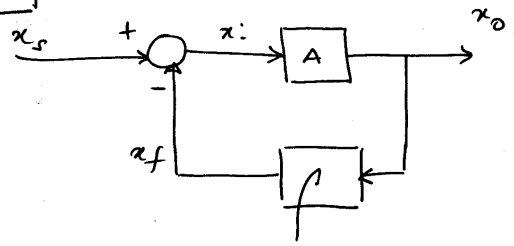
EL2 F7

10.1



$$\left.\begin{array}{l} x_i = x_s - x_f \\ x_f = \beta\, x_o \\ x_o = A\, x_i \end{array}\right\} \quad \frac{x_o}{A} = x_s - \beta\, x_o$$

$$(1 + A\beta)\, x_o = A\, x_1$$

$$A_f \equiv \frac{x_o}{x_1} = \frac{A}{1 + A\beta} \xrightarrow[A \gg 1]{} A_f \simeq \frac{1}{\beta}$$

Conditions:

$A = 10^4$

$A_f = 100$

$\beta = ?$

$$A_f + A_f A \beta = A$$

$$\beta = \frac{A - A_f}{A_f \times A} = \frac{10\,000 - 100}{10^4 \times 10^2} = 0.0099$$

$$A_f = \frac{A}{1 + A\beta} = \frac{10^3}{1 + 10^3 \times 0.0099} = 91.743$$

$$\frac{\Delta A_f}{A_f} = \frac{100 - 91.743}{100} \simeq 8.26\,\%$$

10.10

$$A_f = \frac{A}{1+A\beta}$$

$$dA_f = \frac{1}{1+A\beta}\,dA - \frac{A\beta}{(1+A\beta)^2}\,dA$$

$$dA_f = \frac{1+A\beta - A\beta}{(1+A\beta)^2}\,dA$$

$$\frac{dA_f}{A_f} = \frac{1}{1+A\beta}\,\frac{dA}{A}$$

$A_f = 25 \pm 1\%$

$A = A \pm 10\%$

$A = ?$

$\beta = ?$

$$0.01 = \frac{1}{1+A\beta} \times 0.1$$

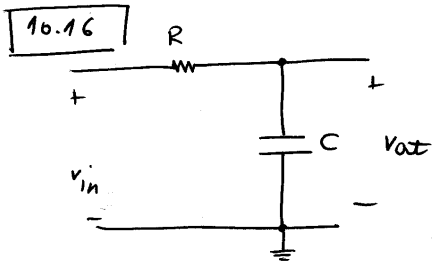
$$0.01 + 0.01 A\beta = 0.1$$

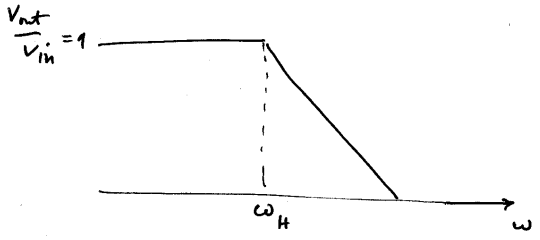
$$A\beta = \frac{0.1 - 0.01}{0.01} = 9$$

$$A = A_f(1+A\beta) = 25 \times 10 = 250$$

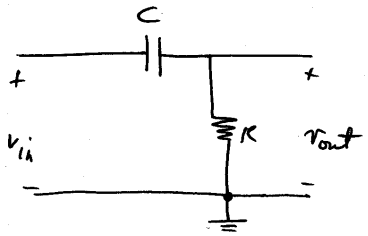
$$A\beta = 9 \Rightarrow \beta = \frac{9}{250} = 0.036$$

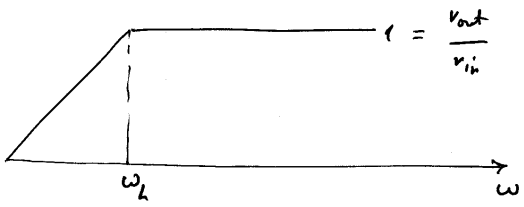
10.16



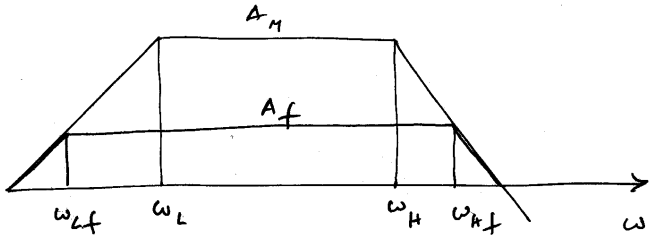


$$\frac{v_{out}}{v_{in}} = \frac{1/j\omega C}{R + \frac{1}{j\omega C}} \overset{j\omega = s}{=} \frac{1/sC}{R + \frac{1}{sC}} = \frac{1}{1 + sRC} \overset{RC = \frac{1}{\omega_H}}{=} \frac{1}{1 + s/\omega_H}$$





$$\frac{v_{out}}{v_{in}} = \frac{R}{R + \frac{1}{j\omega C}} \overset{j\omega = s}{=} \frac{R}{R + \frac{1}{sC}} = \frac{sRC}{1 + sRC} = \frac{1}{1 + \frac{1}{sRC}} = \frac{1}{1 + \frac{\omega_L}{s}}$$



$$A_f = \frac{A}{1 + A\beta}$$

$$A(s) = \frac{A_M}{1 + s/\omega_H} \longrightarrow A_f = \frac{\frac{A_M}{1 + s/\omega_H}}{1 + \beta \frac{A_M}{1 + s/\omega_H}}$$

$$A_f = \frac{\frac{A_M}{1 + s/\omega_H}}{\frac{1 + s/\omega_H + \beta A_M}{1 + s/\omega_H}} = \frac{A_M}{1 + s/\omega_H + \beta A_M} = \frac{A_M}{(1 + \beta A_M)\left[1 + \frac{s}{\omega_H (1 + \beta A_M)}\right]}$$

$$A_f = \frac{\frac{A_M}{1+\beta A_M}}{1 + s/[\omega_H (1+\beta A_M)]}$$

$$\boxed{\omega_{Hf} = \omega_H (1+\beta A_M)}$$

$$A(s) = \frac{A_M}{1+\omega_L/s} \longrightarrow A_f = \frac{\frac{A_M}{1+\omega_L/s}}{1+\beta \frac{A_M}{1+\omega_L/s}}$$

$$A_f = \frac{\frac{A_M}{1+\omega_L/s}}{\frac{1+\omega_L/s+\beta A_M}{1+\omega_L/s}} = \frac{A_M}{1+\omega_L/s+\beta A_M} = \frac{A_M}{(1+\beta A_M)\left[1+\frac{\omega_L}{s(1+\beta A_M}\right]}$$

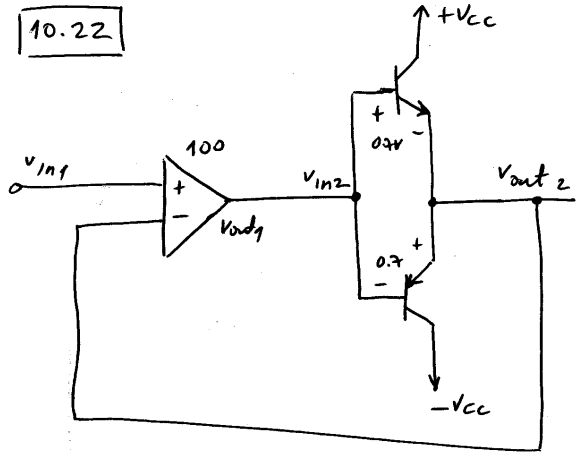
$$\boxed{\omega_{Lf} = \frac{\omega_L}{1+\beta A_M}}$$

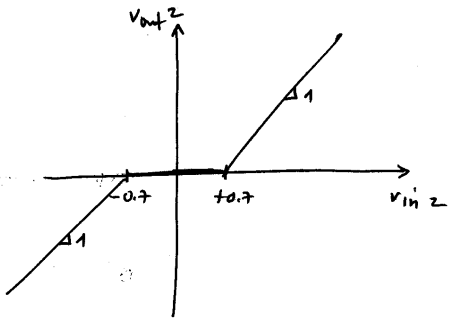
$$A_f = \frac{A_M}{1+\beta A_M} \longrightarrow 10 = \frac{1000}{(1+\beta A_M)} \Leftrightarrow (1+\beta A_M) = 100$$

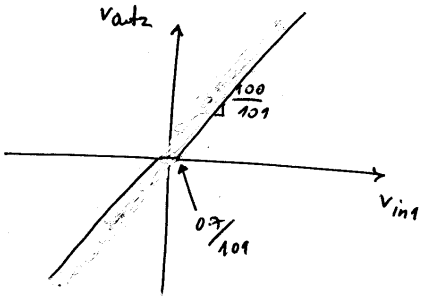
$$\omega_{Hf} = \omega_H (1+\beta A_M) = 10\,KHz \times 100 = 1\,MHz$$

$$\omega_{Lf} = \frac{\omega_L}{1+\beta A_M} = \frac{100\,Hz}{100} = 1\,Hz$$

10.22







$$v_{out1} = 100\,(v_{in1} - r_{out2})$$

$$r_{out1} = v_{out2} \pm 0.7\ V$$

$$v_{out2} \pm 0.7 = 100\,v_{in1} - 100\,r_{out2}$$

$$100\,v_{in1} = (1 + 100)\,r_{out2} \pm 0.7$$

$$r_{out2} = \frac{100}{101}\,v_{in1} \mp \frac{0.7}{101}$$