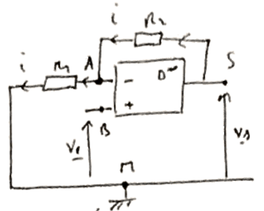
DM AO

Exercice 1

Rq : $V_B - V_A = \varepsilon = 0$ $\boxed{V_A = V_B}$



2 méthodes

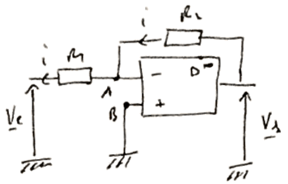
1* DT : $\frac{R_1}{R_1+R_2} \cdot V_s = V_e$

$\boxed{H = \frac{V_s}{V_e} = \frac{R_1+R_2}{R_1} > 1}$

ou :

2* Millman : $V_A = \frac{\frac{V_s}{R_2} + \cancel{\frac{V_A}{R_1}}}{\frac{1}{R_1} + \frac{1}{R_1}} = \frac{R_1}{R_1+R_1} V_s = V_B = V_e$

$\boxed{H = \frac{R_1+R_2}{R_1} > 1}$

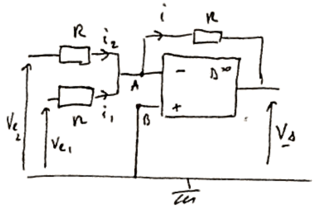


LDM $V_A = V_B = 0$ * $i = \frac{-(V_e - V_A)}{R_1} = \frac{V_s - \cancel{V_A}}{R_2}$ $V_A = V_B = 0$

$\boxed{\frac{V_s}{V_e} = -\frac{R_2}{R_1}}$

ou Millman : * $\frac{\frac{V_e}{R_1} + \frac{V_s}{R_2}}{\frac{1}{R_1} + \frac{1}{R_2}} = V_A = V_B = 0$

$\boxed{\frac{V_s}{V_e} = -\frac{R_2}{R_1}}$

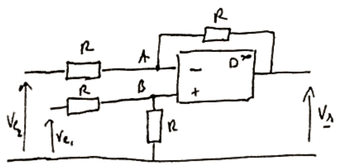


* Millman $\frac{\frac{V_{e1}}{R} + \frac{V_{e2}}{R} + \frac{V_s}{R}}{\frac{1}{R} + \frac{1}{R} + \frac{1}{R}} = V_A = V_B = 0$

Soit $\boxed{V_s = -(V_{e1} + V_{e2})}$ Sommateur inverseur

* LDM & LDN : $i = i_1 + i_2$

$-\frac{V_s}{R} = \frac{V_{e1}}{R} + \frac{V_{e2}}{R}$ car $V_A = 0$ soit $V_s = -(V_{e1} + V_{e2})$.



Millman : $V_A = \frac{\frac{V_{e2}}{R} + \frac{V_s}{R}}{\frac{1}{R} + \frac{1}{R}}$ $V_B = \frac{\frac{V_{e1}}{R} + \frac{0}{R}}{\frac{1}{R} + \frac{1}{R}}$.

Or $V_A = V_B$ $V_{e2} + V_s = V_{e1}$

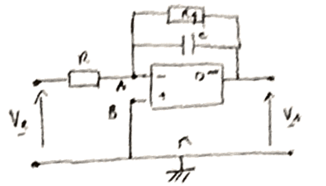
$\boxed{V_s = V_{e1} - V_{e2}}$ Soustracteur.

* DT : $V_B = V_{e1} \frac{R}{R+R} \Rightarrow V_B = \boxed{\frac{V_{e1}}{2} = V_A}$

$(V_A - V_{e2}) = (V_s - V_{e2}) \cdot \frac{R}{R+R} = \frac{V_s - V_{e2}}{2}$ Soit $\frac{V_A}{2} - V_{e2} = \frac{V_s}{2} - \frac{V_{e2}}{2} \iff \frac{V_s}{2} = \frac{V_{e1}}{2} - \frac{V_{e2}}{2}$

$\boxed{V_s = V_{e1} - V_{e2}}$

Exercice 2



a) On boucle sur E- ⇒ linéaire $\varepsilon = 0$ $V_A = V_B$

b) $R_f = 0$

$\frac{\frac{V_e}{R} + \frac{V_s}{Z_c}}{\frac{1}{R} + \frac{1}{Z_c}} = V_A = V_B = 0$

$V_s = -\frac{Z_c}{R} V_e$ $\boxed{V_s = \frac{-V_e}{jwRC}}$

retour R $\boxed{V_s = -\frac{1}{RC}\int V_e(t)\,dt}$ intégrateur.

$\boxed{H = \frac{j\,w_c}{w}}$ avec $w_c \equiv \frac{1}{RC}$

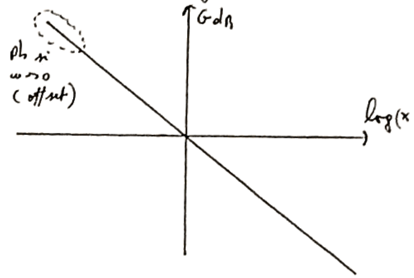
Pb si V_e possède un offset V_{e0}.

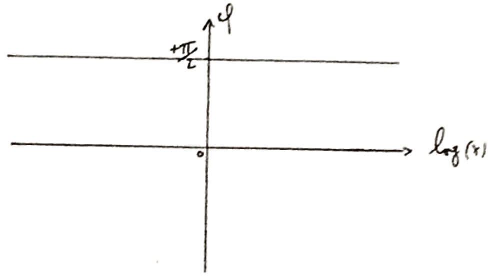
$\int V_{e0}\,dt = V_{e0}.t + C^{te} \longrightarrow \pm\infty$.

induit un phénomène de dérive vers la saturat°.

$|H| = G = \frac{w_c}{w} \equiv \frac{1}{x}$

$G_{dB} = -20\log(x)$.





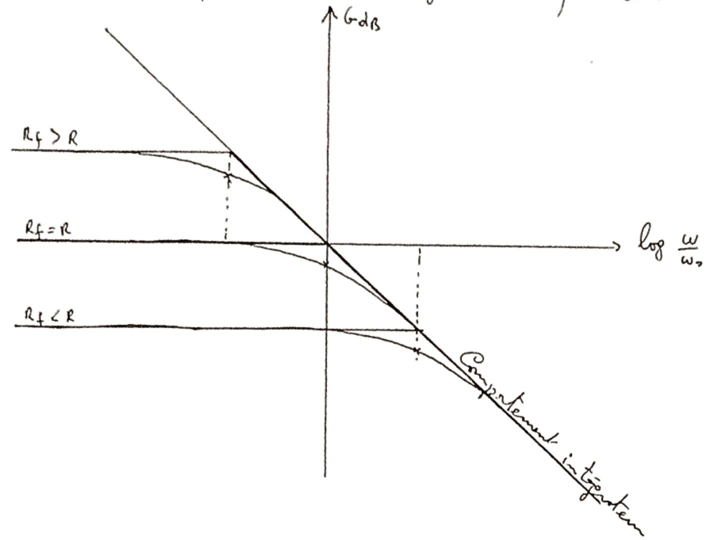
c) On remplace Z_c par $Z_{eq} = Z_c // R_f = \frac{Z_c R_f}{R_f + Z_c} = \frac{R_f}{1 + jwR_fC}$

Soit $H = \frac{V_s}{V_e} = -\frac{\frac{R_f}{R}}{1 + jwR_fC}$ $H = \frac{H_0}{1 + j\frac{w}{w_c}}$ $\begin{cases} H_0 = -\frac{R_f}{R} < 0 \\ w_c = \frac{1}{R_f C} \end{cases}$

* $w \ll w_c$ $H \simeq H_0$ passe bas & plus de Pb de dérive car $|H|$ est borné en $w \to 0$
* $w \gg w_c$ $H \simeq \frac{H_0 w_c}{jw}$ passe bas & comportement intégrateur 1^{er} ordre. (-20dB/déc)
* $w = w_c$ $H = \frac{H_0}{1+j}$ ↳ $G = \frac{H_0}{\sqrt{2}}$

Soit $\omega_0 = \frac{1}{RC}$ une pulsat° de référence $\boxed{\omega_c = \frac{1}{R_f C} = \frac{R}{R_f}\cdot \omega_0}$

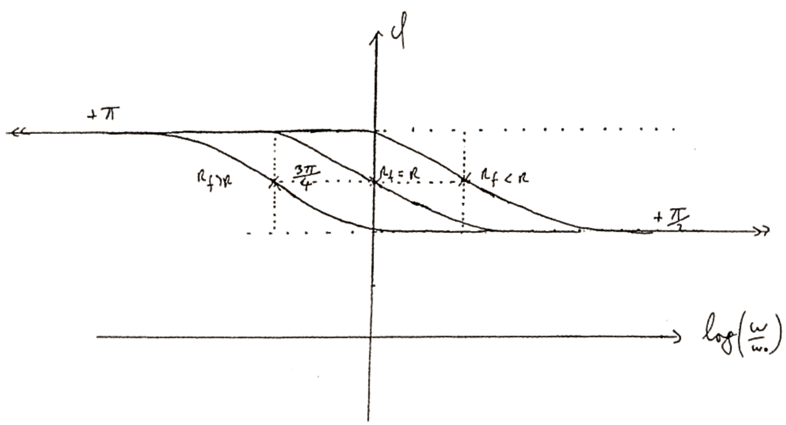
$|H_0| = \frac{R_f}{R}\cdot 1 = \frac{R_f}{R}\, G_0$ $\quad G_0 = 1$ gain de référence :



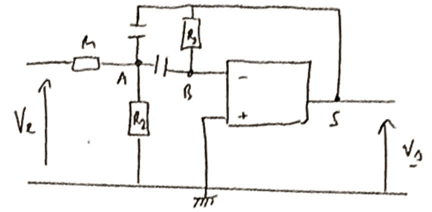
$\omega \ll \omega_c \qquad \underline{H} \simeq -\frac{R_f}{R} \qquad \boxed{\varphi = \pi}$

$\omega \gg \omega_c \qquad \underline{H} \simeq \frac{-\frac{R_f}{R}\omega_c}{j\omega} \qquad \boxed{\varphi = +\frac{\pi}{2}}$ (intégrateur)

$\omega = \omega_c \qquad \underline{H} \simeq -\frac{R_f}{R}\,\frac{1}{1+j} \qquad \varphi = \overbrace{\arg(-1)}^{\pi} - \overbrace{\arg(1+j)}^{\frac{\pi}{4}} \qquad \boxed{\varphi = \frac{3\pi}{4}}$



* filtre actif :



$$* \ \underline{V}_B = \frac{\frac{\underline{V}_s}{R_3} + \underline{V}_A\, j\omega C}{\frac{1}{R_3} + j\omega C} = \underline{V}_- = \underline{V}_+ = 0 \qquad \boxed{\underline{V}_s = -\underline{V}_A\, j\omega R_3 C}$$

$$* \ \underline{V}_A = \frac{\frac{\underline{V}_e}{R_1} + \underline{V}_s j\omega C + \frac{0}{R_2} + \cancel{\underline{V}_B}\, j\omega C}{\frac{1}{R_1} + \frac{1}{R_2} + 2j\omega C} \quad \text{Soit} \quad \frac{-\underline{V}_s}{j\omega R_3 C}\Big[\overbrace{\frac{R_1+R_2}{R_1R_2}}^{1/R_{eq}} + 2j\omega C\Big] - \underline{V}_s\, j\omega C = \ldots = \frac{\underline{V}_e}{R_1}$$

$$\boxed{-\underline{V}_s\Big[\frac{+2}{R_3} + j\omega C + \frac{1}{j\omega R_3 R_{eq} C}\Big] = \frac{\underline{V}_e}{R_1}} \Rightarrow \text{P bande } \underline{H} = \frac{H_0\, j\frac{\omega}{Q\omega_0}}{1-\left(\frac{\omega}{\omega_0}\right)^2 + j\frac{\omega}{Q\omega_0}}$$

$$\underline{H} = \frac{\underline{V}_s}{\underline{V}_e} = -\frac{j\omega R_3 R_{eq} C}{R_1} \times \frac{1}{1 - \frac{\omega^2 \cancel{R_3 R_{eq} C^2}}{\omega_0^2 \cancel{R_3 R_{eq} C^2}} + j\frac{\omega\, 2R_{eq}\cancel{C}}{\omega_0 \sqrt{R_{eq}R_3 \cancel{C^2}}}} \qquad \frac{\omega}{\omega_0}\, 2\sqrt{\frac{R_{eq}}{R_3}} \rightarrow \frac{\omega}{\omega_0}\,\frac{1}{Q} \Rightarrow \boxed{Q = \sqrt{\frac{R_3}{4R_{eq}}}}$$

$$\boxed{\omega_0 = \frac{1}{\sqrt{R_3 R_{eq} C^2}}}$$

enfin $H_0\, j\frac{\omega}{Q\omega_0} = -\frac{j\omega R_3 \cancel{R_{eq} C}}{R_1\, \omega_0 \cancel{\sqrt{R_{eq}R_3C^2}}} \times \frac{1}{Q}\sqrt{\frac{\cancel{R_3}}{4\cancel{R_{eq}}}}$

Soit $H_0\, \cancel{\frac{j\omega}{Q\omega_0}} = -\cancel{\frac{j\omega}{Q\omega_0}}\cdot\frac{R_3}{R_1}\,\frac{1}{2} \qquad \boxed{H_0 = -\frac{R_3}{2R_1}}$