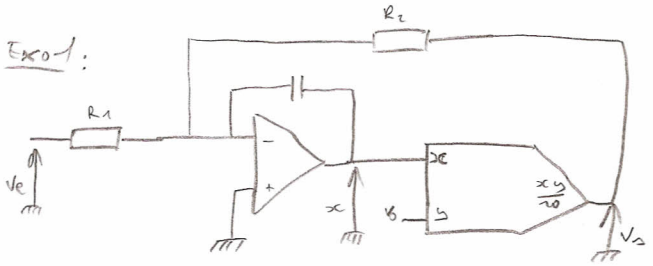
Correction exam :

• Exo 1 :



$Z_c = \frac{1}{jC\omega}$ $\quad V_s = \frac{x V_0}{10} \Rightarrow x = \frac{V_s 10}{V_0}$

$$V^- = \frac{\frac{V_e}{R_1} + \frac{x}{Z_c} + \frac{V_s}{R_2}}{\frac{1}{R_1} + \frac{1}{Z_c} + \frac{1}{R_2}}$$

$V^+ = 0$

On en déduit : $V_e Z_c R_2 + x R_1 R_2 + V_s Z_c R_1 = 0$

$V_e Z_c R_2 + \frac{V_s 10}{V_e} R_1 R_2 + V_s Z_c R_1 = 0$

$V_s \left(\frac{10 R_1 R_2}{V_0} + Z_c R_1 \right) = - R_2 Z_c V_e$

$$\boxed{\frac{V_s}{V_e} = \frac{- R_2 Z_c}{Z_c R_1 + \frac{10 R_1 R_2}{V_0}}}$$

$$\frac{V_s}{V_e} = \frac{- R_2}{R_1 + \frac{10 R_1 R_2}{V_0 Z_c}} = - \frac{R_2}{R_1} \times \frac{1}{1 + \frac{10 R_2}{V_0 Z_c}}$$

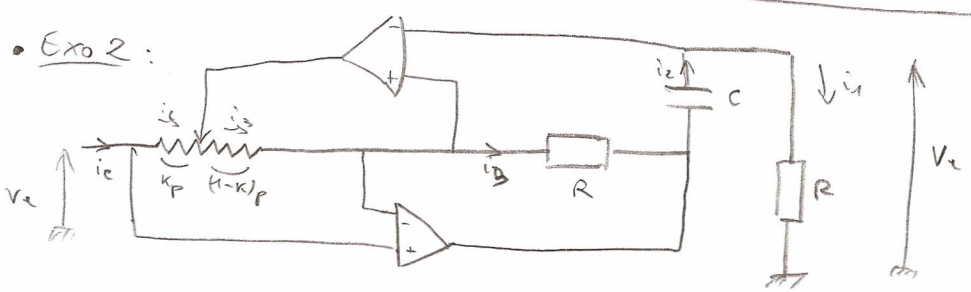
$$\Rightarrow \frac{V_s}{V_e} = - \frac{R_2}{R_1} \times \frac{1}{1 + j \frac{10 R_2 C \omega}{V_0}}$$

Filtre passe bas

$$\Rightarrow \boxed{H(\omega) = \frac{H_0}{1 + j \frac{\omega}{\omega_0}} \quad ; \quad H(0) = - \frac{R_2}{R_1}}$$

$$\boxed{\omega_0 = \frac{V_0}{10 R_2 C}}$$

• Exo 2 :



$V_e = R i_1$ $\quad i_2 = - R C p \, i_3$

$i_1 = i_2$ $\quad k p \, i_4 + (1-k) p \, i_3 = 0$

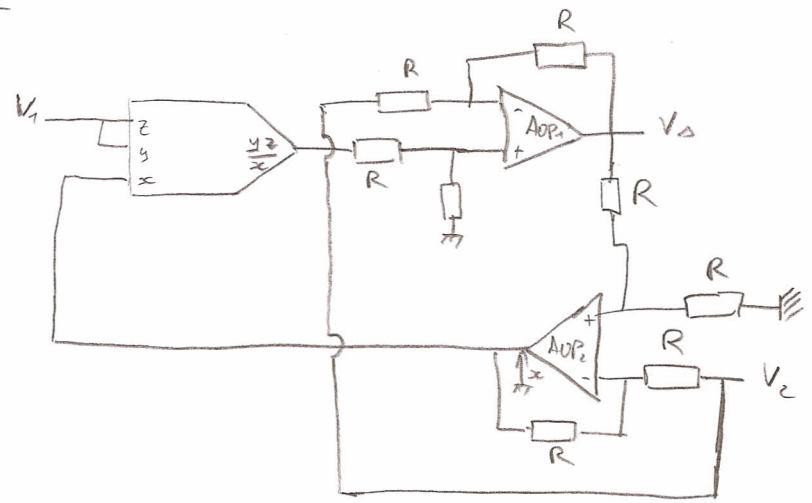
$R i_3 + \frac{i_2}{Cp} = 0$ $\quad i_4 = - \frac{1-k}{k} i_3$ or $i_4 = i_e$

$i_2 = - R C p \, i_3$ or $i_3 = - \frac{k}{1-k} i_4$

$i_2 = R C p \times \frac{k}{1-k} i_4$ or $i_4 = i_e$ et $i_2 = i_1$ et $i_2 = \frac{V_e}{R}$

$$\Rightarrow \frac{V_e}{R} = R C p \frac{k}{1-k} i_e \Rightarrow \boxed{Z_e = \frac{V_e}{i_e} = \frac{k}{1-k} R^2 C p}$$

• Exo3 :



• AOP_2 : $V^+ = \frac{V_\Delta}{2}$

$V^- = \frac{\frac{x}{R} + \frac{V_2}{R}}{\frac{1}{R} + \frac{1}{R}} = \frac{x + V_2}{2}$

$V^+ = V^-$

$\Rightarrow \frac{x + V_2}{2} = \frac{V_\Delta}{2} \Rightarrow \boxed{x = V_\Delta - V_2}$

• AOP_1 : $V^+ = \frac{V_1^2}{2x}$

$V^- = \frac{V_\Delta + V_2}{2}$

$V^- = V^+$

$\Rightarrow \frac{V_1^2}{2x} = \frac{V_\Delta + V_2}{2}$

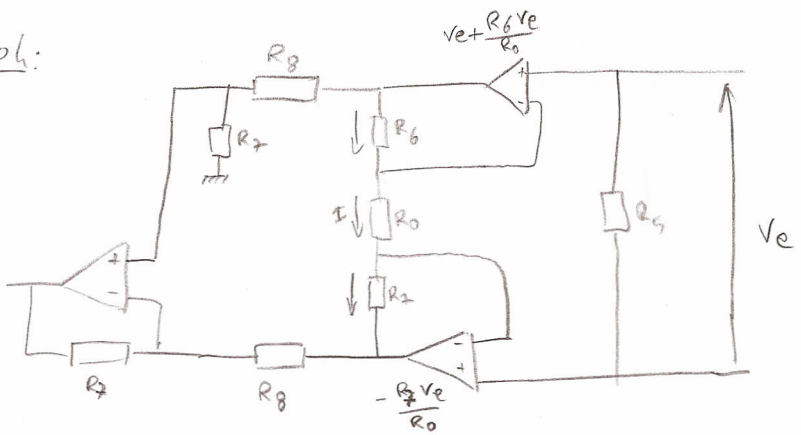
$\Rightarrow \frac{V_1^2}{x} = V_\Delta + V_2$

$\Rightarrow V_1^2 = (V_\Delta + V_2)(V_\Delta - V_2)$

$\Rightarrow V_1^2 = V_\Delta^2 - V_2^2$

$\Rightarrow \boxed{V_\Delta = \sqrt{V_1^2 + V_2^2}}$ $\Rightarrow$ on calcule le module.

• Exo4 :



$I = \frac{V_e}{R_0}$

$V^+ = \frac{R_7}{R_7 + R_8} \times \left(V_e + \frac{R_6 V_e}{R_0}\right) = \frac{R_7}{R_7 + R_8} V_e \left(1 + \frac{R_6}{R_0}\right)$

$V^- = \frac{\frac{V_\Delta}{R_7} - \frac{R_7 V_e}{R_0 / R_0^2}}{\frac{1}{R_7} + \frac{1}{R_8}}$

$\Rightarrow V^- = \frac{V_\Delta R_8 - \frac{R_7^2}{R_0} V_e}{R_7 + R_8}$

$V^+ = V^-$

$\Rightarrow \frac{R_7}{R_7 + R_8} V_e \left(1 + \frac{R_6}{R_0}\right) = \frac{V_\Delta R_8 - \frac{R_7^2}{R_0} V_e}{R_7 + R_8}$

$\Rightarrow R_7 V_e \left(1 + \frac{R_6}{R_0}\right) + \frac{R_7^2}{R_0} V_e = R_8 V_\Delta$

$\Rightarrow V_\Delta = \left[\frac{R_7}{R_8}\left(1 + \frac{R_6}{R_0}\right) + \frac{R_7^2}{R_0 R_8}\right] V_e$

si $R_6 = R_7 = R_8 = R$

$\Rightarrow \boxed{V_\Delta = \left(1 + \frac{2R}{R_0}\right) V_e}$