = h_{11}\cdot I_b$$

$$U = U_1 \cdot \frac{R}{R + \frac{1}{j\omega C_1}} = U_1 \cdot \frac{R\cdot j\omega C_1}{1 + R\cdot j\omega C_1},$$

$R = R_1 // R_2 // h_4 = 870\ \Omega$

$$\Rightarrow\quad U_1 = h_{11}\cdot I_b \cdot \frac{1 + j\omega C_1 R}{j\omega C_1 R}$$

$$F = \frac{U_2}{U_1} = \frac{-h_{21}\cdot R_3 \cdot I_b \cdot \frac{1}{1 + j\omega C_2 R_2}}{h_{11}\cdot I_b \cdot \frac{1 + j\omega C_1 R}{j\omega C_1 R}}$$

$$= \frac{-h_{21}\cdot R_3}{h_{11}} \cdot \frac{1}{1 + j\omega C_2 R_3} \cdot \frac{j\omega C_1 R}{1 + j\omega C_1 R}$$

$$|F| = 200 \cdot \frac{1}{\sqrt{1^2 + (\omega C_2 R_3)^2}} \cdot \frac{\omega C_1 R}{\sqrt{1^2 + (\omega C_1 R)^2}}$$

b)

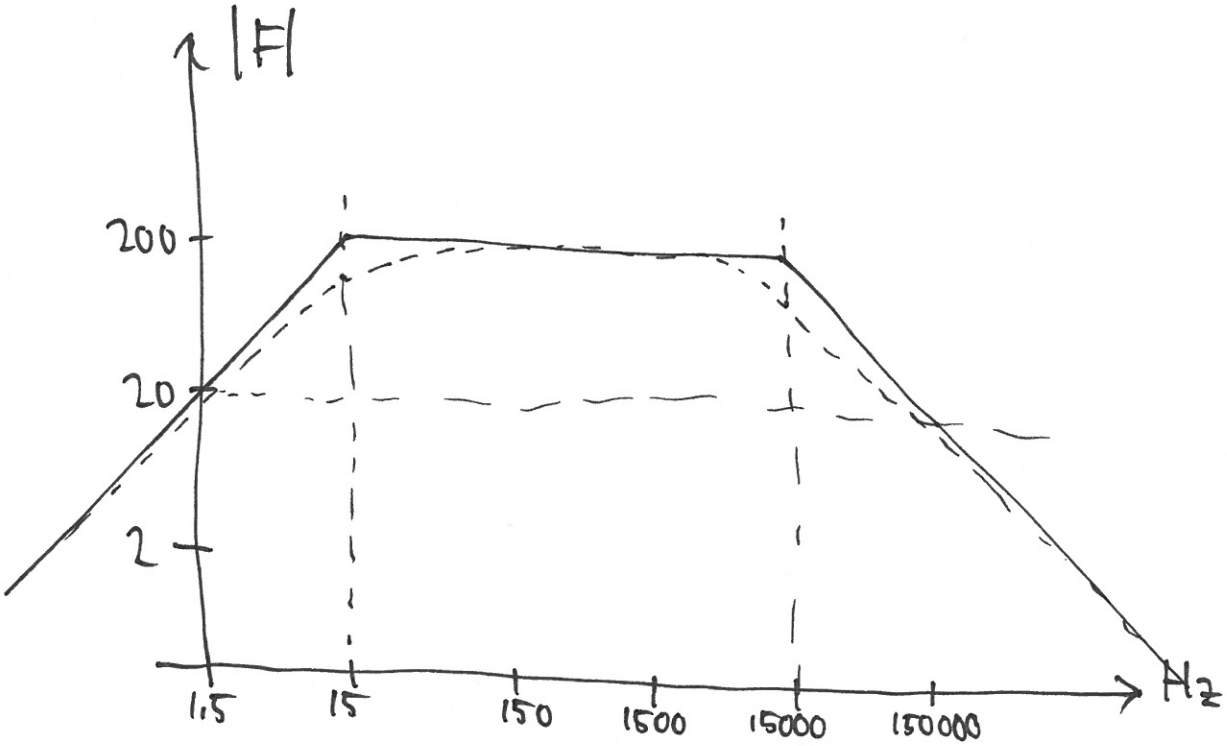
$$\omega_0 C_2 R_3 = 1 \Leftrightarrow \quad \omega_0 = \frac{1}{C_2 R_3} = \frac{1}{5.3n \cdot 2k} = 94340$$

$$\omega = 2\pi f \Rightarrow$$

$$f_0 = 15\,kHz$$

$$\omega_u C_1 R = 1 \Leftrightarrow \quad \omega_u = \frac{1}{C_1 R} = \frac{1}{12.2\mu \cdot 870} = 94.26$$

$$\Rightarrow f_u = 15\ Hz$$




Då $f \ll f_u$ och $f \gg f_0$ faller kurvan med 20 dB / 10 ggr per dekad