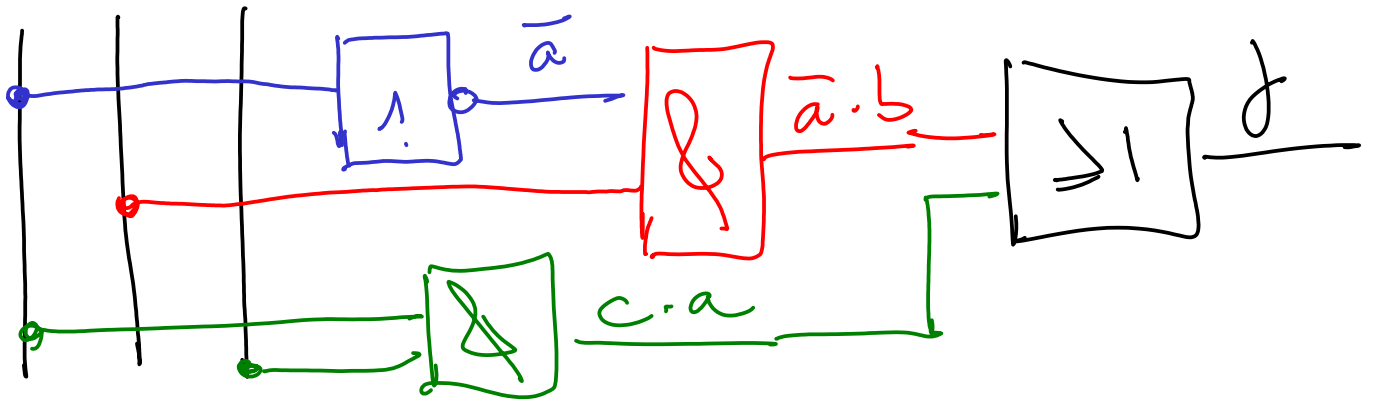


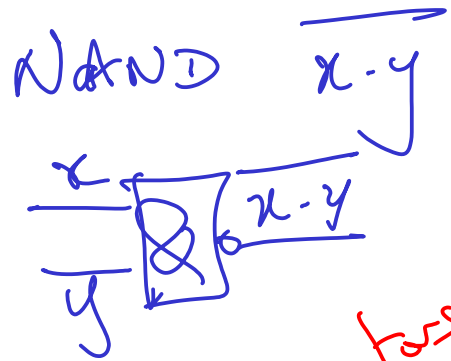
# Revisions

Logigramme de  $f = \bar{a} \cdot b + c \cdot a$

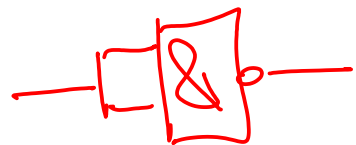


avec des NAND

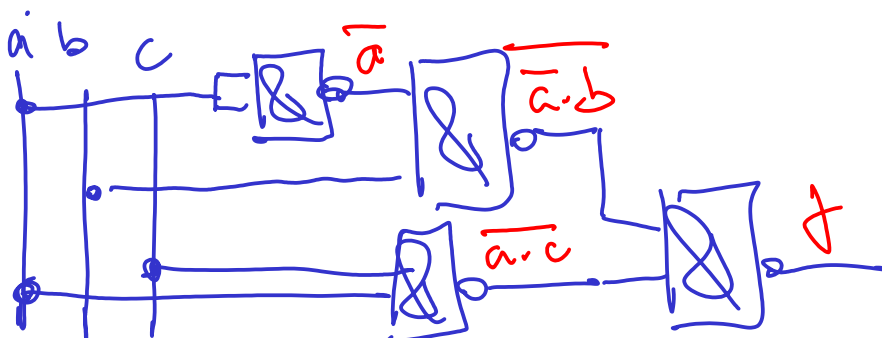
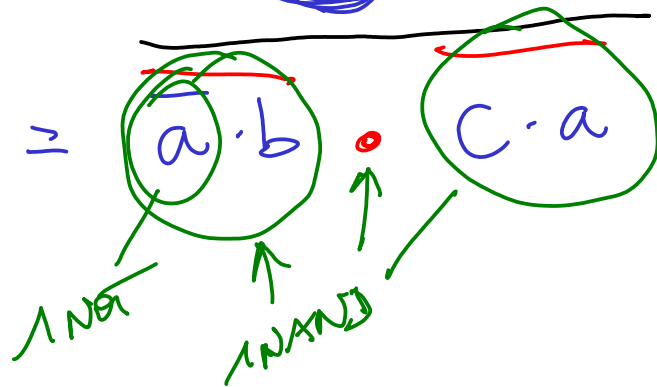
th. de Morgan




2 transistors  
NOT en NAND



$$f = \bar{a} \cdot b + c \cdot a$$



Avec des NOR  $\overline{x+y}$    $\overline{x+y}$

$$f = \overline{a} \cdot b + c \cdot \overline{a}$$

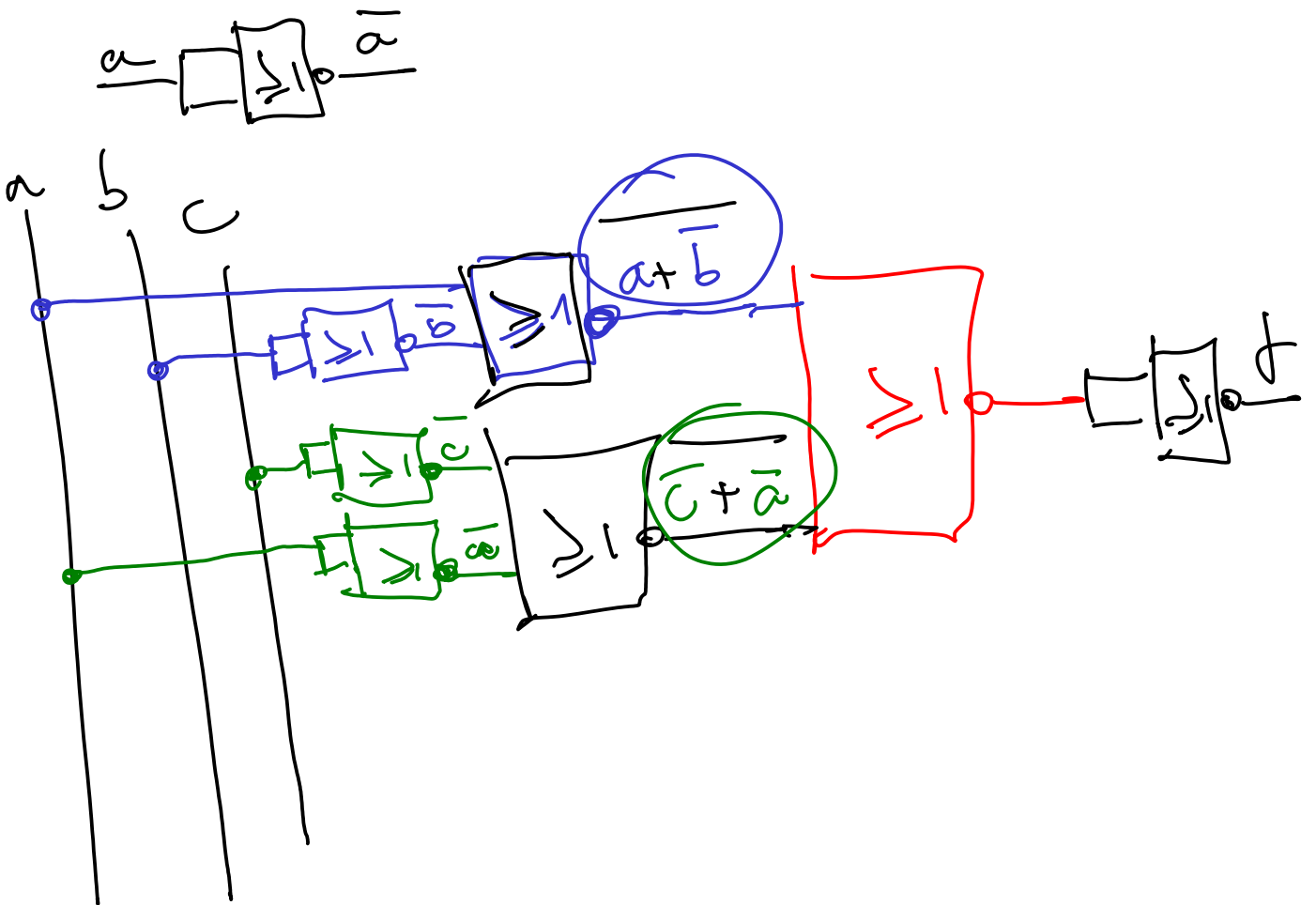
$$= \overline{\overline{a \cdot b}} + \overline{\overline{c \cdot a}}$$

$\overline{\overline{c \cdot a}} = \overline{\overline{c} + \overline{a}}$  (NOR)

$$\overline{\overline{a \cdot b}} = \overline{\overline{a} + \overline{b}} = a + b$$

$\overline{\overline{a} + \overline{b}}$  (NOR)

4 NOR et 3 NOR



Complement à 2

7 - 12 sur 5 bits

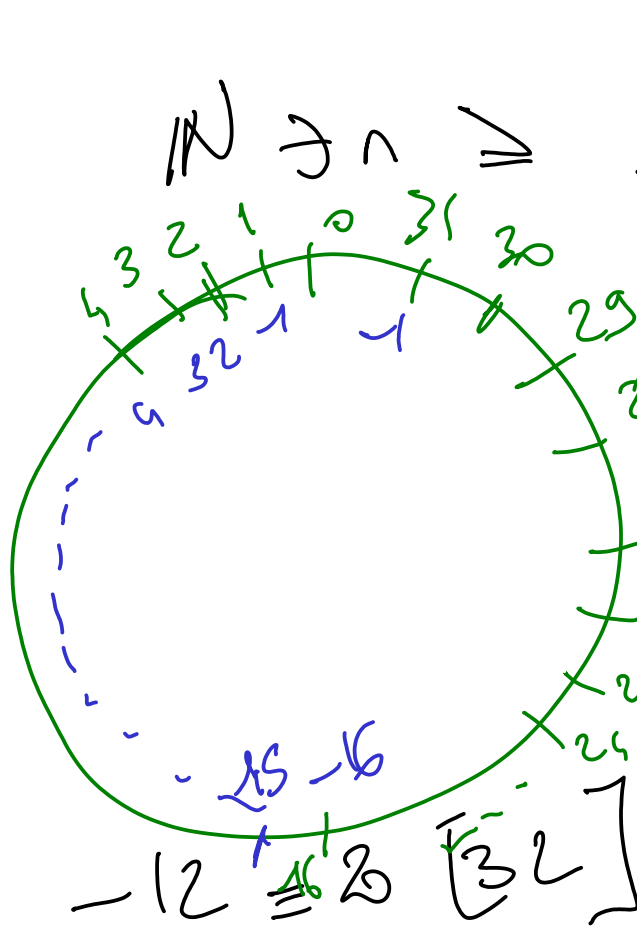
$$11011 = 31 - 4 = 2^5 - 1$$

$$\begin{array}{r} 7 \quad 6 \quad 5 \quad 4 \quad 3 \quad 2 \\ \hline 7 \quad 0 \quad 0 \quad 1 \quad 1 \quad 1 \\ + -12 \quad 1 \quad 0 \quad 1 \quad 0 \quad 0 \\ \hline \end{array}$$

majorité

$$N \leq 2^n = e$$

$$27 \equiv 27 - 32 \pmod{32} \\ \equiv -5 \pmod{32}$$



$$\frac{\ln(12)}{\ln(2)} = \frac{\ln(3) + 2\ln(2)}{\ln(2)}$$

$$= 2 + \frac{\ln(3)}{\ln(2)}$$

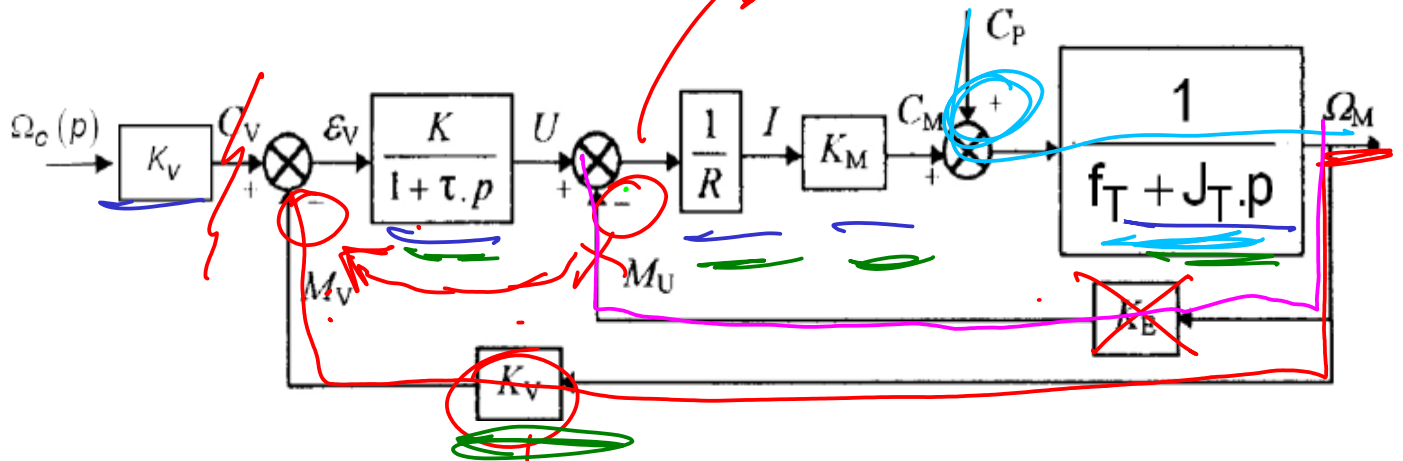
$$n \geq 5$$

$$2^5 = 32$$

- 20 = 16 + 4
- 16 → -16
- 17 → -15
- 18 → -14

- 15 → -13
- 20 → -12

Simplifiez le schéma-bloc  $\Omega_n$  ( $k_v k / 1 + G_p + k_e$ )



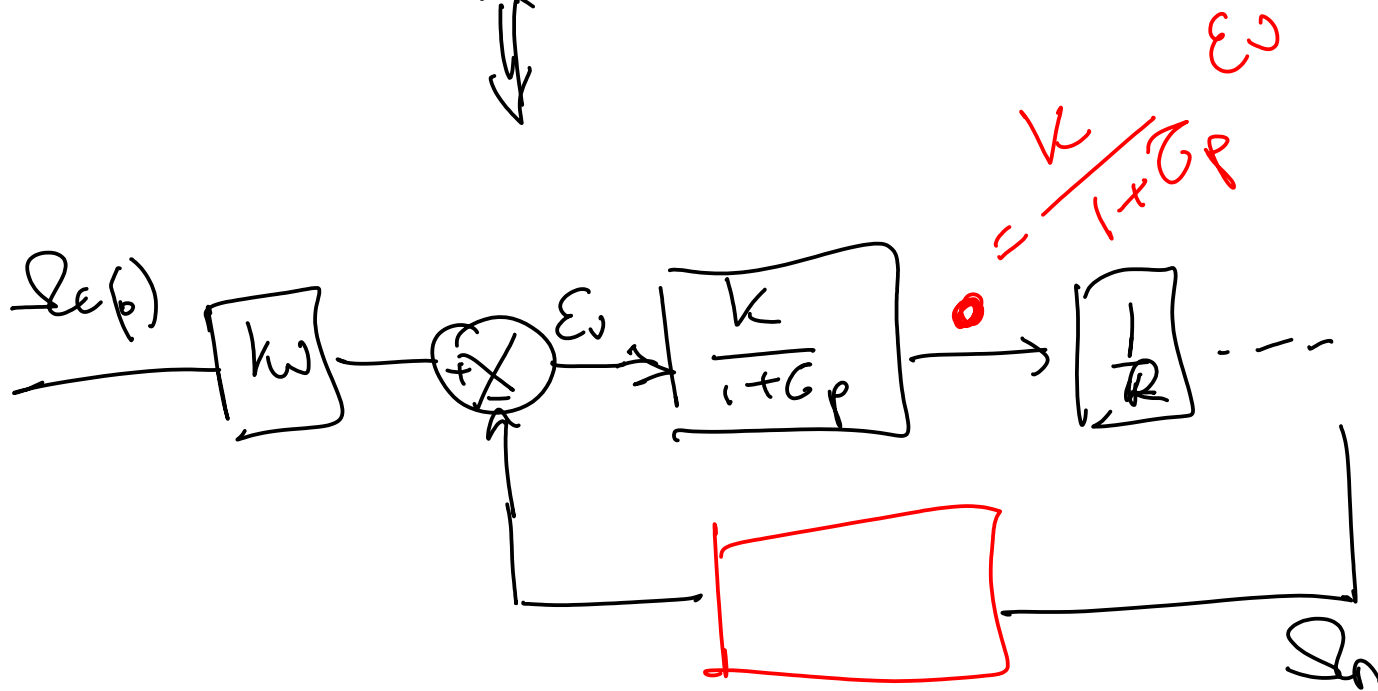
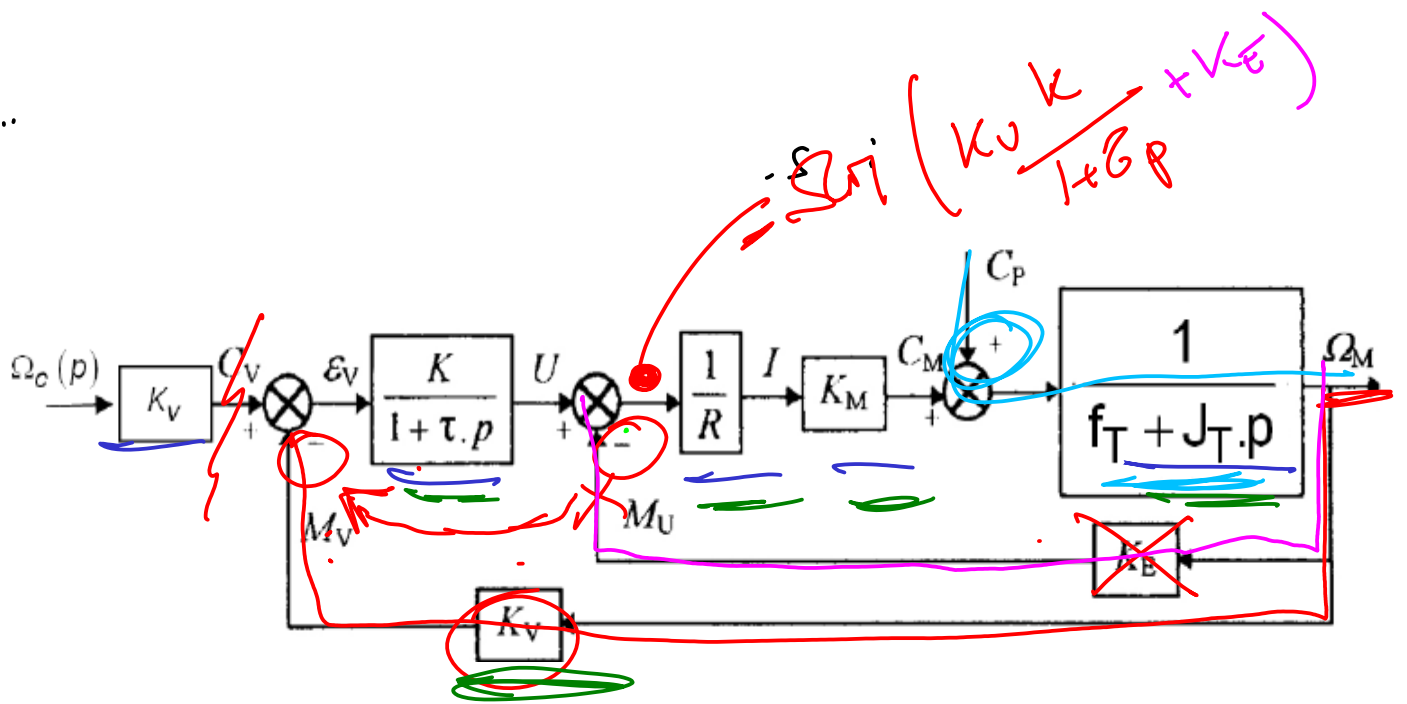
l'expression de  $\Omega_n = f(\Omega_c, C_p)$   
 $= H_1(p) \Omega_c(p) + H_2(p) C_p(p)$

$$k_v + \frac{k_e (1 + G_p)}{k}$$

ps formule de block.

$$H_1(p) = \frac{\Omega_n(p)}{\Omega_c(p)} = \frac{k_v k k_n}{(1 + G_p) R (f_T + J_T p)} \div \frac{k k_n (k_v + k_e (1 + G_p) / k)}{(1 + G_p) R (f_T + J_T p)}$$

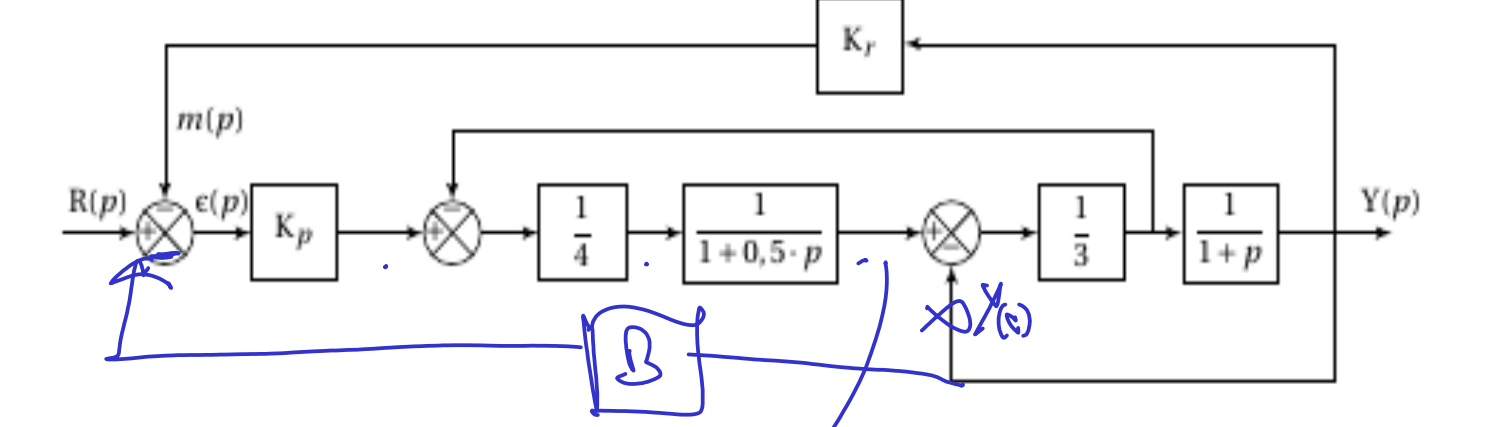
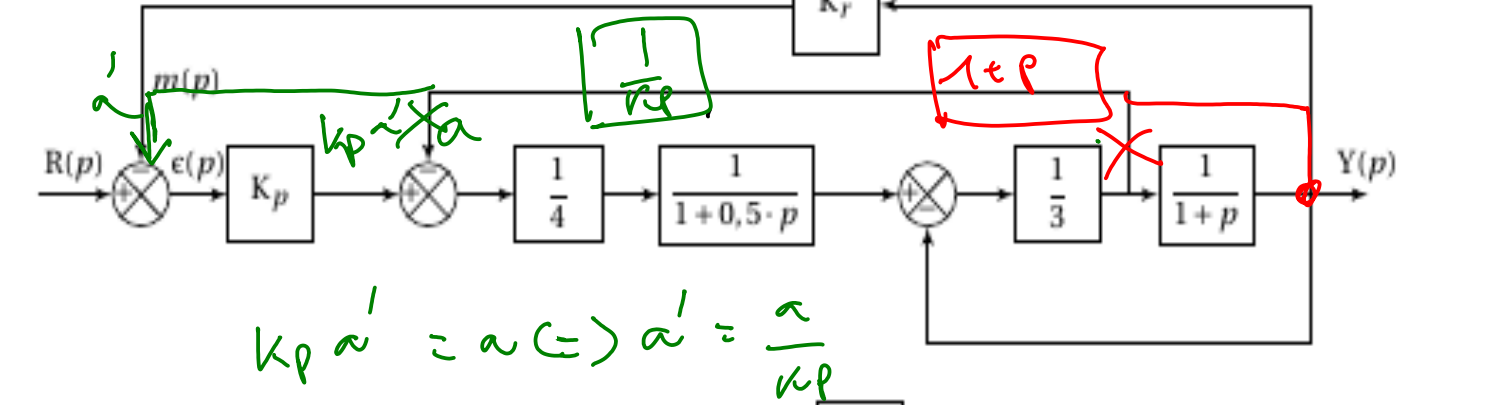
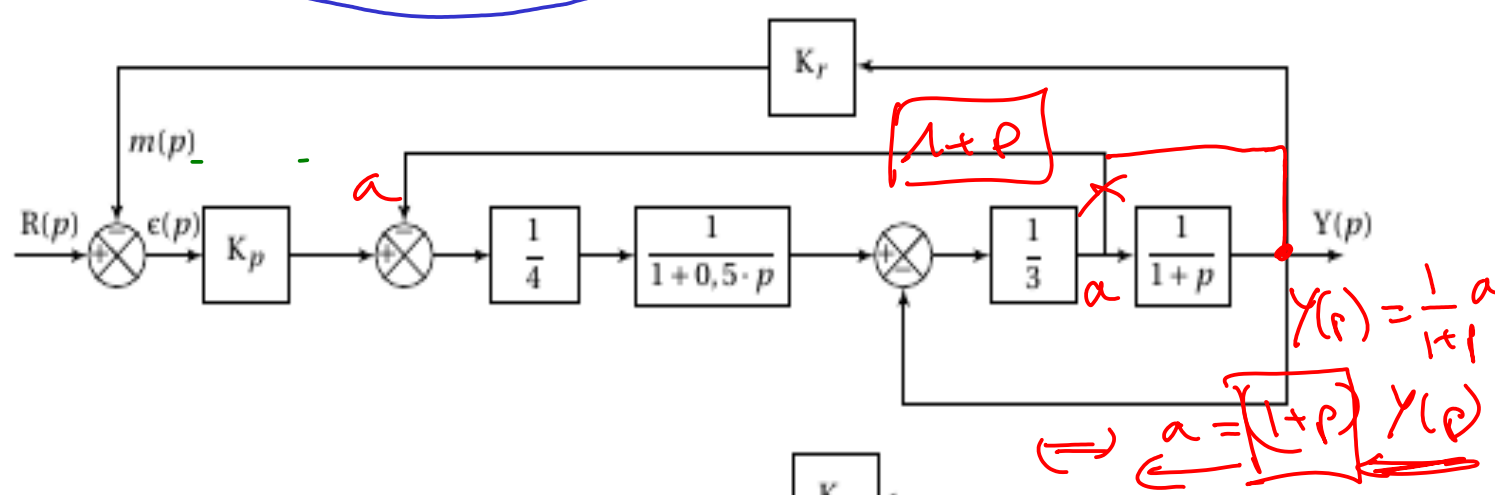
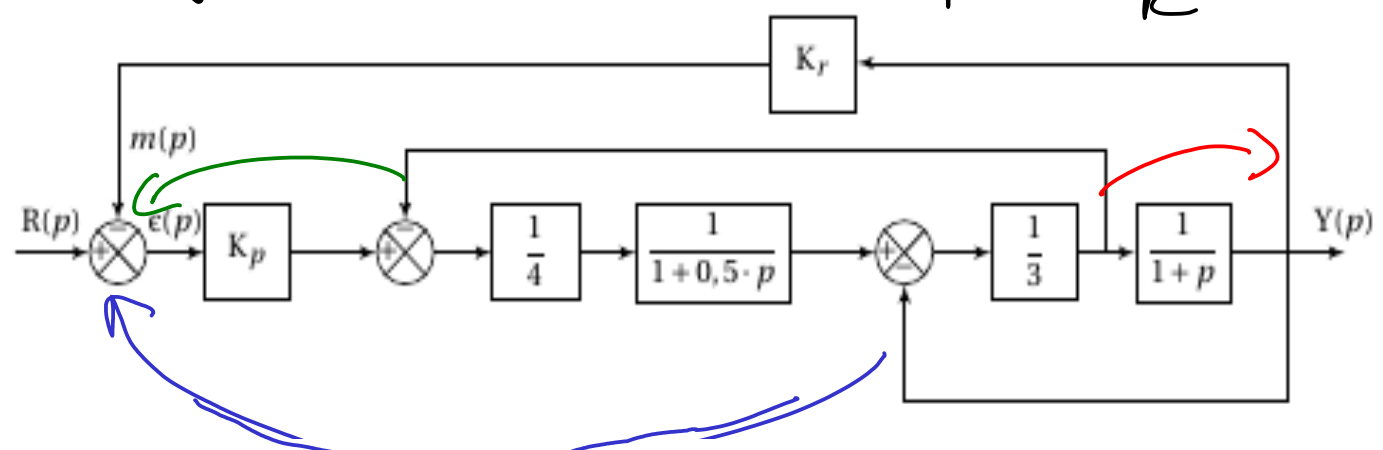
$$H_2(p) = \frac{\Omega_n(p)}{C_p(p)} = \frac{1}{f_T \cdot J_T p} \div \frac{1}{f_T \cdot J_T p}$$



$$+ \cancel{\Omega_M} \left( \frac{K_V K}{1+G_P} + K_E \right) = + \cancel{\Omega_M} \left[ \frac{K}{1+G_P} \right]$$

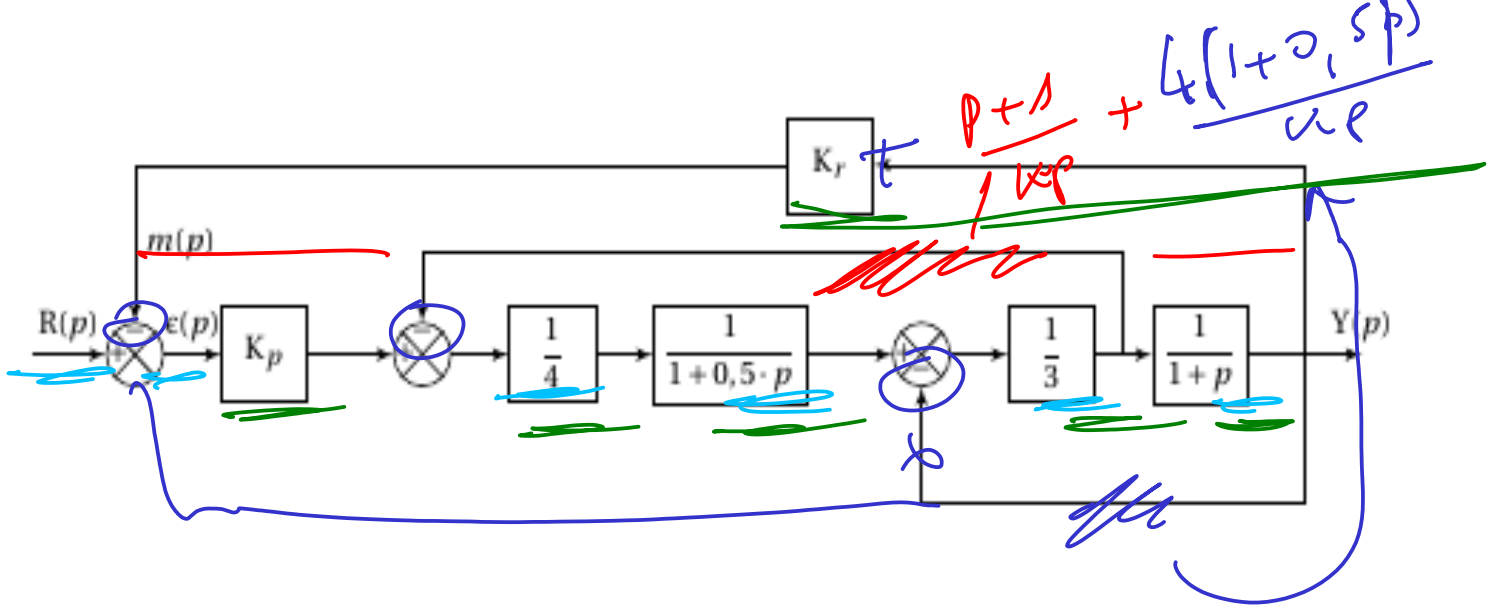
$$\Rightarrow \frac{K}{1+G_P} \left( K_V + \frac{K_E (1+G_P)}{K} \right) = \left[ \frac{K}{1+G_P} \right]$$

Simplifying the schematic blocks, puis  $\frac{Y}{R}$  ?



$$B = \frac{4(1+0,5p)}{K_p}$$

$$\Leftrightarrow Y(p) \cdot B \cdot K_p \cdot \frac{1}{4} \cdot \frac{1}{1+0,5p} = Y(p)$$

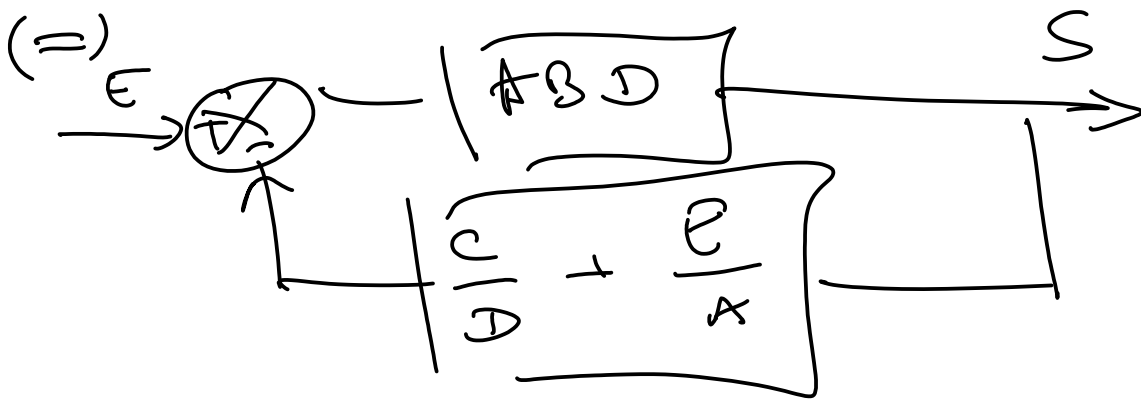
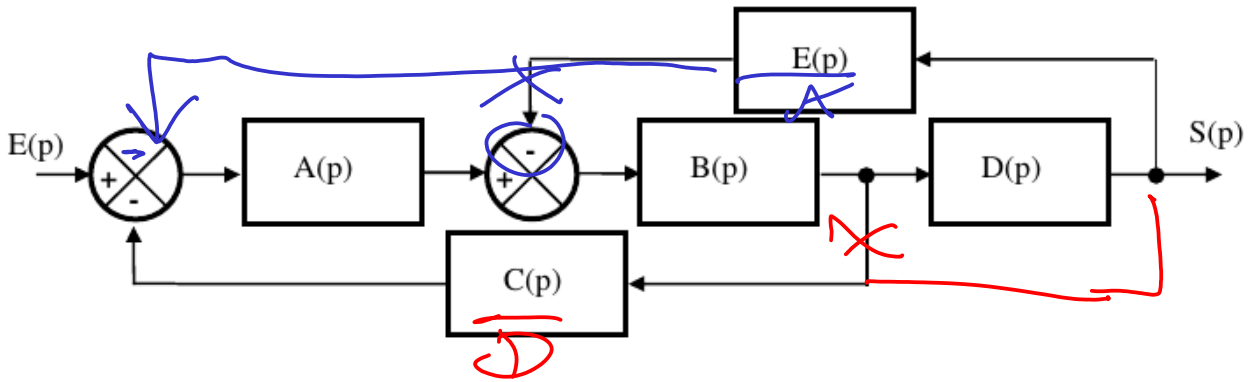


$$\frac{Y(p)}{R(p)} = \frac{k_p}{4 \cdot (1+0,5p)^3 (1+p)}$$

$$\sim + \frac{k_p}{4(1+0,5p)^3 (1+p)} \left( K_r + \frac{p+1}{K_r} + \frac{4(1+0,5p)}{K_r} \right)$$



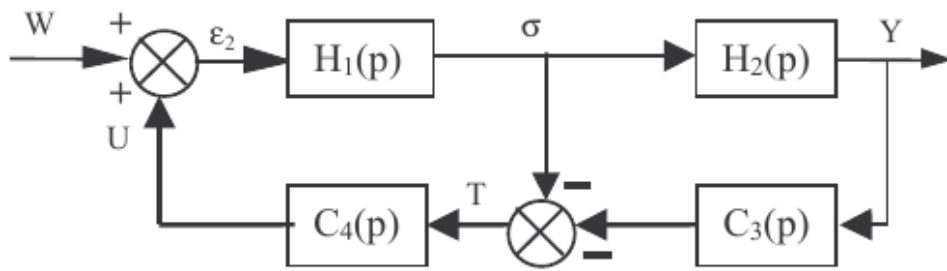
Simplifying le schéma-blocs, puis  $\frac{S}{E}$  ?



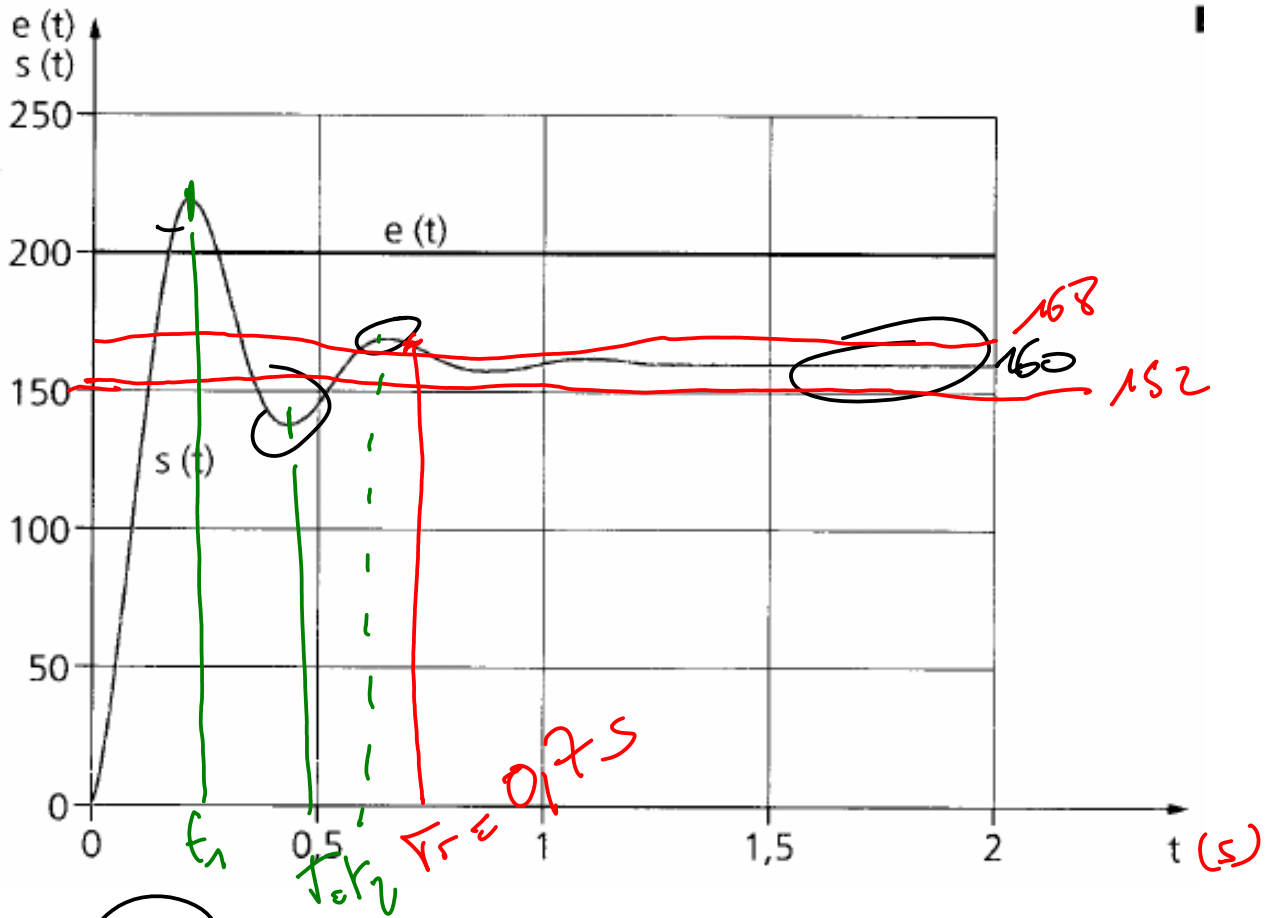
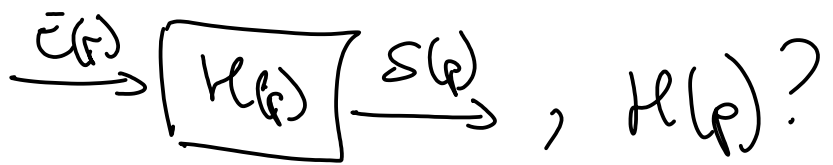
$$\frac{S}{E} = \frac{ABD}{1 + ABD \left( \frac{C}{D} + \frac{E}{A} \right)}$$

$$= \frac{ABD}{1 + ABC + BDE}$$

Simplifying the block diagram, plus  $\frac{Y}{W}$  ?



Identification



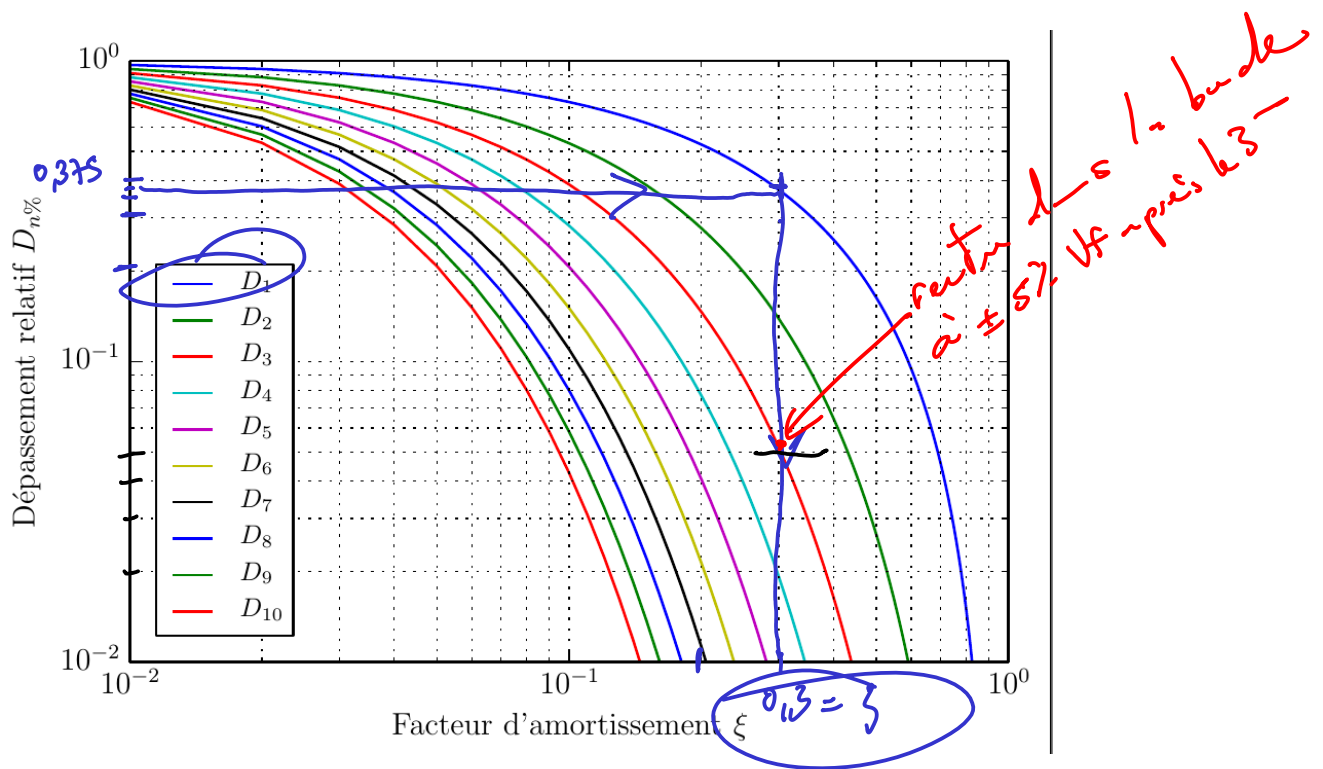
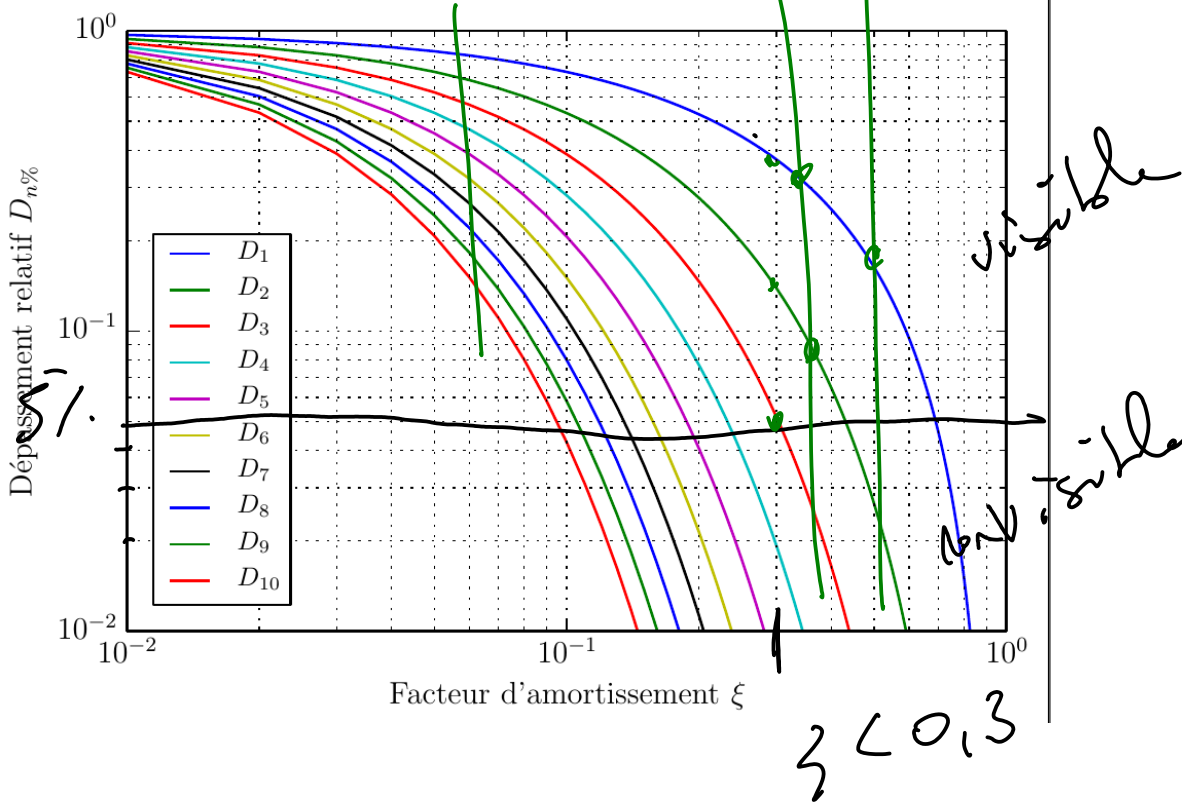
$\left( \frac{1}{k} \right)$

$$1 + \frac{23}{\omega^2} p + \frac{1}{\omega^2} p^2$$

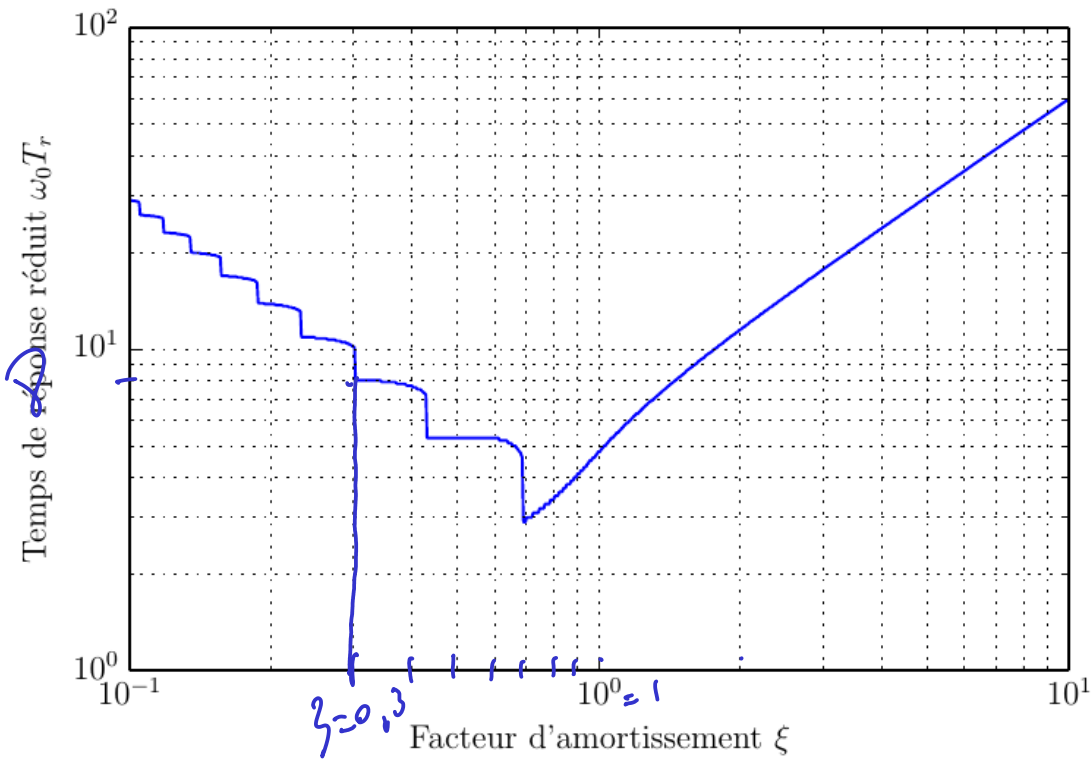
1, 2, 1 différences  
3 variables  
 $\hookrightarrow \{ 0, 3$

VF:  $k = \frac{160}{200} = \frac{4}{5} = 0,8$

Di:  $\frac{220 - 160}{160} = \frac{6}{16} \approx 37,5\%$



$\zeta = 0.3$

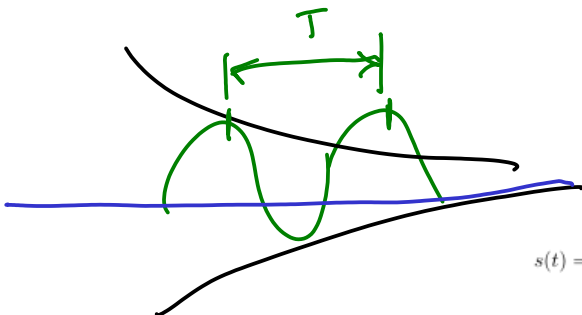


$$\left. \begin{array}{l} \omega_0 T_r = 8 \\ T_r = 0,17 \end{array} \right\} \omega_0 = \frac{8}{0,17} \approx 47 \text{ rad}\cdot\text{s}^{-1}$$

$$\frac{2\pi}{T} = \omega = \omega_0 \sqrt{1 - \zeta^2}$$

$$t_1 = \frac{T}{2}, \quad t_k = k \frac{T}{2} = \frac{k \pi}{\omega_0 \sqrt{1 - \zeta^2}}$$

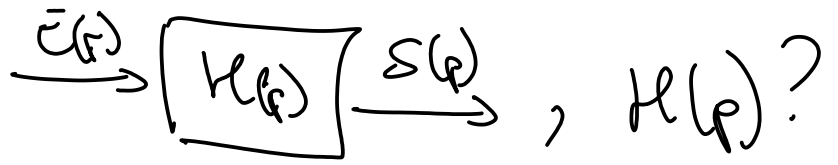
$$t_1 = 0,33 \text{ s} \rightarrow \omega_0 = \frac{\pi}{t_1 \sqrt{1 - \zeta^2}} = \frac{\pi}{0,33 \sqrt{0,81}} \approx 10 \text{ rad}\cdot\text{s}^{-1}$$



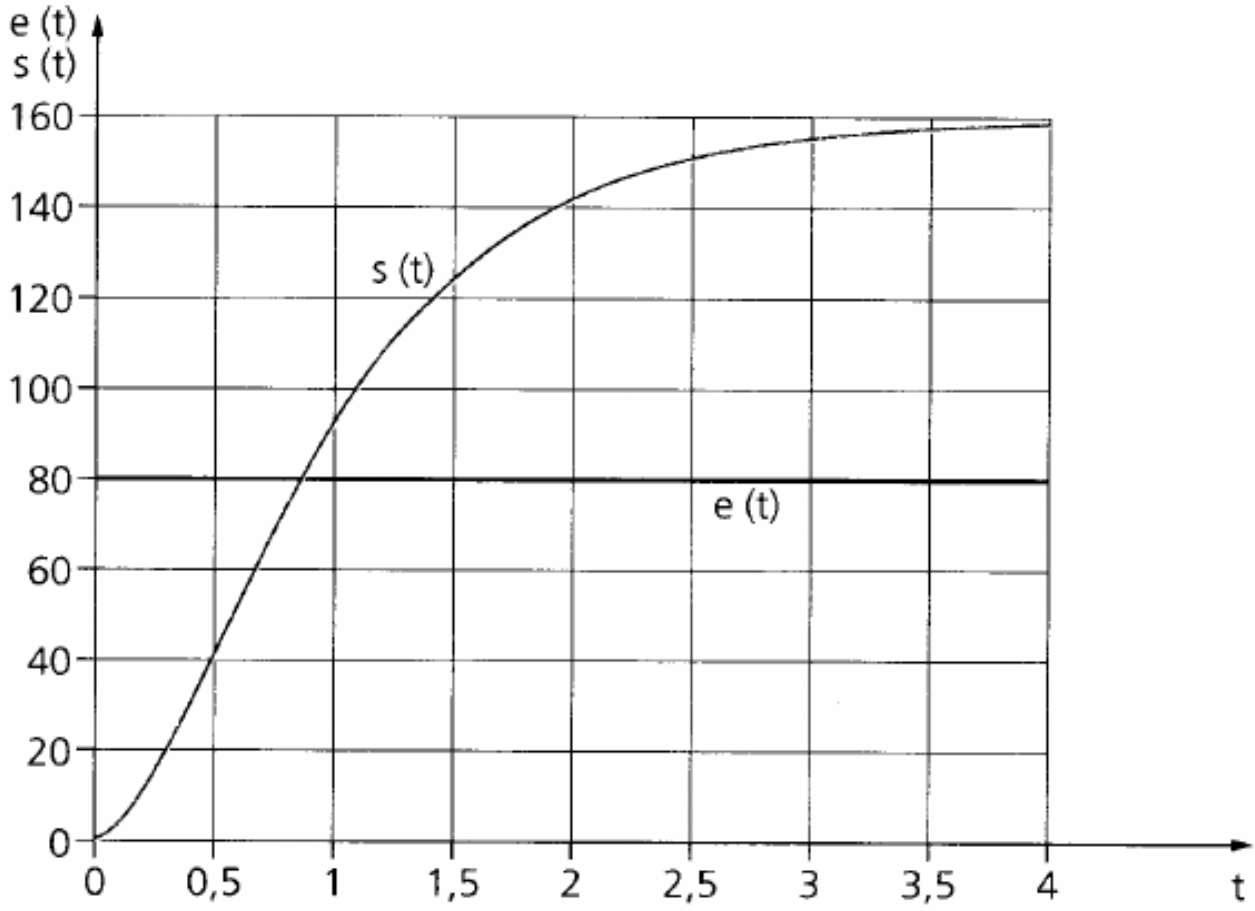
$e^{-at}$

$$s(t) = K e_0 \left[ 1 - \exp(-\xi \omega_0 t) \left( \cos(\omega_0 t \sqrt{1 - \xi^2}) + \frac{\xi}{\sqrt{1 - \xi^2}} \sin(\omega_0 t \sqrt{1 - \xi^2}) \right) \right] u(t)$$

Identification

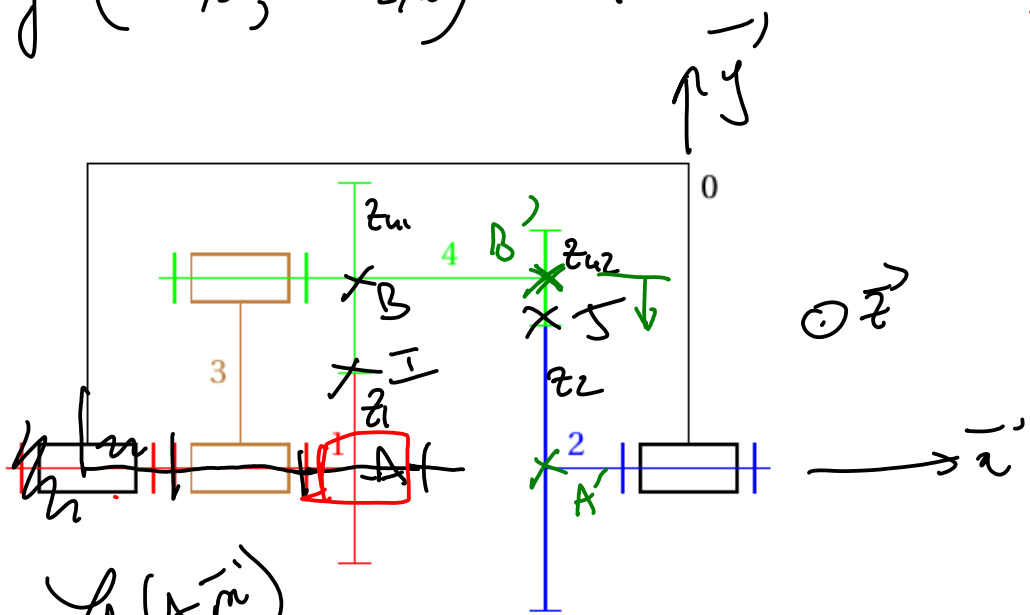


H



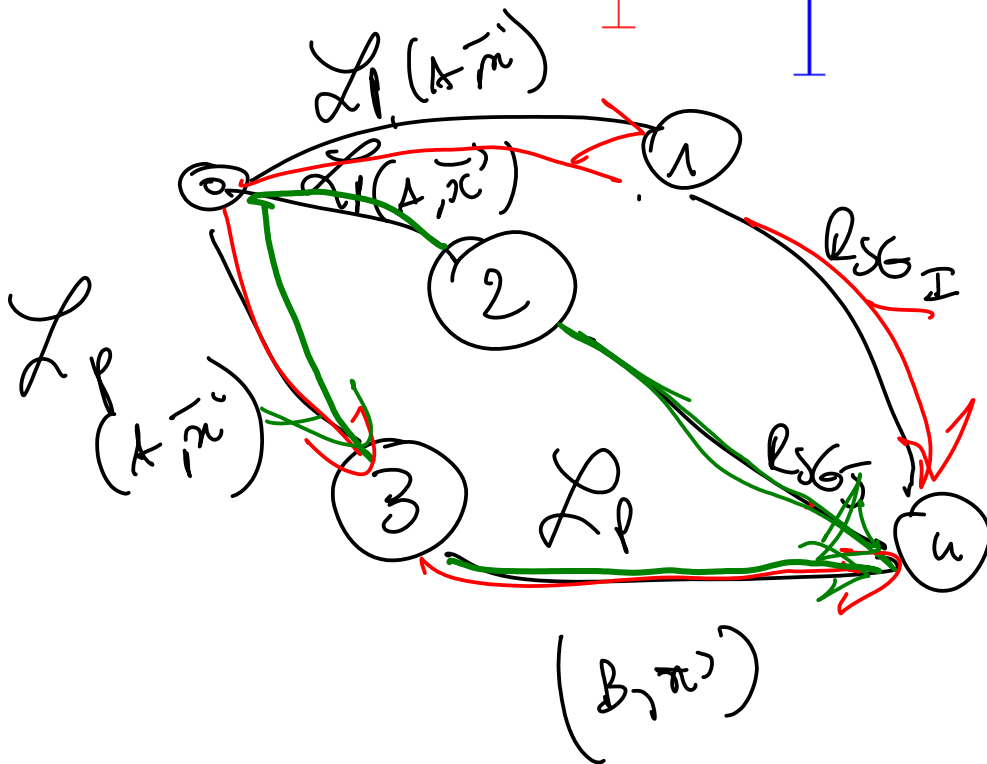
$$\omega_{2/0} = f(\omega_{1/0}, \omega_{3/0}) \quad ?$$

++



$\odot \vec{z}$

$\rightarrow \vec{x}$



$\vec{v}_u$ ?

RSG I :  $\vec{v}_{I, u/1} = \vec{0}$

par composition des vitesses au point I,

on a :

$$\vec{v}_{I, u/1} = \vec{v}_{I, u/3} + \underbrace{\vec{v}_{I, 3/0} - \vec{v}_{I, 1/0}}_{\vec{v}_{I, 3/1}}$$

Avec  $\mu$  chargeant le point:

$$\begin{aligned}\overrightarrow{V_{F,4/3}} &= \cancel{\overrightarrow{V_{B,4/3}}} + \overrightarrow{\Omega_{4/3}} \wedge \overrightarrow{BF} \\ &= \omega_{43} \vec{a}' \wedge -R_{41} \vec{y}'\end{aligned}$$

$$= -R_{41} \omega_{43} \vec{z}'$$

$$\begin{aligned}\overrightarrow{V_{I,3/0}} &= \cancel{\overrightarrow{V_{A,3/0}}} + \overrightarrow{\Omega_{3/0}} \wedge \overrightarrow{AI} \\ &= \omega_{30} \vec{a}' \wedge R_{31} \vec{y}'\end{aligned}$$

$$= \omega_{30} R_{31} \vec{z}'$$

$$\overrightarrow{V_{I,1/0}} = \omega_{10} R_{11} \vec{z}' \quad (3 \rightarrow 1)$$

$$\text{Donc : } \vec{z}' : 0 = -R_{41} \omega_{43} + (\omega_{30} - \omega_{10}) R_{31}$$



RS6 en J  $\vec{V}_{J,4/2} = \vec{0}$

Prescription des vitesses au point J,  
on a :

$$\vec{V}_{J,4/2} = \vec{V}_{J,4/3} + \underbrace{\vec{V}_{J,3/0} - \vec{V}_{J,2/0}}_{\vec{V}_{J,3/2}}$$

Avec ps changeant de point  $\vec{V}_{J,3/2}$  & tel que  $\vec{B}'_J \cdot \vec{\pi} = 0$

$$\vec{V}_{J,4/3} = \cancel{\vec{V}_{B,4/3}} + \Omega_{4/3} \wedge \vec{B}'_J$$

$$= \omega_{43} \vec{\pi}' \wedge -k_2 \vec{y}'$$

$$= -\omega_{43} k_2 \vec{z}'$$

$$\vec{V}_{J,3/0} = \vec{V}_{A,3/0} + \Omega_{3/0} \wedge \vec{A}'_J$$

$$= \omega_{30} \vec{\pi}' \wedge k_2 \vec{y}'$$

$$= \omega_{30} k_2 \vec{z}'$$

$$\vec{V}_{J,1/0} = \omega_{10} k_2 \vec{z}' \quad (3 \rightarrow 2)$$

d'où  $\vec{z}' : 0 = -\omega_{43} k_2 + (\omega_{30} - \omega_{10}) k_2$

$$\begin{cases} 0 = -R_{u1} \omega_{u3} + (\omega_{30} - \omega_{10}) R_1 \\ 0 = -\omega_{u3} R_{u2} + (\omega_{30} - \omega_{20}) R_2 \end{cases}$$

$$\Leftrightarrow \begin{cases} \omega_{u3} = (\omega_{30} - \omega_{10}) \frac{R_1}{R_{u1}} \\ \omega_{u3} = (\omega_{30} - \omega_{20}) \frac{R_2}{R_{u2}} \end{cases}$$

$$\Leftrightarrow \left\{ \begin{array}{l} \dots \\ \dots \end{array} \right.$$

$$R_2 \leftarrow R_2 - R_1$$

$$(E) \quad 0 = (\omega_{30} - \omega_{20}) \frac{R_2}{R_{u2}} - (\omega_{30} - \omega_{10}) \frac{R_1}{R_{u1}}$$

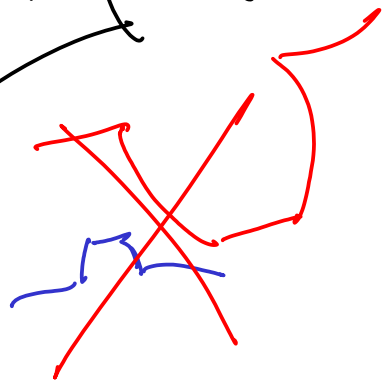
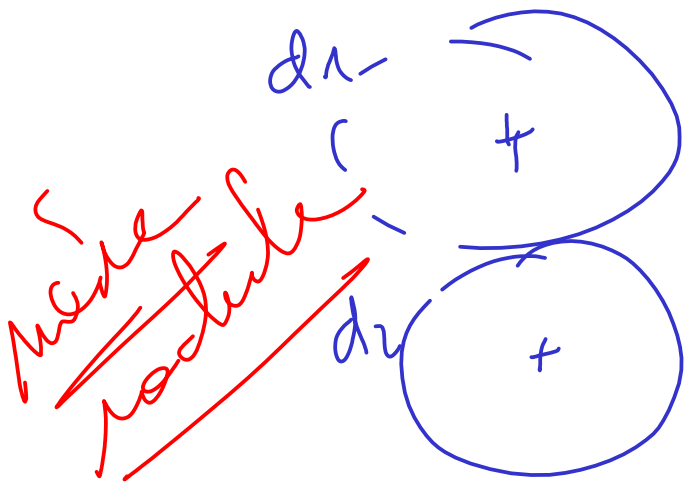
$R \leftarrow$  engener,  $R_2, R_{u2}$   
 $d = n z = \frac{R_2}{R_{u2}} \frac{z_1 z_2}{z_1 z_2}$

$$(E) \Leftrightarrow \omega_{20} = \frac{z_{u2}}{z_1} \left( \omega_{10} \frac{z_1}{z_{u1}} + \omega_{30} \left( \frac{z_2}{z_{u2}} - \frac{z_1}{z_{u1}} \right) \right)$$

$$\Rightarrow \omega_{20} = \omega_{10} \delta + \omega_{30} (1 - \delta)$$

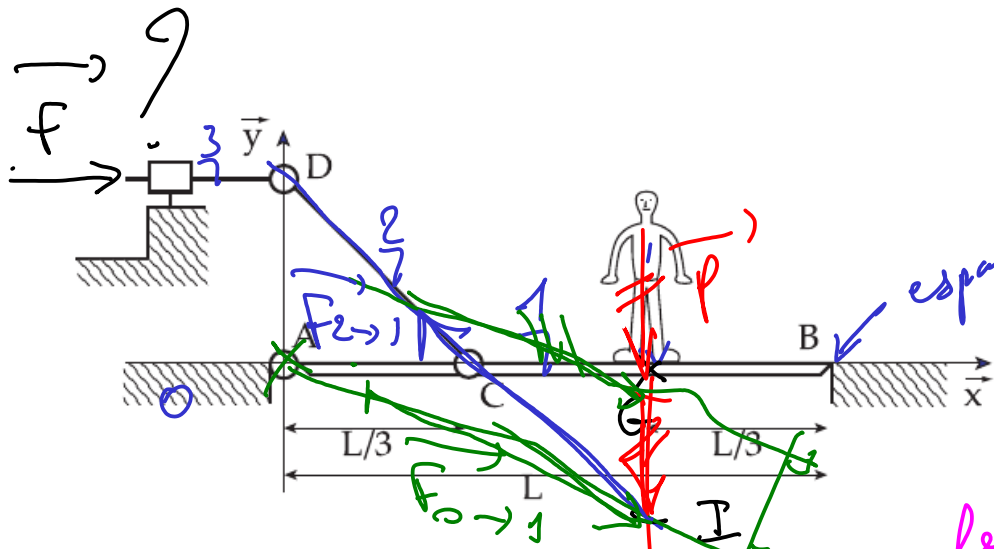
$$\delta = \frac{z_1 z_{u2}}{z_1 z_{u1}}$$

$d =$  diámetro primitivo (mm)  
 $= m \cdot z$  — ab de dentes  
module (mm/dente)  
característica de tábua



$$\frac{d_1}{d_2} = \frac{m z_1}{m z_2} = \frac{z_1}{z_2}$$

$$r_i = \frac{d_i}{2}, \quad i \in \{1, 2\}$$



++

espace

Resolution plane

Graphique de structure



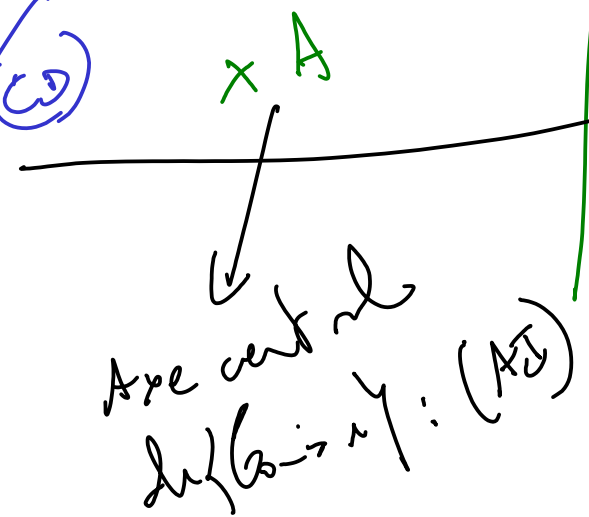
Strategie:

- 1) isole les solides sansisi 2) lines
- 2) ———— syst —
- 3) ———— E —
- 3) ———— solides

1) isole 2

Axe central est la droite (DC)

2) isole 3

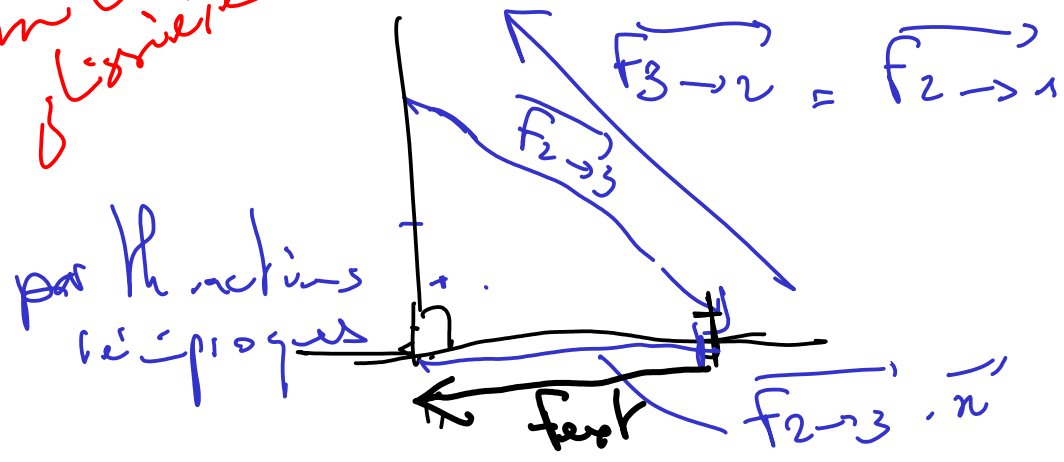


- 1) ———— 3 ————
- 2) ———— syst —
- 3) ———— 3 ————

3) On isole 3. eq de résultante selon  $\vec{n}'$ :

$$\vec{f}_{0 \rightarrow 3} \cdot \vec{n}' + \vec{f}_{2 \rightarrow 3} \cdot \vec{n}' + \underline{\underline{f_{ext}}} = 0$$

normale à la surface

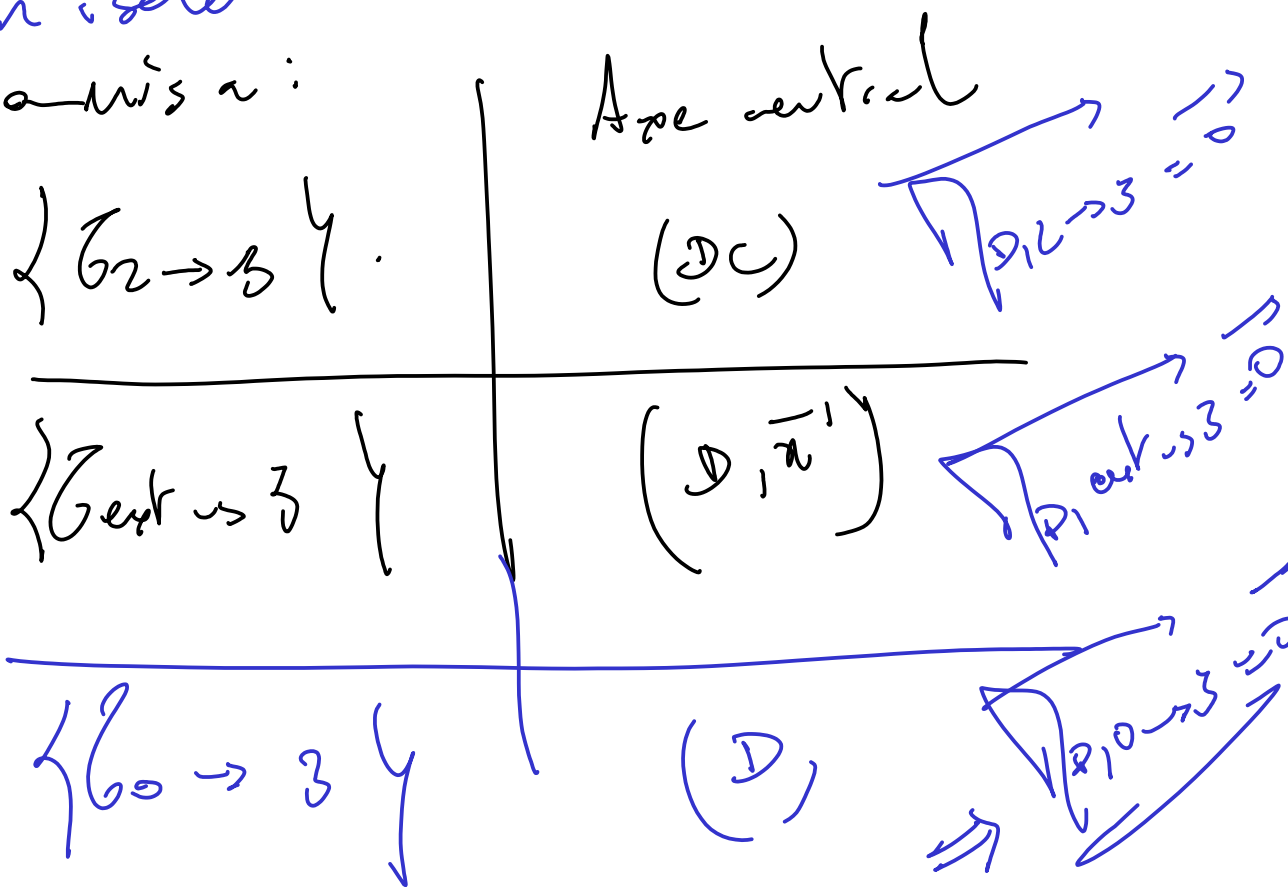


par les actions réciproques

$\{G_{0 \rightarrow 3}\}$  est un glissement en D

cas: On isole 3.

3 cas possibles:



3 series à 3 AN:

$\{G_2 \rightarrow 3\}$  ( $\in \mathcal{D}$ )

$\{G_{ext} \rightarrow 3\}$  ( $\in \mathcal{D}$ ,  $\pi'$ )

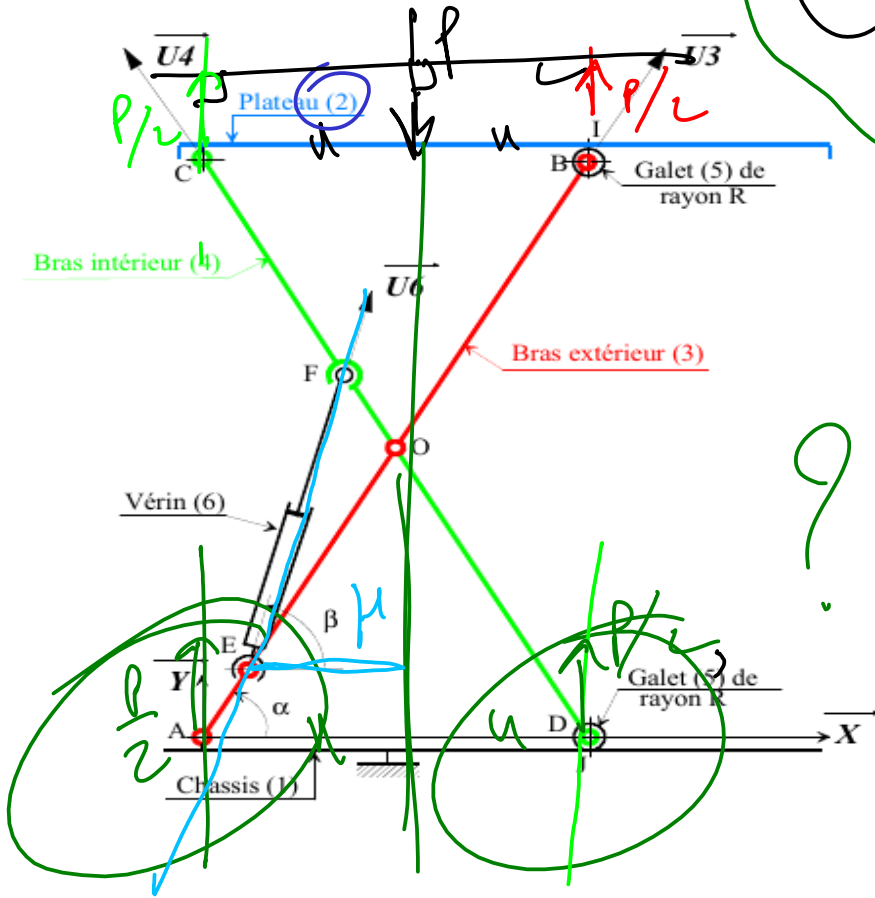
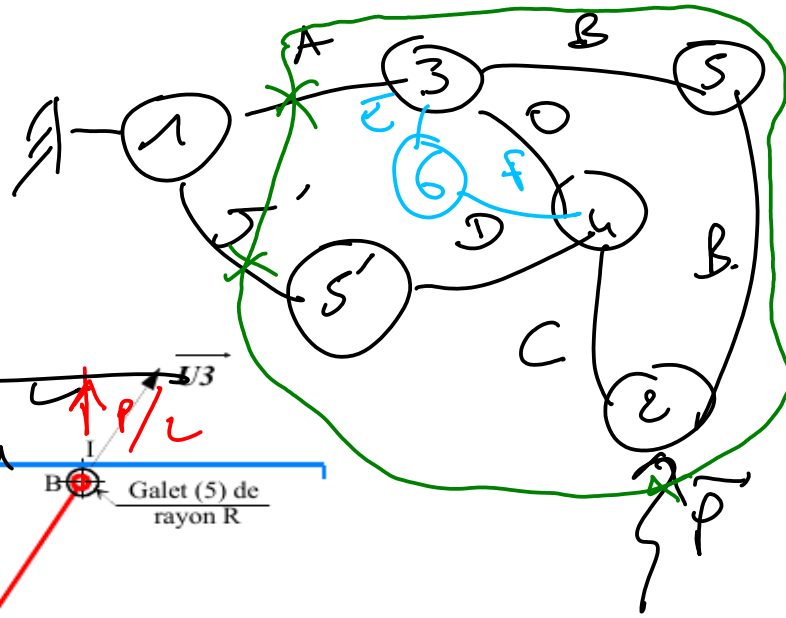
$\{G_5 \rightarrow 3\}$

Stages en  $\mathcal{D}$   
à  $F_0 \rightarrow 3 \neq 0'$

eq. de moment en  $\mathcal{D}$ :

~~$\mathcal{D}, 2 \rightarrow 3$~~  +  ~~$\mathcal{D}, ext \rightarrow 3$~~  +  $\mathcal{D}, 0 \rightarrow 3 = 0'$

table équilibre  
 $F_6 \rightarrow 4$  ?



Stratégie

(analyse)

- n) isole les galets 5 et 5', soumis à 2 liaisons,  
 $\Rightarrow$  axe central }  $\mathcal{C}_5 \rightarrow 2\mathcal{L} : (\vec{i}, \vec{j})$  ✓  
 $\mathcal{C}_{5'} \rightarrow 2\mathcal{L} : (\vec{i}, \vec{j})$  ✓

isole 6. . .

- c) isole 2. Pas symétrique on  $\vec{i}, \vec{j}$  et  $\vec{n}_c$

- 3) isole  $\{2, 3, 4, 5, 5', 6\}$  soumis à 3 liaisons

2 des axes antérieurs  $\{G_0 \rightarrow S'\}$  et  $\{G_{ext} \rightarrow z\}$  sont parallèles

donc  $\{G_0 \rightarrow u\}$  est la droite  $(A, \vec{y})$ ,

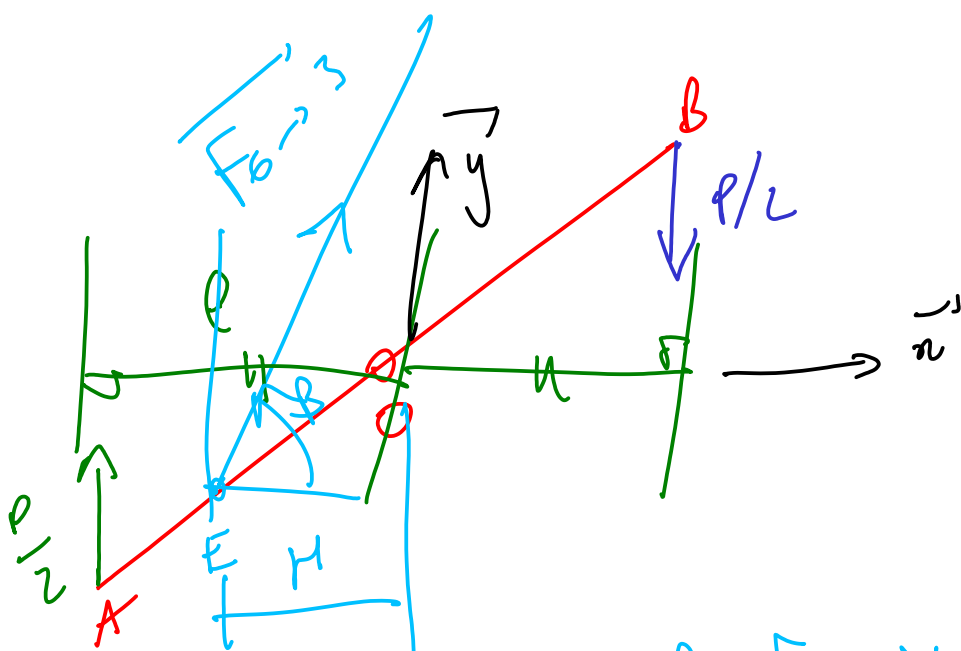
par symétrie on obtient:

$$\vec{f}_{0 \rightarrow 4} = \frac{p}{2} \vec{y}$$

$$\vec{f}_{0 \rightarrow S'} = \vec{f}_{S' \rightarrow 3} = \frac{p}{2} \vec{y}$$

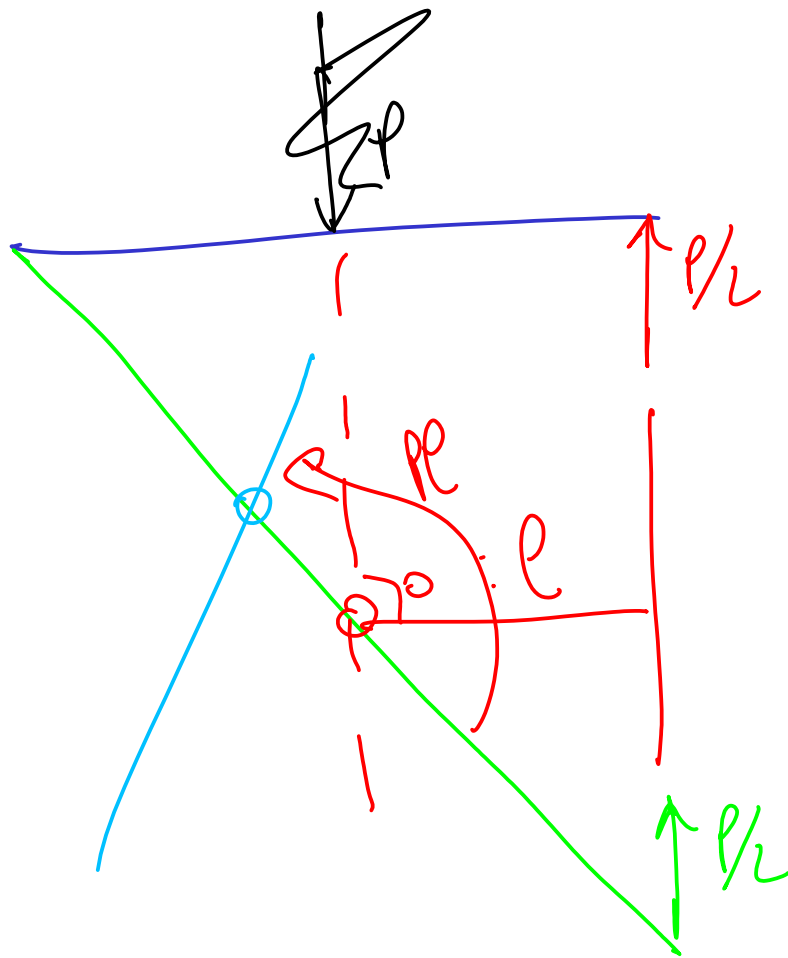
h) On isole 3; eq. moment en O

$$\vec{f}_{0 \rightarrow 3} = f_{03} \vec{u}_3$$

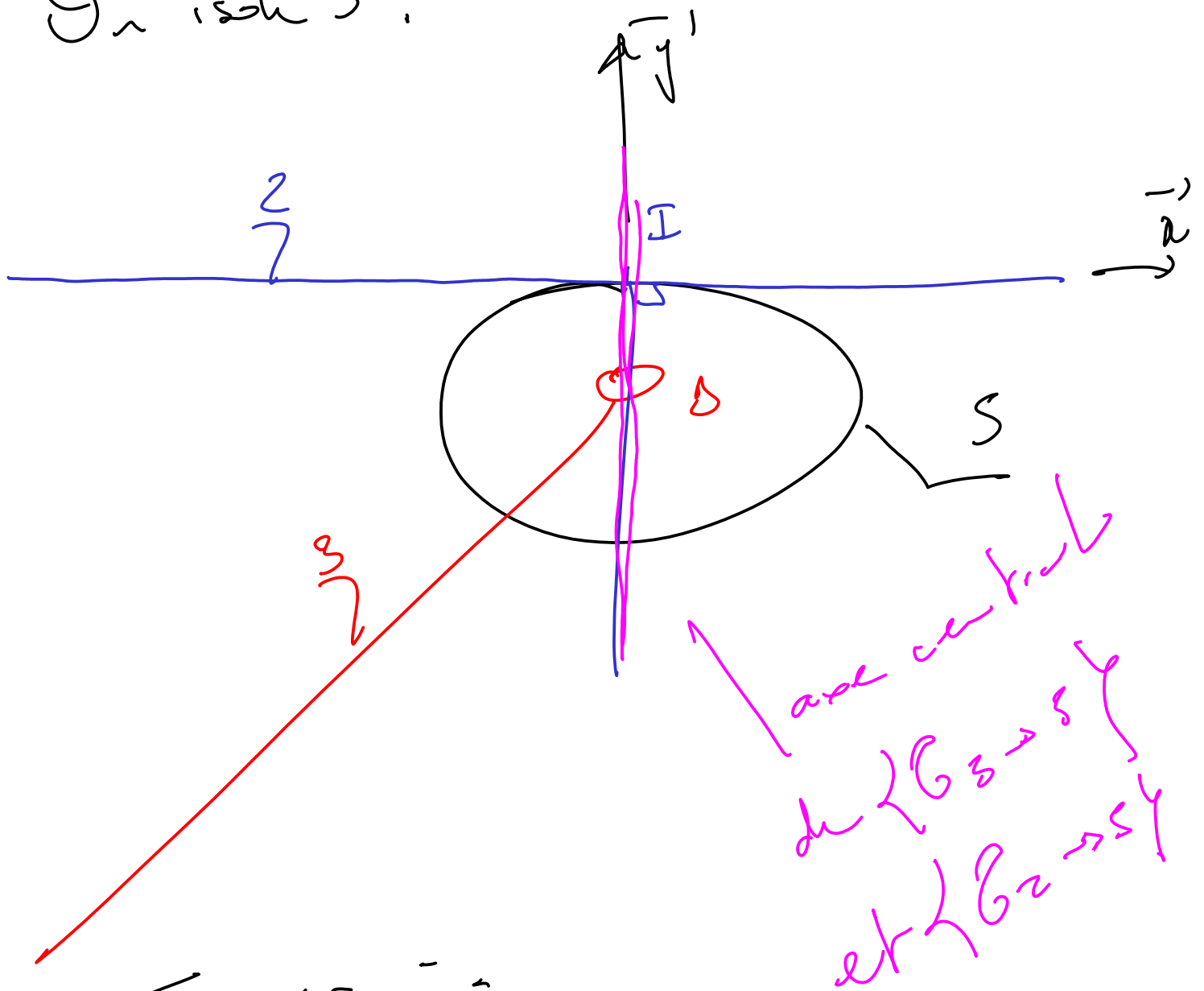


$$-PE - \sin \beta f_{03} h = 0$$





On isole  $S$ .

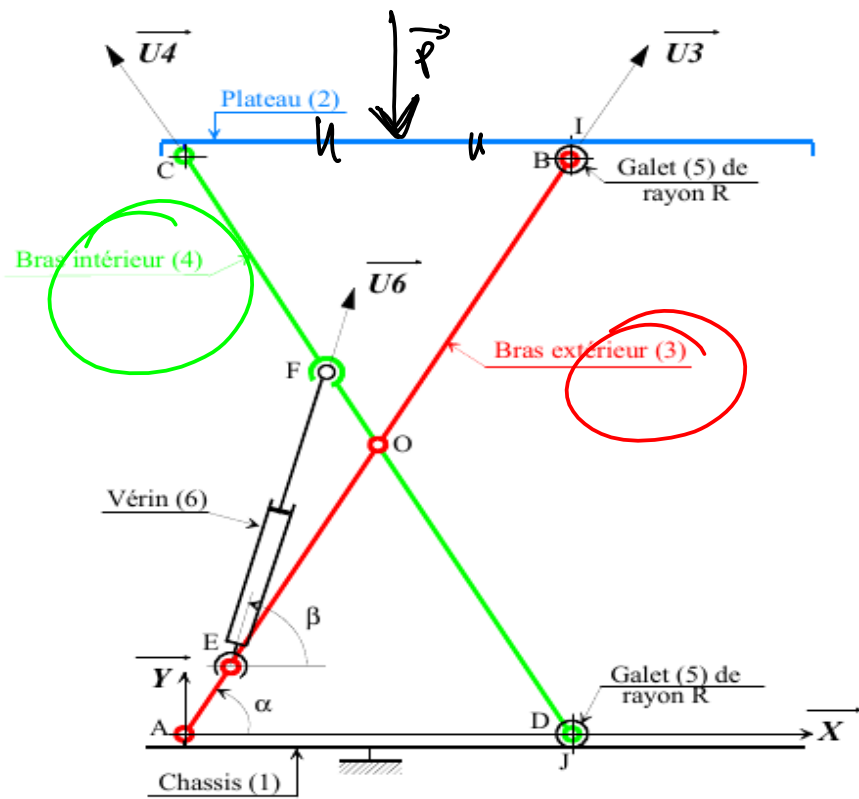


Soit  $S$  à :

- La sphère apl de normale  $(Ib) = (I, y')$   
avec 2 *gliss*

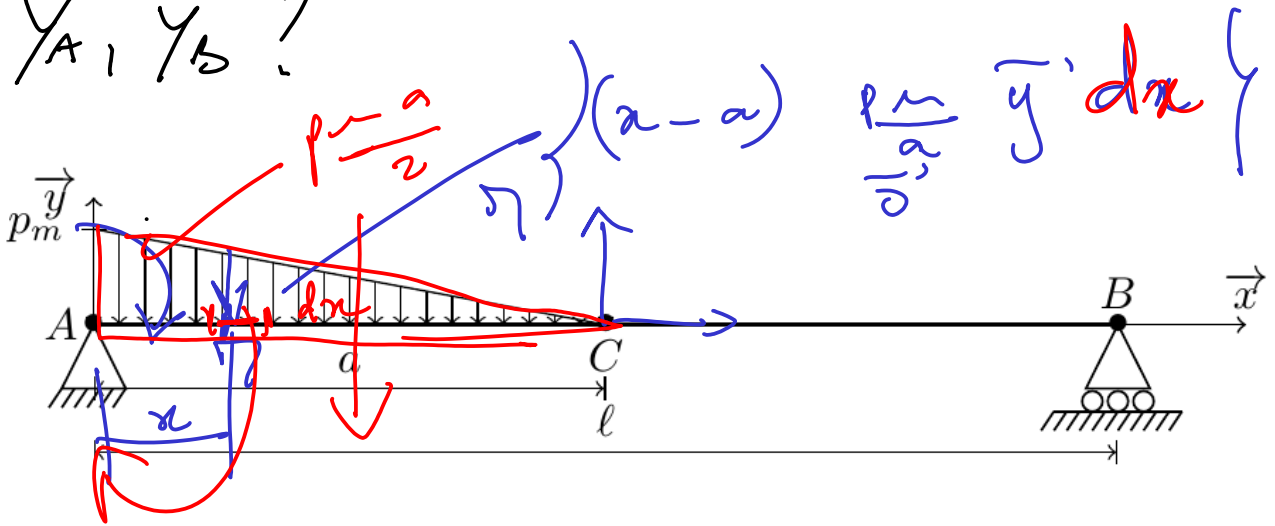
- Le pivot d'axe  $(b, \bar{z})$  avec 3.

*gliss*  
*sur b*  
ps h. d'un solide soumis à  
 $\Sigma$  *gliss*  $S$



- 1) solides gamés : 2 classes :  $S, S'$
- 2) synchrés : 6
- 3) solides 3 classes : 2
- 4) synchrés { 2, 3, 4, 5, S', 6 }

$y_A, y_B?$



$$d\vec{M}_A = + \underbrace{x}_{>0} \underbrace{(x-a)}_{<0} \frac{p_m}{a} dx \vec{z}$$

$$\vec{R} = \int_0^a (x-a) \frac{p_m}{a} y' dx$$

$$= \left[ \frac{(x-a)^2}{2} \right]_0^a \frac{p_m}{a} y'$$

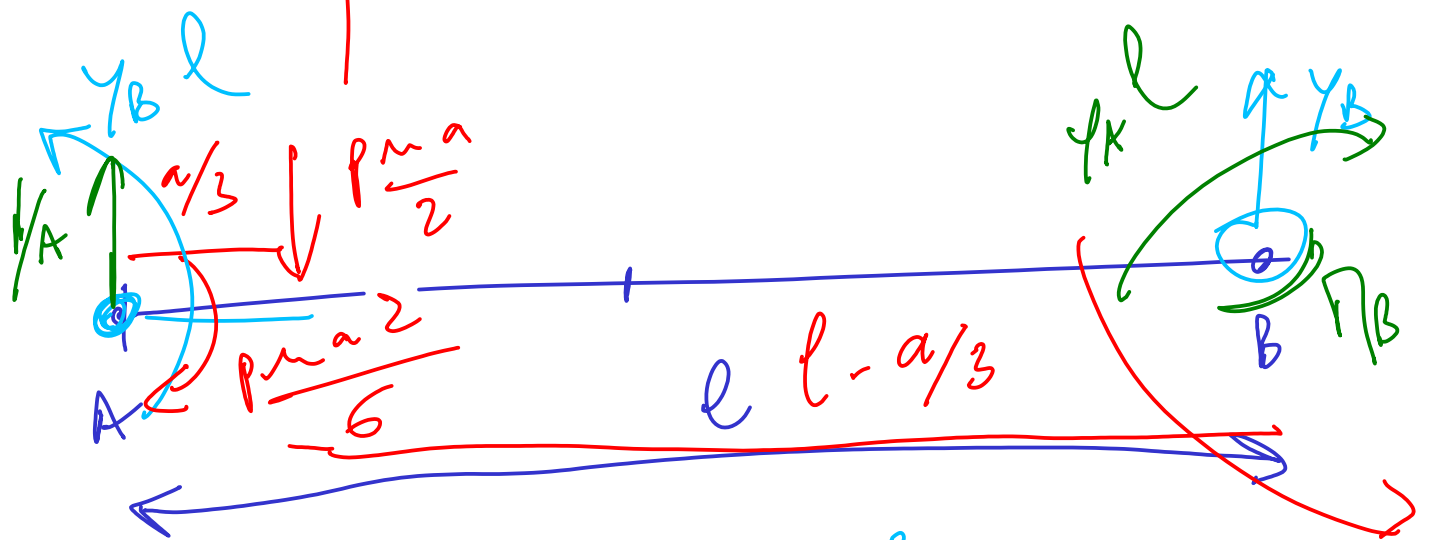
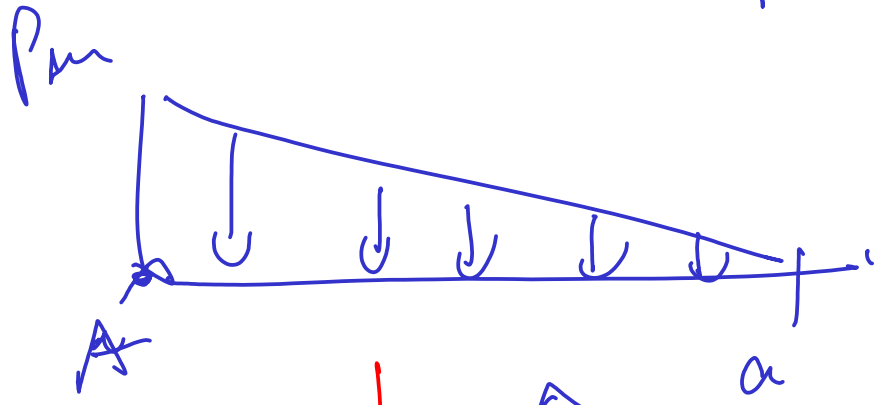
$$= - \frac{p_m a}{2} y'$$

$$\vec{M}_A = \int_0^a + x (x-a) \frac{p_m}{a} dx \vec{z}$$

$$= \left[ -a \frac{x^2}{2} + \frac{x^3}{3} \right]_0^a \frac{p_m}{a} \vec{z}$$

$$\overline{r}_A = -\frac{ca^2}{6} \overline{z}^2 = -\frac{p_m a}{2} \frac{a}{3} \overline{z}^2$$

p.m.

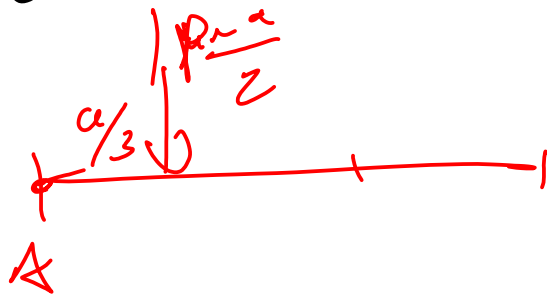


$$r_B = \frac{p_m a^2}{6 \cdot l}$$

$$r_A = \frac{p_m a (3l - a)}{6l} = \frac{p_m a}{2} - \frac{p_m a^2}{6l}$$

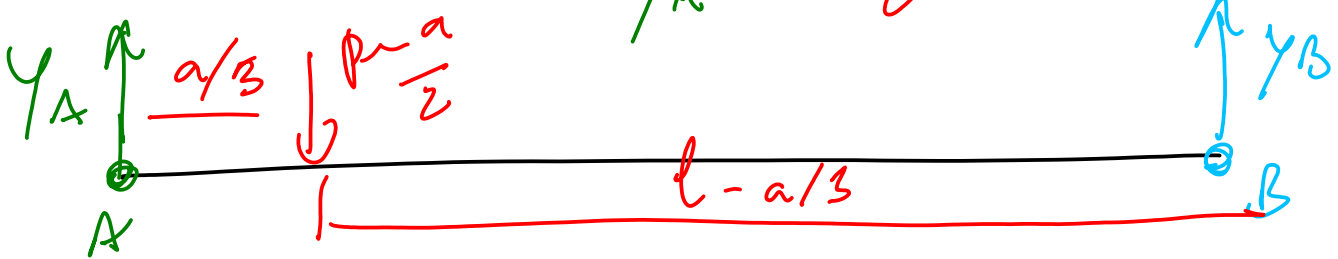
1) An élémentaire

2) An globale en A



3) Statique 2 inc  $\rightarrow$  2 eq  $\left\{ \begin{array}{l} \sum F_y \\ \sum M_A \end{array} \right.$

$$Y_A \quad Y_B$$
$$Y_A = \frac{P \cdot a}{2} - Y_B$$

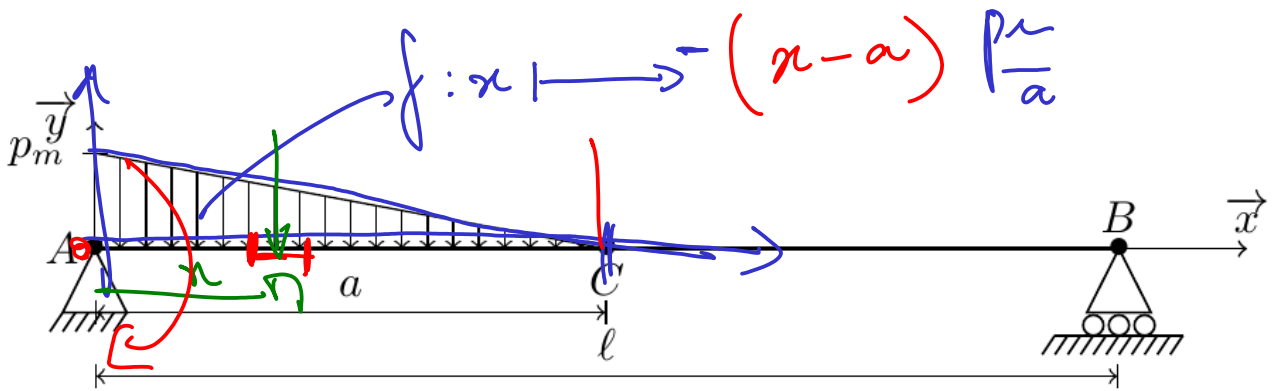


eq. de vent en A =  $\rightarrow$ ,  $\leftarrow$

$$Y_B l - \frac{P \cdot a^2}{6} = 0 \Rightarrow Y_B$$

Eq. de vent de B  $\leftarrow$ ,  $\rightarrow$

$$-Y_A l + \frac{P \cdot a}{2} \left( l - \frac{a}{3} \right) = 0 \Rightarrow Y_A$$



$$d\bar{F}' = (x-a) \frac{p_m}{a} \bar{y}' dx$$

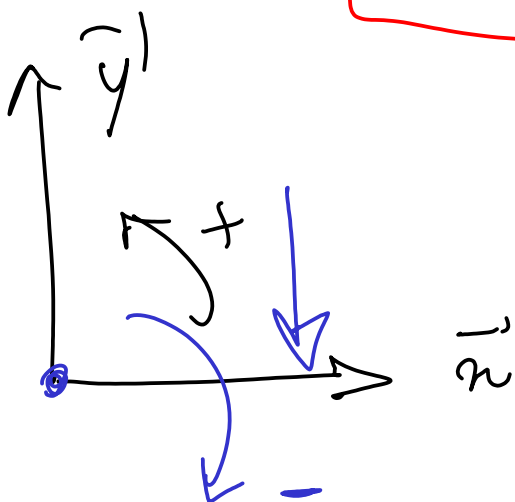
$$\forall x \in [0, a], (x-a) \leq 0$$

$$d\bar{\eta}'_A = \cancel{A \bar{\eta}'_A} + d\bar{F}' \wedge \bar{\eta}'_A$$

$$= (x-a) \frac{p_m}{a} dx \bar{y}' \wedge -x \bar{z}$$

$$= \underbrace{x}_{\geq 0} \underbrace{(x-a)}_{\leq 0} \frac{p_m}{a} dx \bar{z}$$

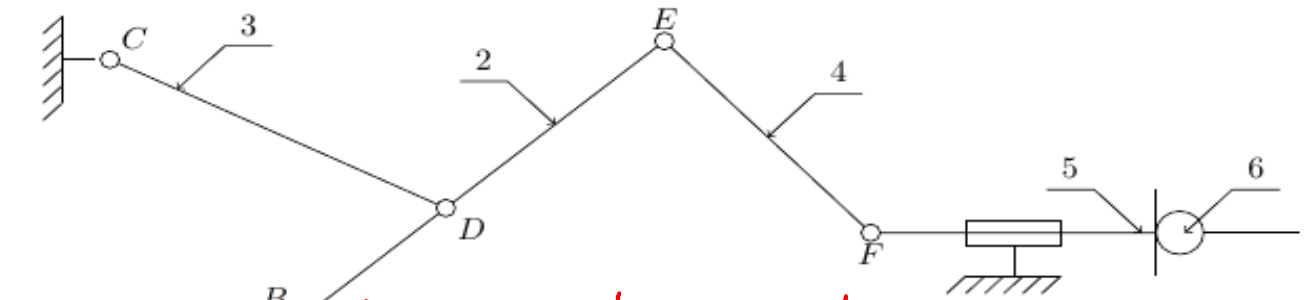
$$\leq 0$$



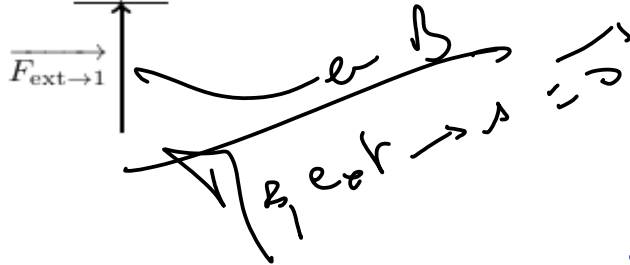
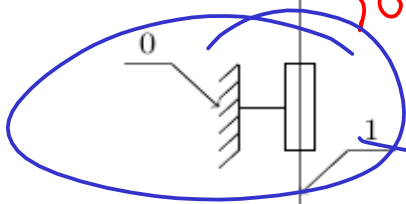
x Pontres que  $\{0 \rightarrow 1\}$  est un glisseur ?

x Axe central de  $\{0 \rightarrow 2\}$  ?

x  $f_{5 \rightarrow 6}$  ?



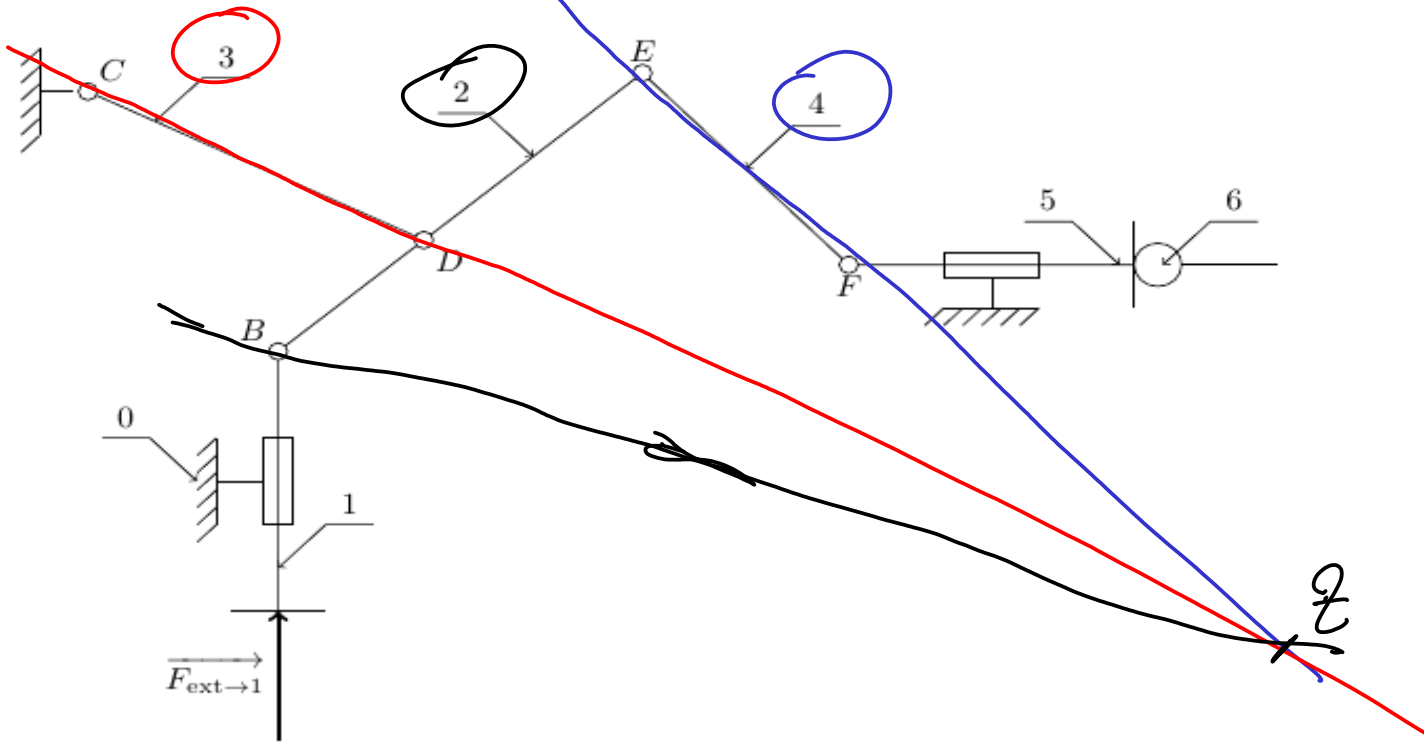
$\{0 \rightarrow 1\}$  glisseur en B  
 $\rightarrow B, 2 \rightarrow 1$



différence (en  $E$ )  
 $\rightarrow B, 0 \rightarrow 1$

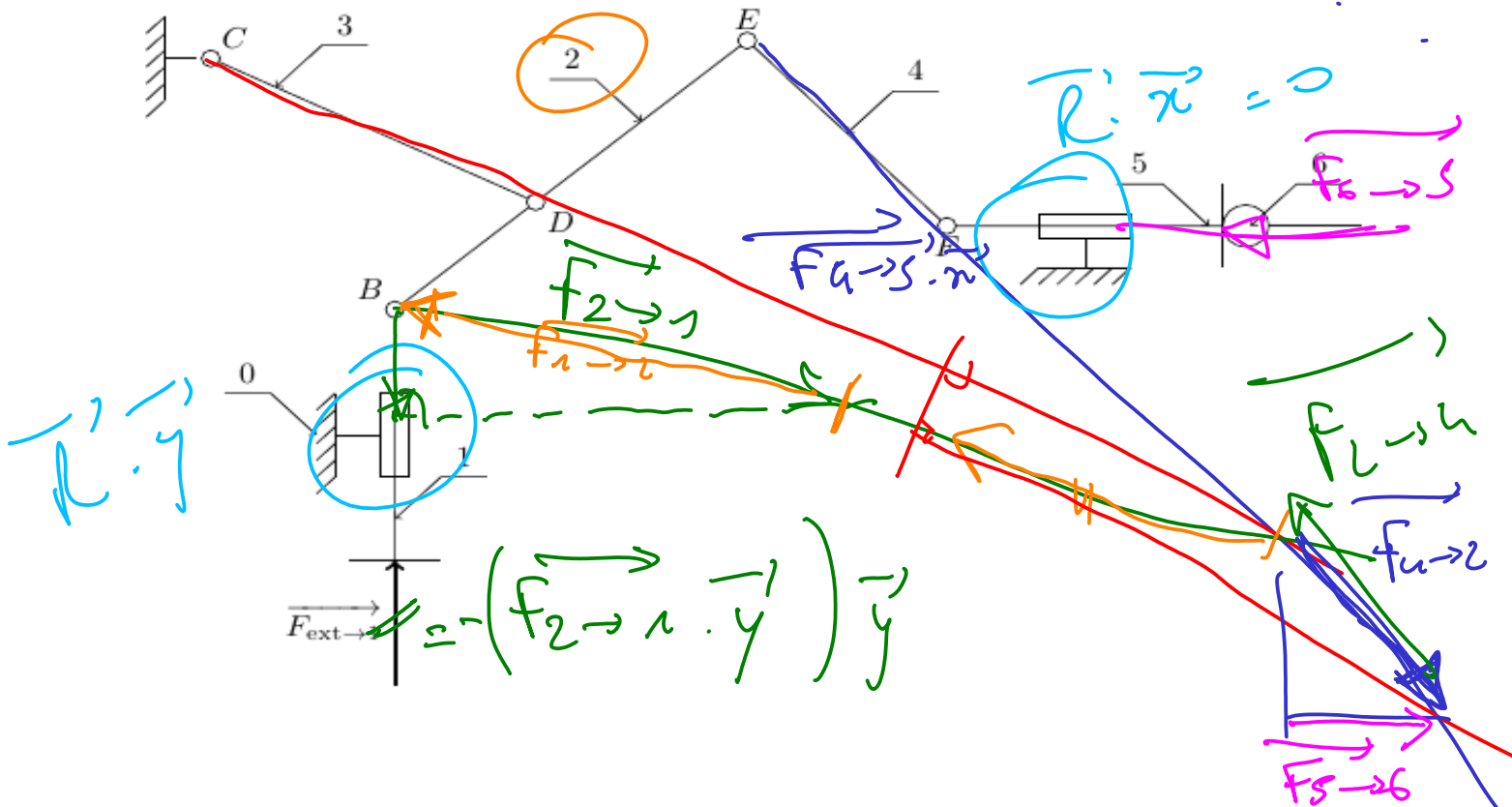


x Axe central de  $\{6 \rightarrow 2\} : (Bz)$

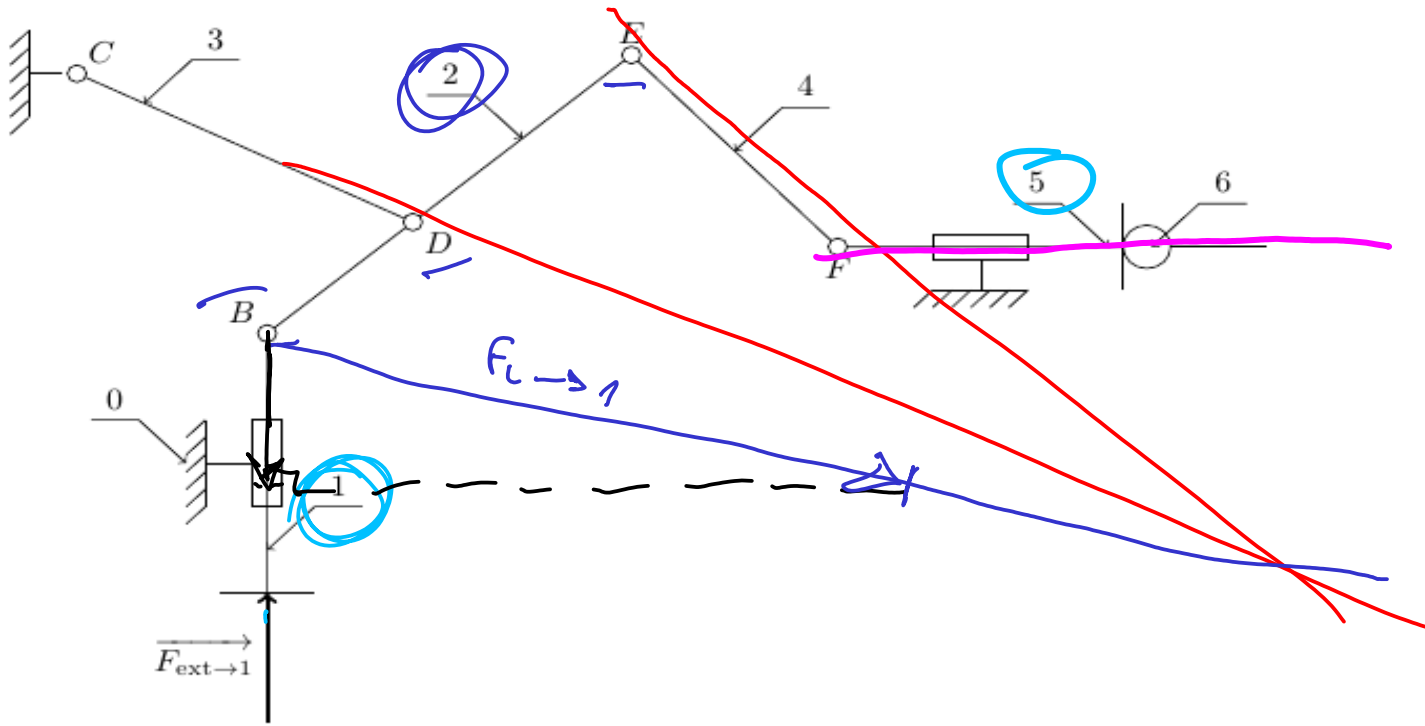


x  $f_{S \rightarrow 6}$  ?

$$\overrightarrow{f_{u \rightarrow 2}} = \overrightarrow{f_{S \rightarrow 4}}$$

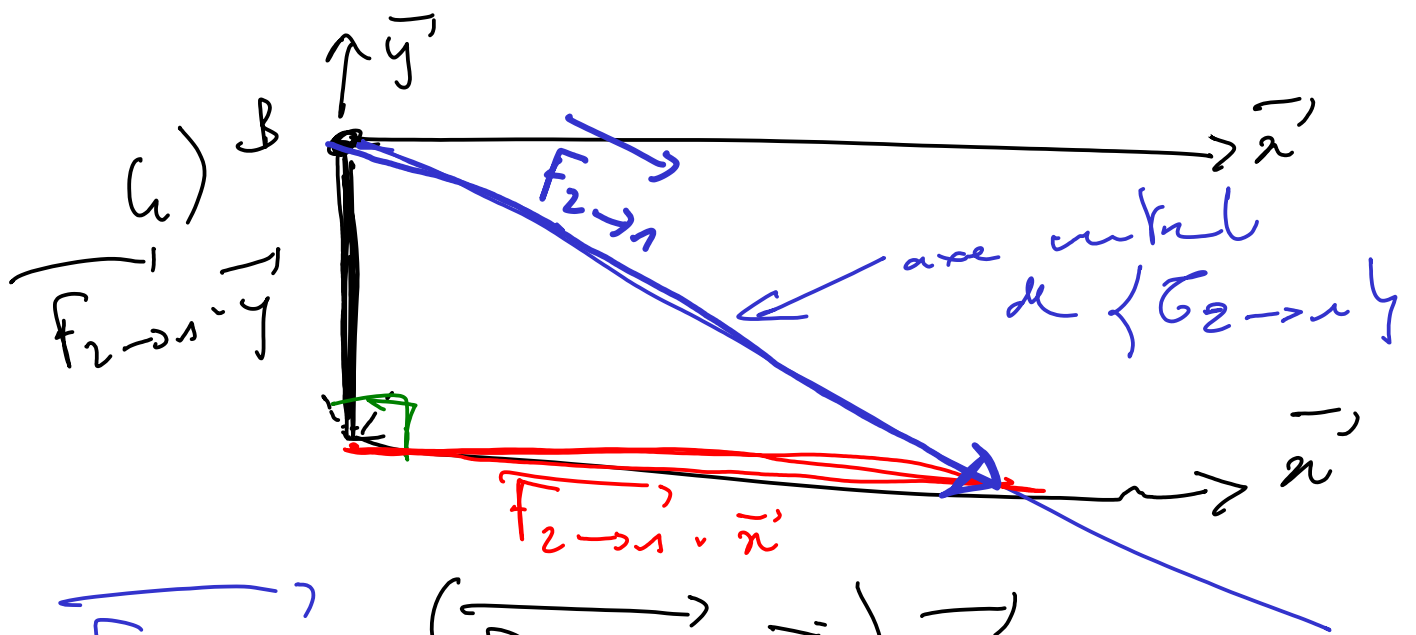


$$\overrightarrow{f_{S \rightarrow 6}} = \left( \overrightarrow{f_{u \rightarrow S}} \cdot \vec{n} \right) \vec{n}$$



- 1) isole 4, isole 3 (sursa 2 glisare)
- 2) isole 2  $\rightarrow$  axe central de  $\{O_2 \rightarrow O_4\}$
- 3) isole 1 -  $\vec{R} \cdot \vec{y}$  (mobilitate glisare)
 
$$\vec{F}_{2 \rightarrow 1} \cdot \vec{y} = -F_{ext \rightarrow 1} \cdot \vec{y}$$
- 4) reconstitui  $\vec{F}_{2 \rightarrow 1}$ , AL  $\vec{F}_{4 \rightarrow 2}$
- 5) isole 2  $\Leftrightarrow \vec{F}_{4 \rightarrow 2}$
- 6) isole 5  $\vec{R} \cdot \vec{n}$  (mobilitate linie)
 
$$\vec{F}_{6 \rightarrow 5} \cdot \vec{n} = -\vec{F}_{4 \rightarrow 5} \cdot \vec{n}$$

$$\vec{F}_{5 \rightarrow 6} \cdot \vec{n} = \vec{F}_{4 \rightarrow 5} \cdot \vec{n} = \text{proiectia } \vec{F}_{2 \rightarrow 4} \cdot \vec{n}$$

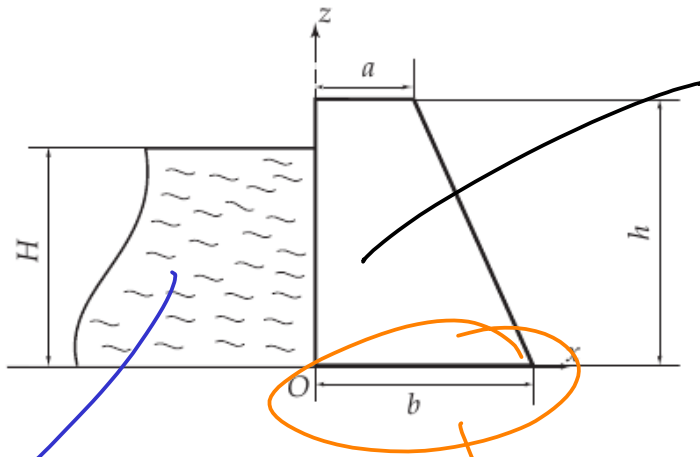
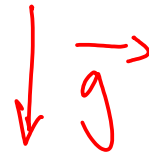


$$F_{2 \rightarrow 1} = (F_{2 \rightarrow 1 \cdot y} \vec{y}) + (F_{2 \rightarrow 1 \cdot x'} \vec{x'})$$

coordonnée

# Barrage poids

*très difficile*



G?

$$\rho_{\text{béton}} = 2,2 \cdot 10^3 \text{ kg} \cdot \text{m}^{-3}$$

$F_{\text{eau}}?$

$$\rho_{\text{eau}} = 10^3 \text{ kg} \cdot \text{m}^{-3}$$

basculement?

$F_{\text{terre}}?$

# Diagrammes de Bode

$$H(p) = \frac{4 + 0,004p}{1 + 0,08p + 0,01p^2} = \underbrace{4}_{\omega} \left( 1 + \frac{p}{250} \right)$$

++

$$\omega_0 = 10 \text{ rad}\cdot\text{s}^{-1}$$

$$\frac{2\zeta}{\omega_0} = \frac{8}{100} \Rightarrow \zeta = \frac{4}{5} \sqrt{\frac{1}{2}}$$

$$\rightarrow 20 \log(2) \sqrt{1 - \zeta^2}$$

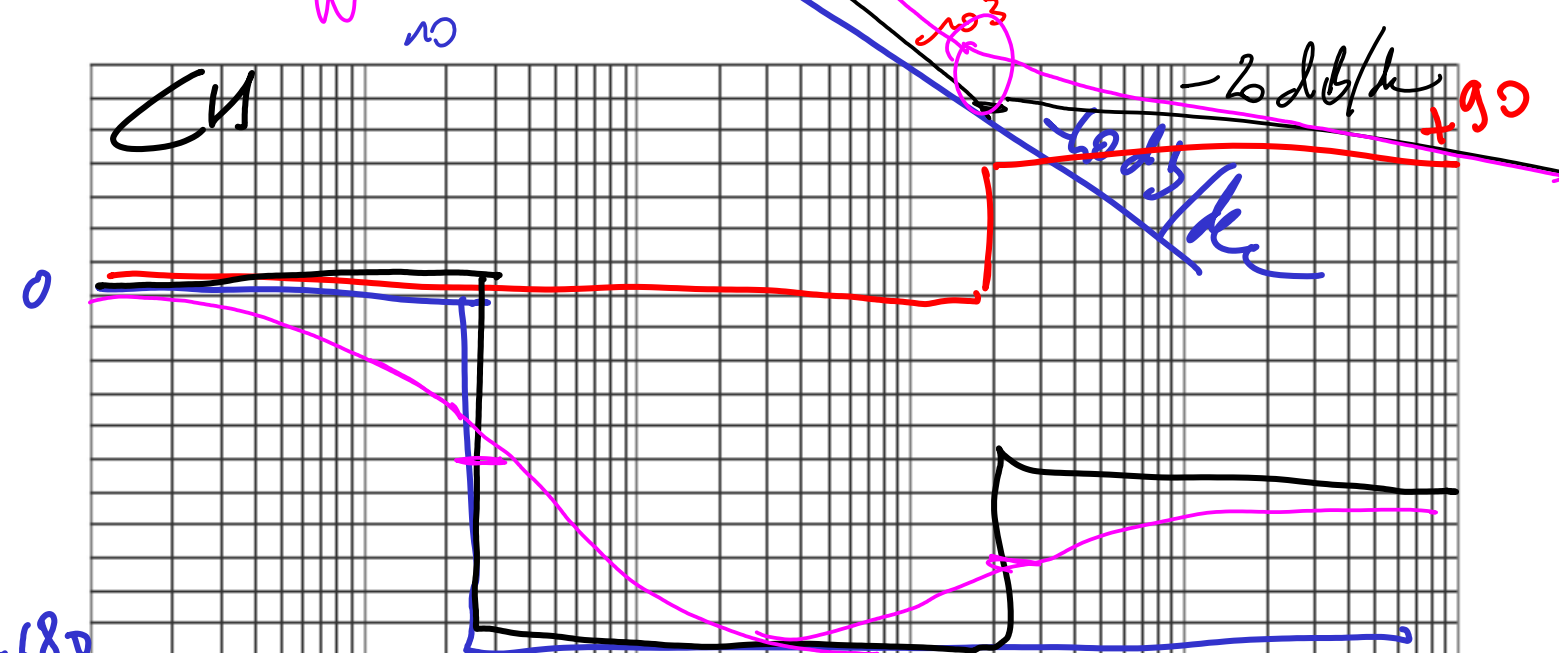
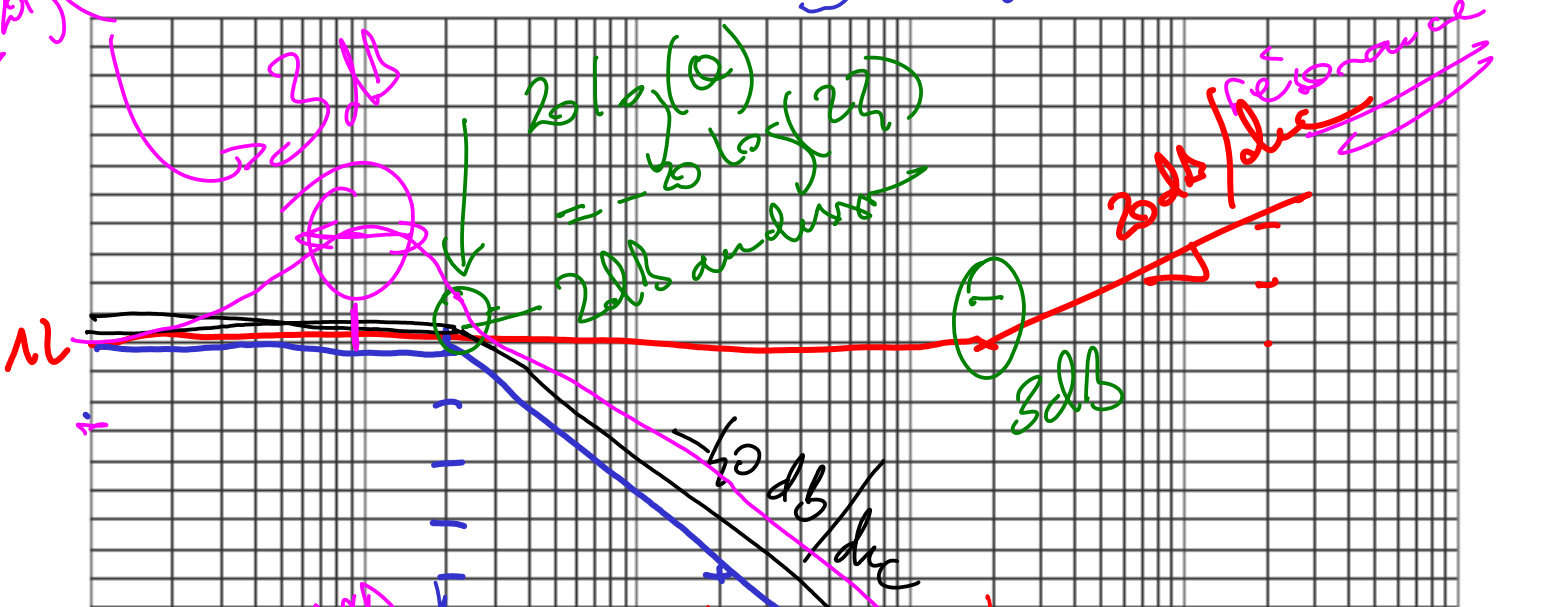
$2 \zeta \omega_0$  ?

$$20 \log(\omega) = -20 \log(2\zeta)$$

20dB/decade

20dB/decade

3dB



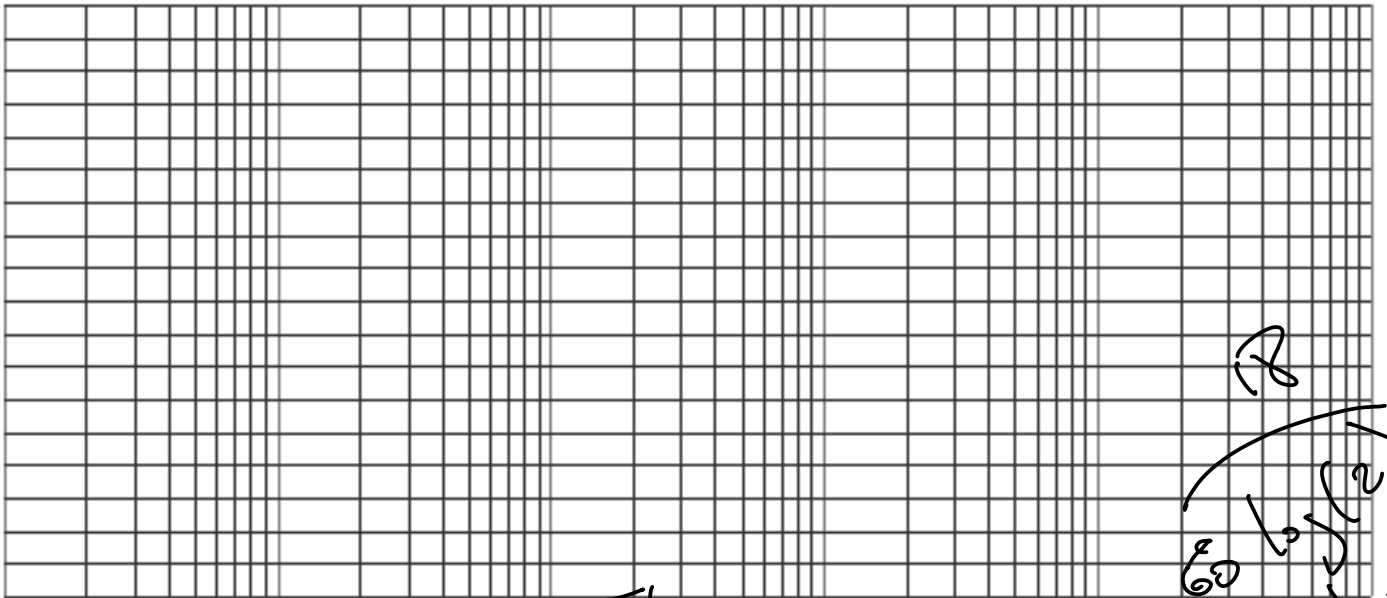
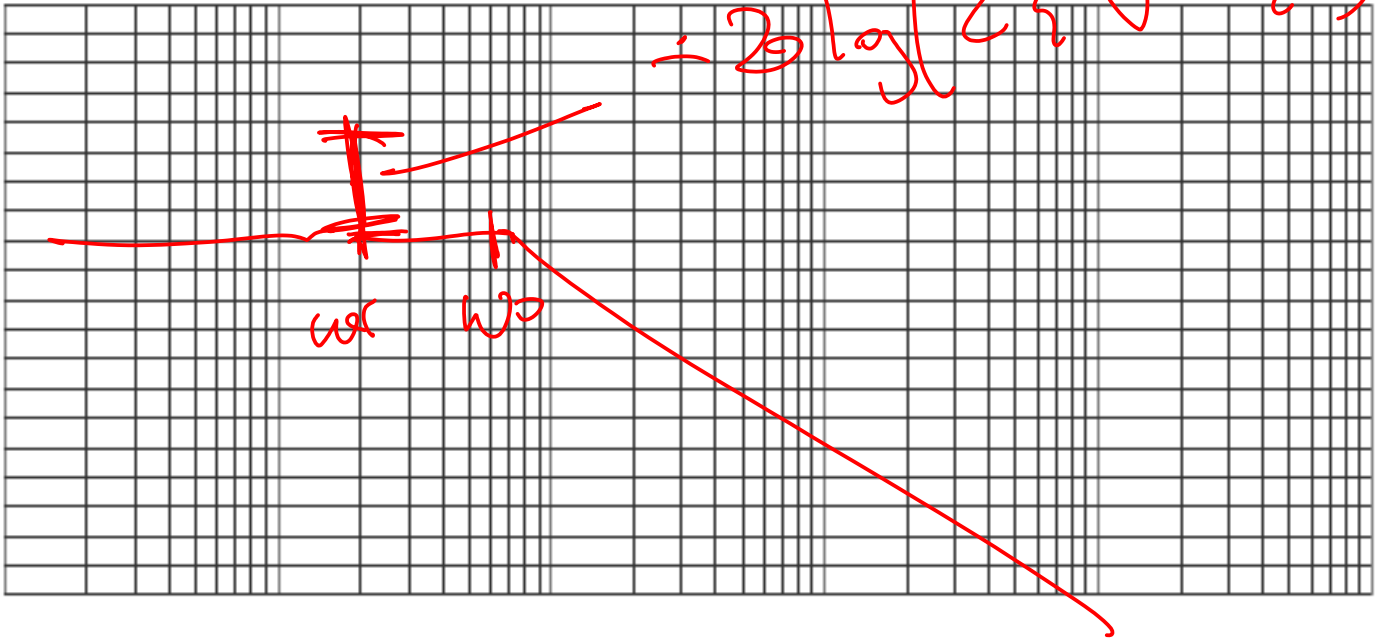
$$\omega_r = \omega_0 \sqrt{1 - 2\zeta^2} = 10 \sqrt{2/3} \approx 8,16 \text{ rad}\cdot\text{s}^{-1}$$

$$20 \log(0,18) = \underbrace{20 \log(2)}_{18} - 20 \approx -2$$

$$|H(j\omega)|_{dB} = 20 \log \left( \frac{K}{24 \sqrt{1-\zeta^2}} \right)$$

"sustained"

$$= 20 \log(24 \sqrt{1-\zeta^2})$$



$$20 \log \left( \frac{K}{24 \sqrt{1-\zeta^2}} \right)$$

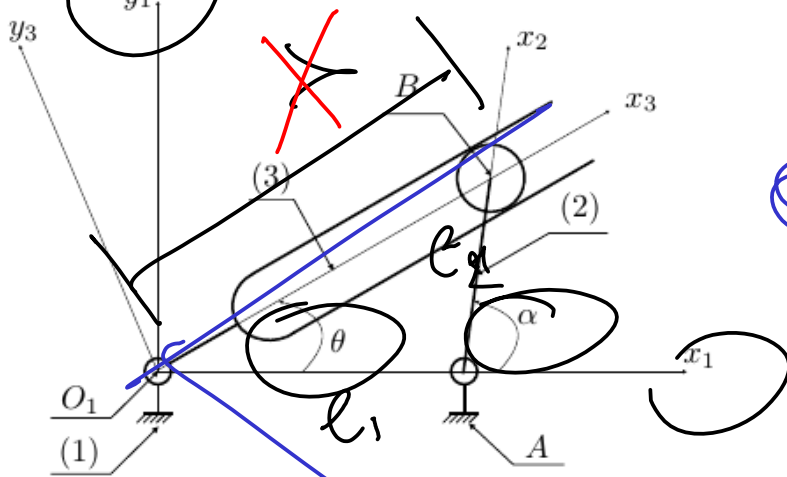
$$\zeta = 0.14$$

$$24 \sqrt{1-\zeta^2} = 24 \sqrt{1-0.0196} \approx 24 \sqrt{0.9804} \approx 23.8$$

$$20 \log(23.8) \approx 27.6$$

$$20 \log(7) \approx 16.9$$

1)  $\vartheta = f(\alpha)$  ?  $\omega_{3/n} = g(\omega_{2/n})$  ?



$\theta \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

1) ps fonction géométrique, on a:

$$\vec{O_1 B} = \vec{O_1 A} + \vec{AB}$$

$$\Rightarrow \vec{x}_3 = l_1 \vec{x}_1 + l_2 \vec{x}_2$$

$$\frac{l_2}{l_1} : \Rightarrow \sin \vartheta = l_2 \sin \alpha$$

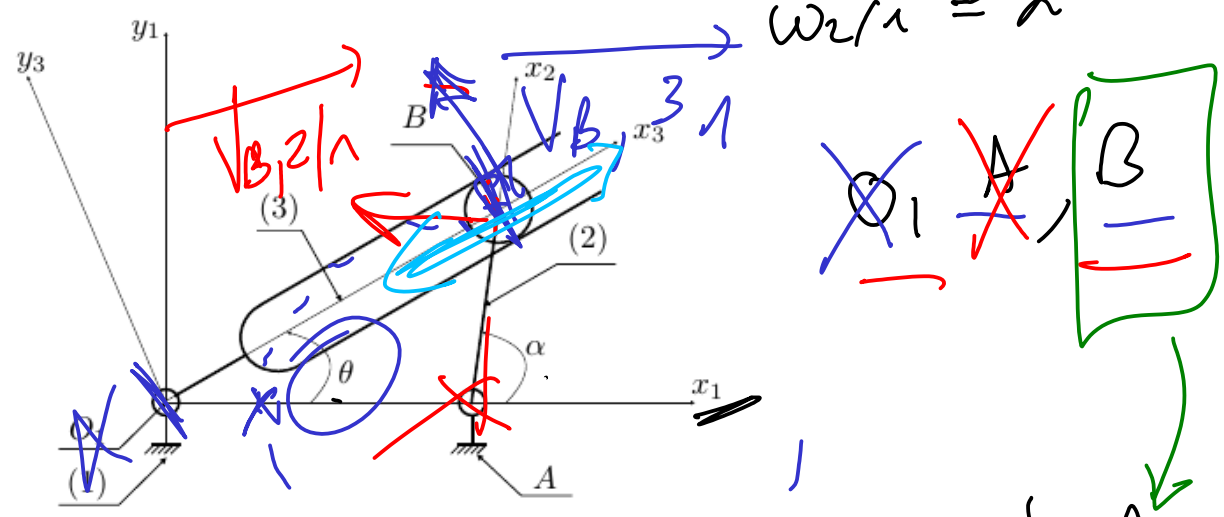
$$\frac{l_1}{l_1} : \Rightarrow \cos \vartheta = l_1 + l_2 \cos \alpha$$

$$\Rightarrow \tan \vartheta = \frac{l_2 \sin \alpha}{l_1 + l_2 \cos \alpha}$$

$$\vartheta = \text{Arctan} \left( \frac{l_2 \sin \alpha}{l_1 + l_2 \cos \alpha} \right) \quad \left[ \frac{-\pi}{2}, \frac{\pi}{2} \right]$$



e)  $\omega_{3/1} = f(\omega_{2/1})$ ?  $\omega_{2/1} = \dot{\theta}$   
 $\omega_{2/1} = \dot{\alpha}$



Par composition des vitesses au point B, on a :

$$\vec{v}_{B,2/2} = \vec{0} = \vec{v}_{B,3/1} - \vec{v}_{B,2/1}$$

avec  $\rho$  chaque de point :

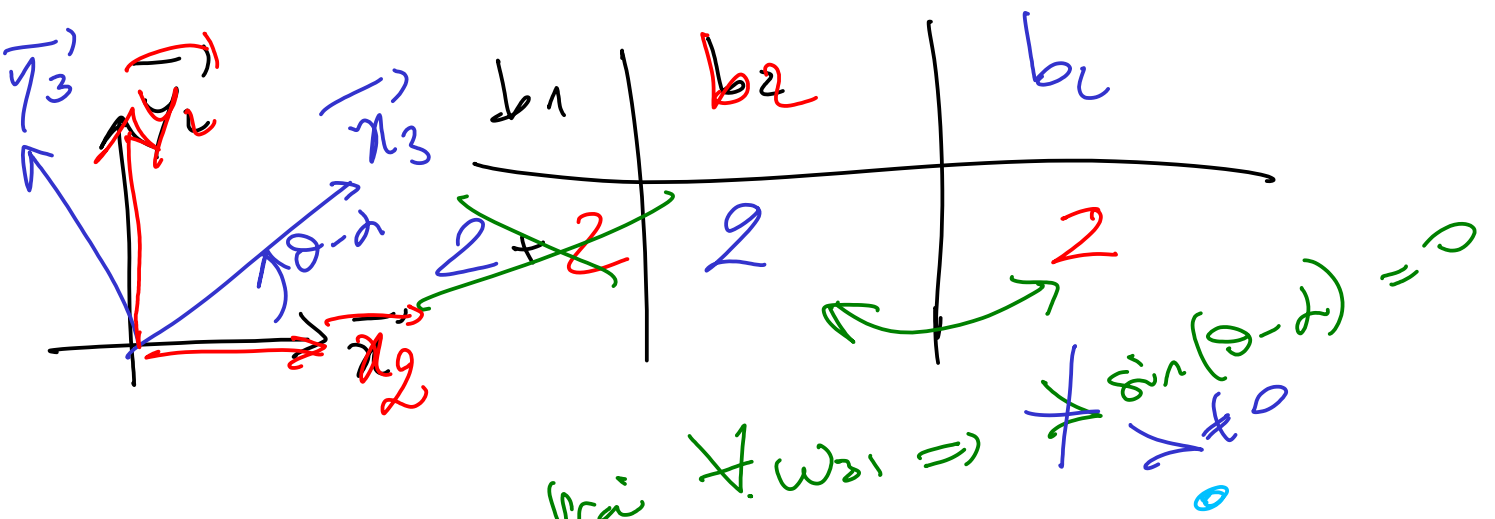
$$\vec{v}_{B,3/1} = \vec{v}_{O_1,3/1} + \vec{\omega}_{3/1} \wedge \vec{O_1B}$$

$$= \omega_{3/1} \vec{y}_3$$

$$\vec{v}_{B,2/1} = \vec{v}_{A,2/1} + \vec{\omega}_{2/1} \wedge \vec{AB}$$

$$= \dot{\alpha} \omega_{2/1} \vec{y}_2$$

$$d'_{21} : \vec{0}'_2 \geq \omega_{3/1} \vec{y}'_3 - l_2 \omega_{2/1} \vec{y}'_2$$



$$(\vec{y}'_3 - l_2 \omega_{3/1} \sin(\alpha - \theta)) = \vec{0}$$

$$l_2 \omega_{3/1} \sin(\alpha - \theta) = \vec{0}$$

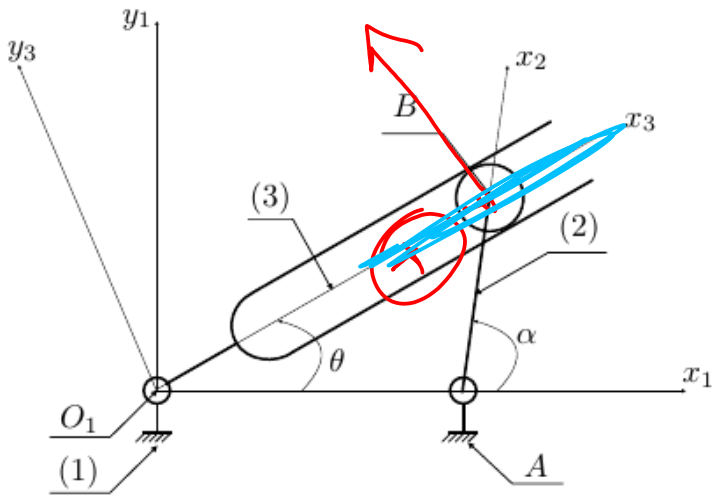
$$d'_{21} : \omega_{3/1} = \frac{l_2 \omega_{2/1} \cos(\theta - \alpha)}{\sin(\alpha - \theta)}$$

$\sqrt{3/2} = \vec{y}'_3$

Circumplex linear

geometrisch non linear

~~$\sin(\alpha - \theta) = 0 \Rightarrow \alpha - \theta = 0$~~  [II] strange non?



$\triangle \dot{\varphi}_3 = 0$

$$\vec{v}_{B,3/2} \cdot \vec{\varphi}_3 = 0$$

$$\vec{v}_{B,3/2} \cdot \vec{\kappa}_3 = -\dot{\varphi}_3 \neq 0$$

$$\vec{v}_{B/3} = \frac{d \vec{O_1 B}}{dt} \Big|_3 = \dot{\varphi}_3 \vec{\kappa}_3$$

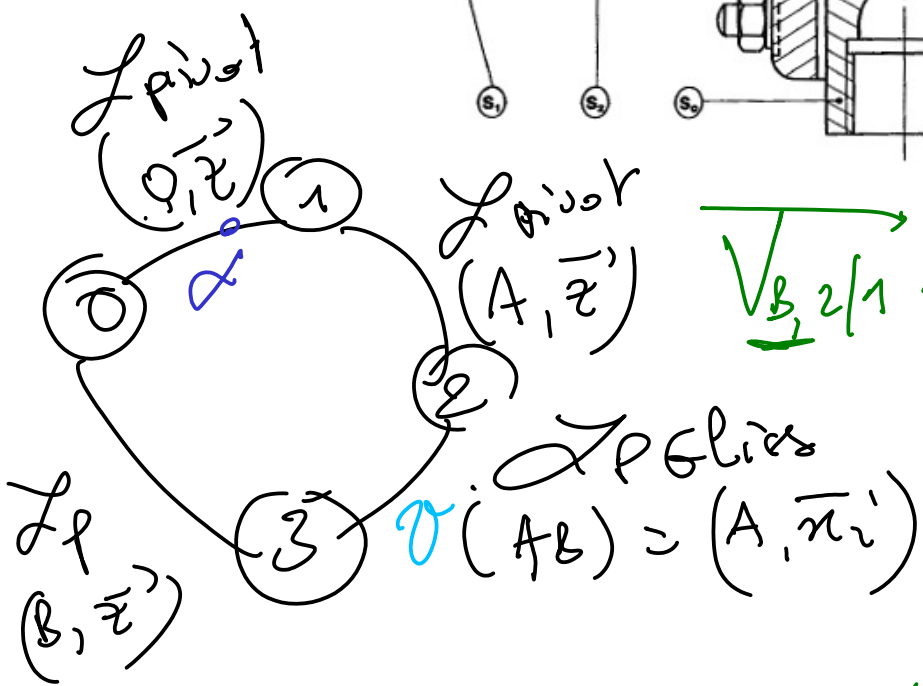
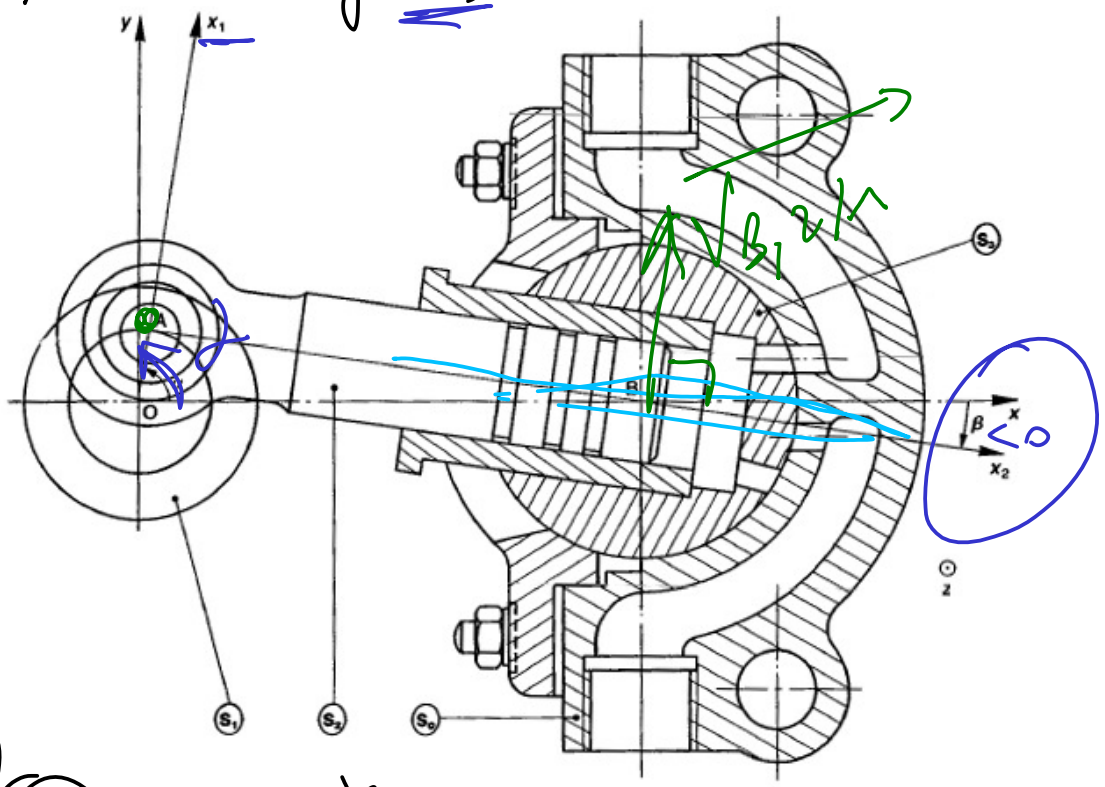
$$\vec{v}_{B/3}' = \vec{v}_{B,2/3} = -\vec{v}_{B,3/2}$$

$$\vec{v}_{B,3/2} \cdot \vec{\varphi}_3 = 0$$

$$= \vec{v}_{B,3/1} \cdot \vec{\varphi}_3$$

$$= \vec{v}_{B,2/1} \cdot \vec{\varphi}_3$$

$$V = \sqrt{B, 2/3} \cdot \vec{\pi}_2' = f(\alpha)$$



$$\sqrt{B, 2/1} \cdot \vec{AB}' = 0$$

indication: la d'équiprojectivité de  $V$  sur le long de  $AB$

$$\begin{aligned} & \sqrt{B, 2/1} \cdot \vec{\pi}_2' \\ & + \sqrt{B, 1/0} \cdot \vec{\pi}_2 \\ & + \sqrt{B, 3/2} \cdot \vec{\pi}_2 \\ & = \sqrt{B, 3/0} \cdot \vec{\pi}_2 \end{aligned}$$

d'où  $v = \sqrt{B, 1/0} \cdot \vec{\pi}_2$

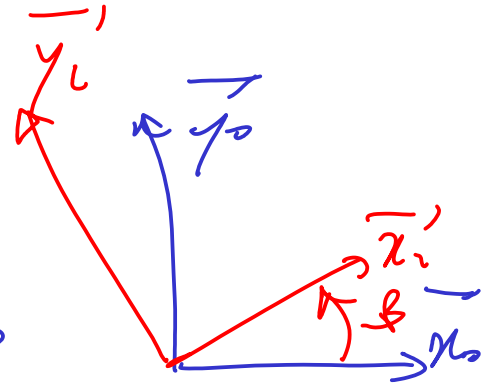
pe déplacement de point, il vient :

$$\vec{v}_{B,110} = \vec{v}_{0,110} + \vec{\omega} \wedge \vec{r}_{0B}$$

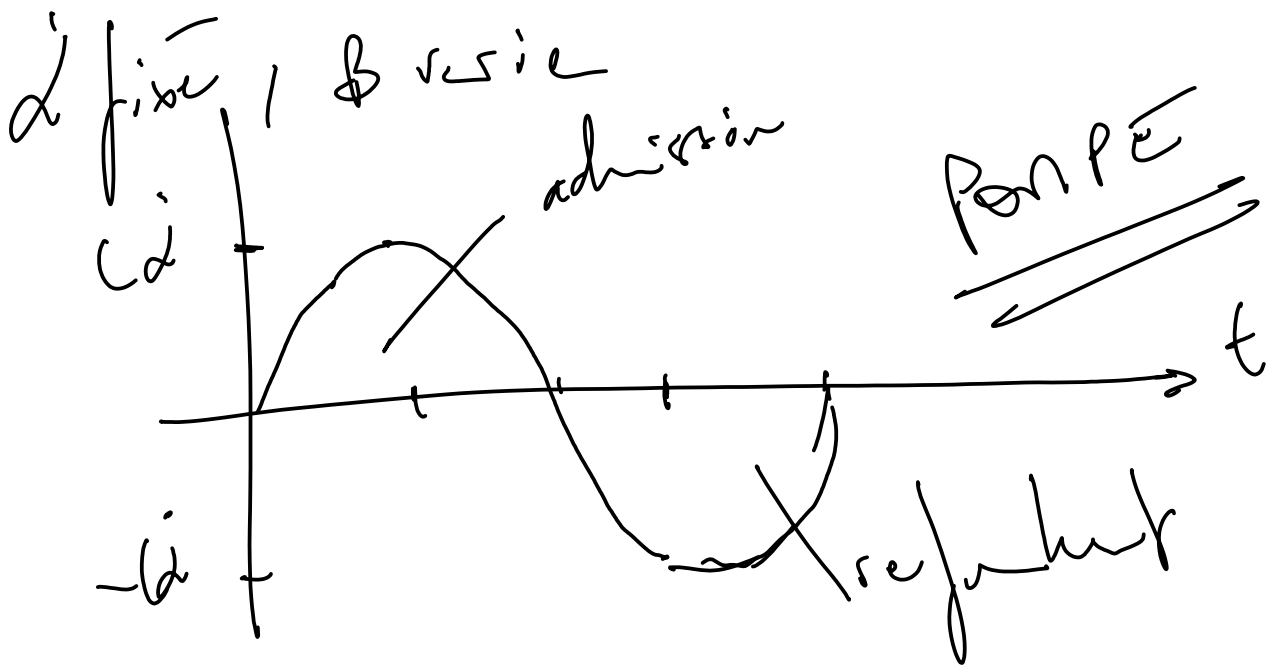
$$= \alpha \vec{z}' \wedge L \vec{r}_0$$

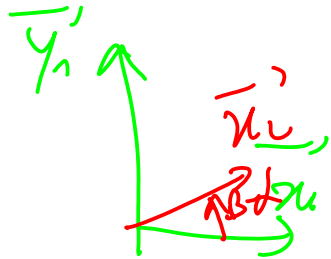
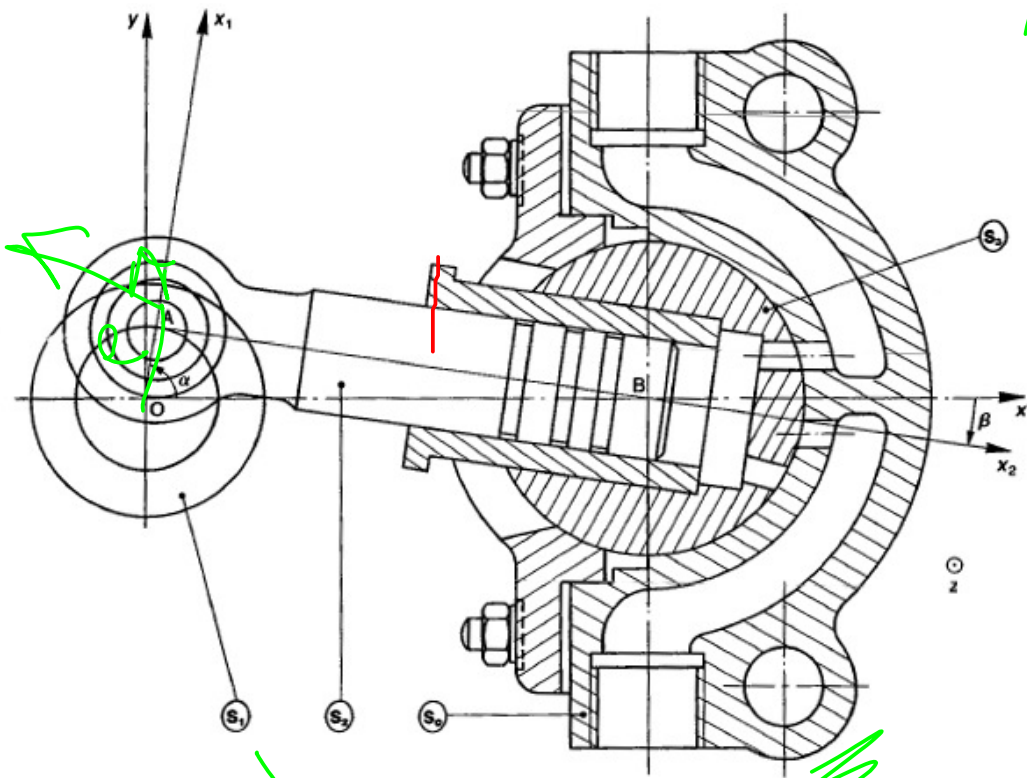
$$= L \dot{\alpha} \vec{y}_0$$

$$\vec{v}_{B,110} \cdot \vec{x}_i' = L \dot{\alpha} \sin \beta$$



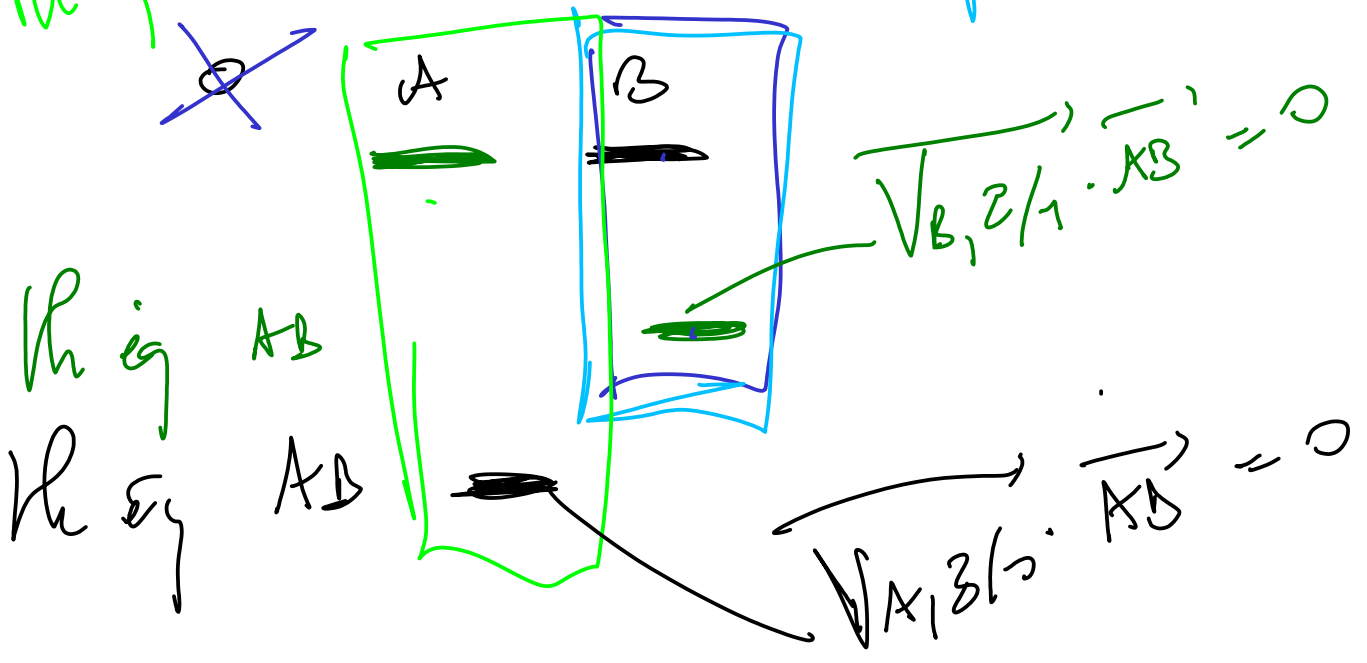
d'oi 
$$v = (L \sin \beta) \dot{\alpha}$$





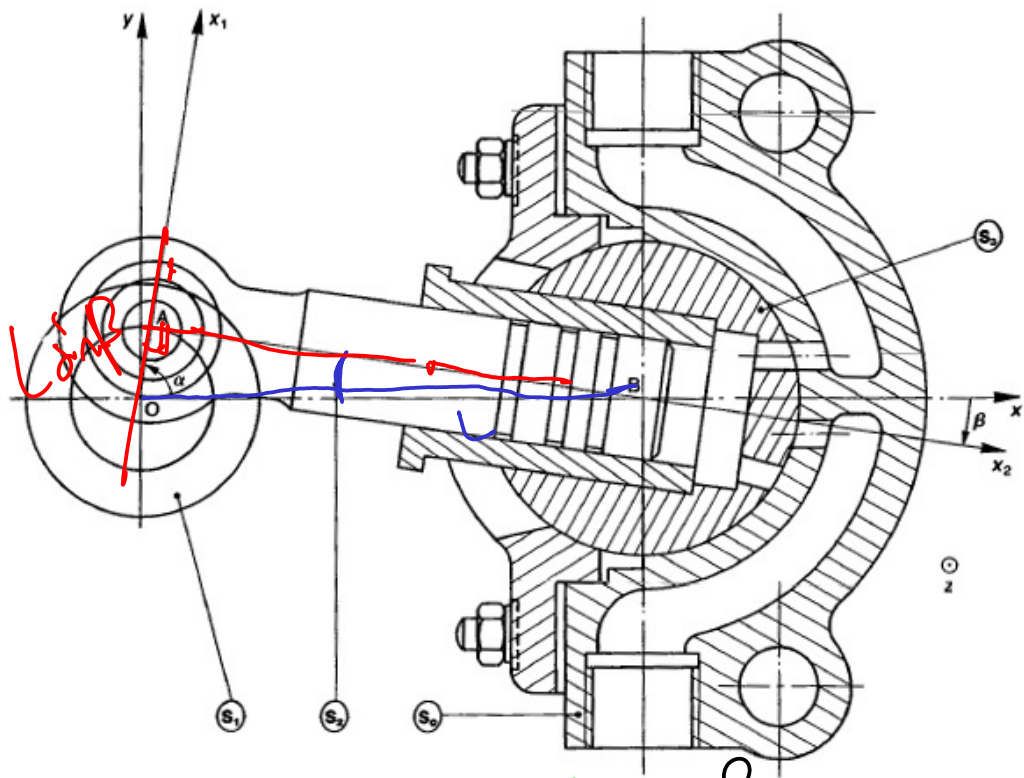
$$\{ \cancel{V_{3/0}} \} = \{ \cancel{V_{3/2}} \} + \{ \cancel{V_{2/1}} \} + \{ \cancel{V_{1/0}} \}$$

$$h_{cy} \cdot A = h_{cy} + h_{cy} + h_{cy}$$



$$\vec{V}_{A,3/2} \cdot \vec{n}_1 = -v$$

$$\vec{V}_{A,1/0} \cdot \vec{n}_1 = e \cdot \alpha \cdot \sin(\phi - \alpha)$$



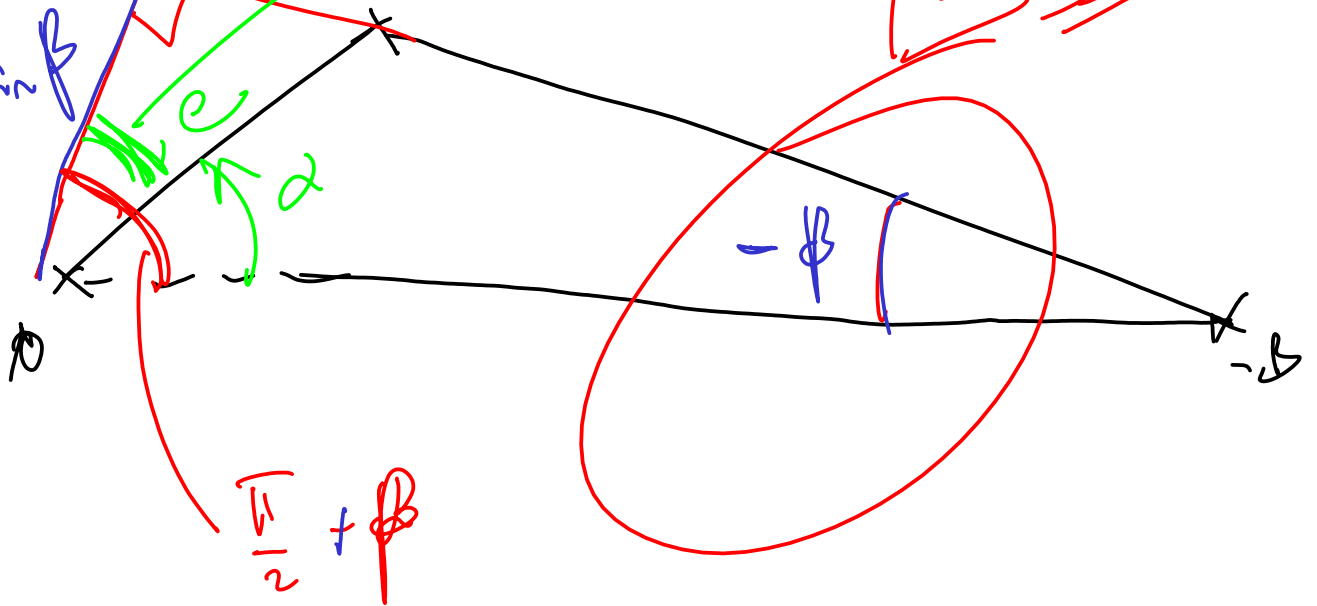
$e \sin(\beta - \alpha) \stackrel{?}{=} L \sin \beta$

$e \sin(\beta - \alpha)$   
 $e \cos\left(\frac{\pi}{2} + \beta - \alpha\right)$

$\frac{\pi}{2} - \beta - \alpha$

Signal

$-L \sin \beta$

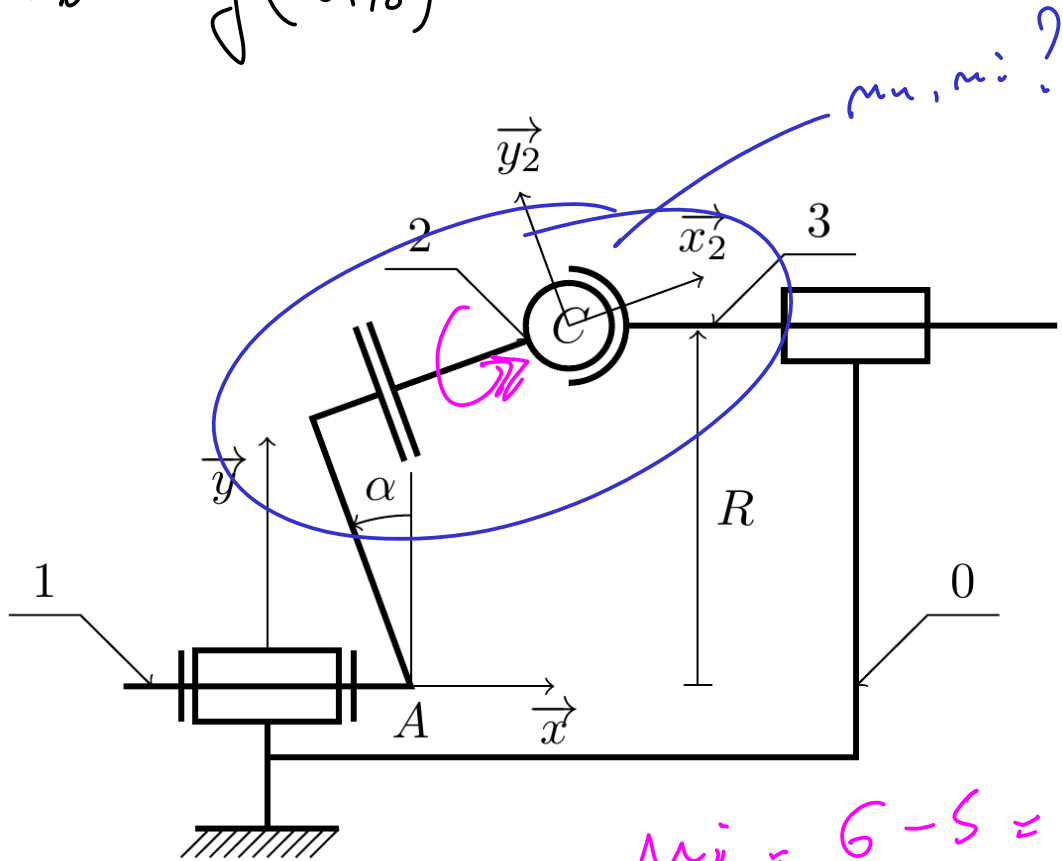


$\frac{\pi}{2} + \beta$

$-\beta$

$$\overline{V_{c_3/0} \cdot \vec{x}'} = \int (\omega_{1/0})$$

+



$$m_i = 6 - 5 = 1$$

2 links in series  
 $\dim(V_{3/2}) = 5 = m_u$   
 $\dim(V_{3/0}) = \dim(V_{3/2}) + \dim(V_{2/0}) \quad \sum \dim = 6$

$$= \left\{ \begin{matrix} p_{32} \vec{n}_i + q_{32} \vec{y}_0 + r_{32} \vec{z}_2 \\ \vec{0} \end{matrix} \right\}$$

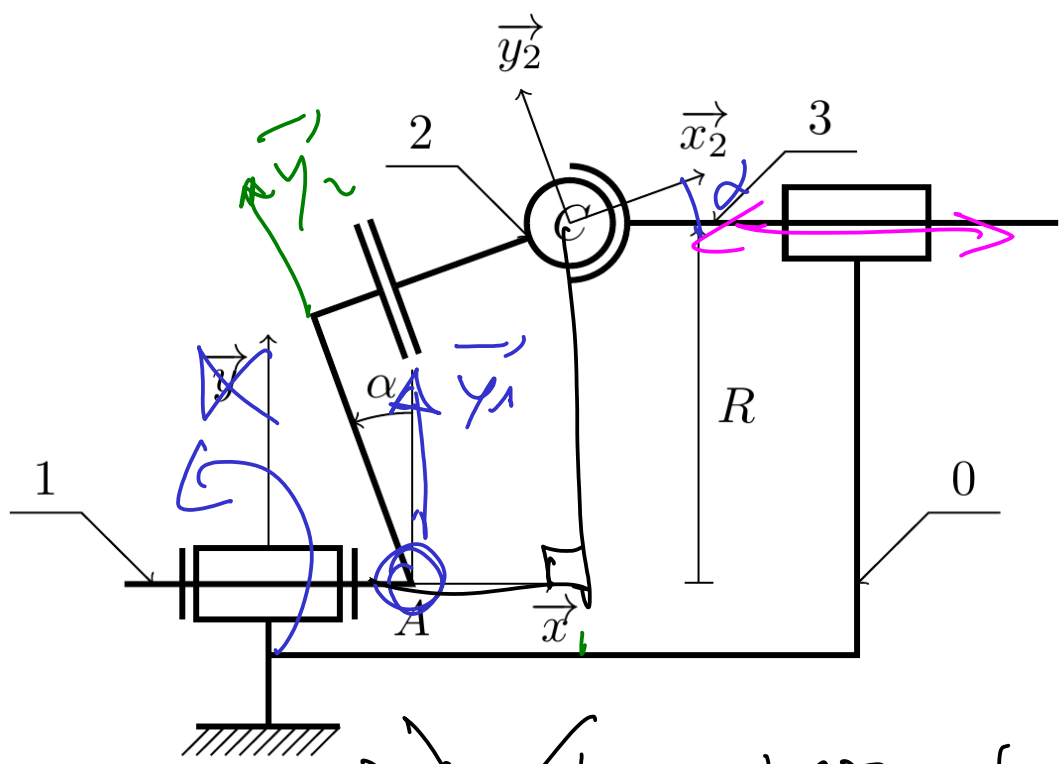
$$+ \left\{ \begin{matrix} p_{21} \vec{n}_u \\ v_{21} \vec{y}_2 + w_{21} \vec{z}_2 \end{matrix} \right\}$$

$$= \left\{ \begin{matrix} (p_{32} + p_{21}) \vec{n}_i + q_{32} \vec{y}_0 + r_{32} \vec{z}_2 \\ \vec{0} \vec{n}_i \quad v_{21} \vec{y}_2 + w_{21} \vec{z}_2 \end{matrix} \right\}$$



+

$$\overline{V_{C,3/0} \cdot \vec{r}_C} = \int (\underline{\omega_{1/0}})$$



$$\{ \underline{V_{3/0}} \} = \{ \underline{V_{2/1}} \} + \{ \underline{V_{1/0}} \}$$

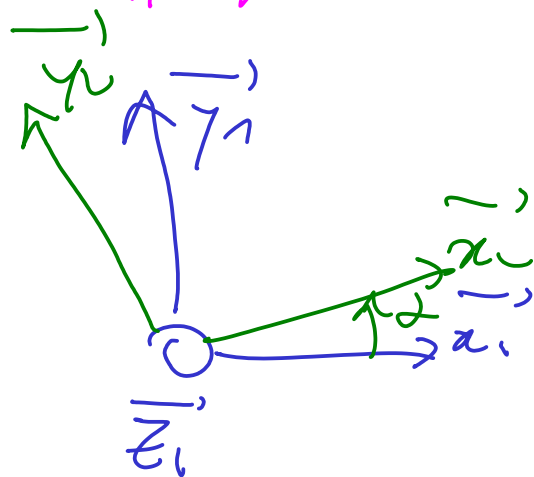
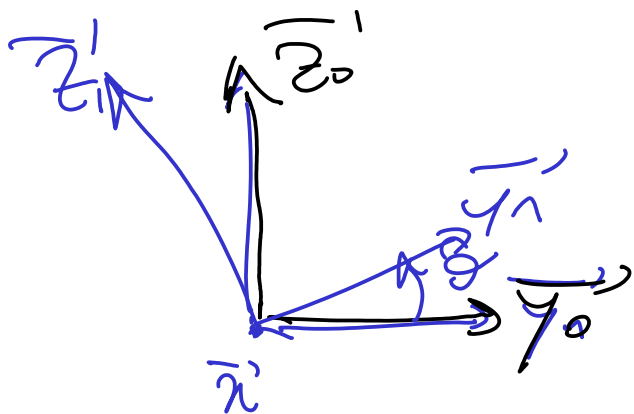
~~C~~

$$\overline{V_{C,3/1} \cdot \vec{r}_C} = 0$$

d'a :

$$\overline{V_{C,3/0} \cdot \vec{r}_C} = \overline{V_{C,1/0} \cdot \vec{r}_C}$$

$$\forall \Pi \in (C, \vec{x}), \{N_{310}\} = \begin{cases} p_{30} \vec{x}' \\ \mu_{30} \vec{x} \end{cases}$$



$$\overline{V_{C, 310}} \cdot \vec{x}_2 = \mu_{30} \cos \alpha$$

↳ changement de point,

$$\begin{aligned} \overline{V_{C, 110}} &= \overline{V_{A, 110}} + \overline{\Omega_{110}} \wedge \overline{AC} \\ &= \omega_{110} \vec{x} \wedge (\cancel{\vec{x}} + R \vec{y}_0) \\ &= R \omega_{110} \vec{z}_0 \end{aligned}$$

$$\vec{z}_0 = \cos \theta \vec{z}_1 + \sin \theta \vec{y}_1$$

$$\begin{aligned} \vec{z}_0 \cdot \vec{x}_2 &= \sin \theta \vec{y}_1 \cdot \vec{x}_2 \\ &= \sin \theta \sin \alpha \end{aligned}$$

$$\overline{V_{C, 110}} \cdot \vec{x}_2 = R \omega_{110} \sin \alpha \sin \theta$$

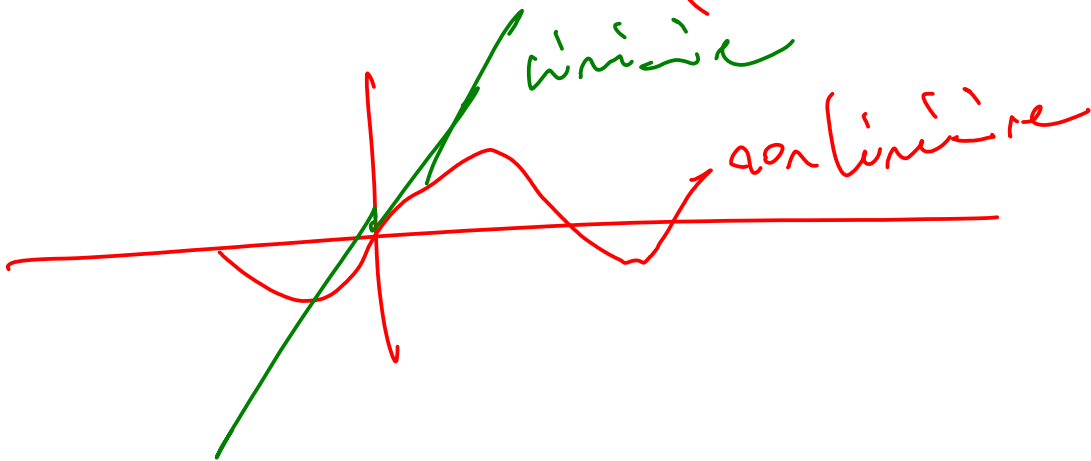
$$\overrightarrow{V_{c,3\phi}}, \overrightarrow{\pi_2} = \mu_{30} \cos \alpha$$

$$\overrightarrow{V_{c,1\phi}} = \overrightarrow{\pi_2} = R \omega_1 / b \sin \alpha \text{ and } \sin \theta$$

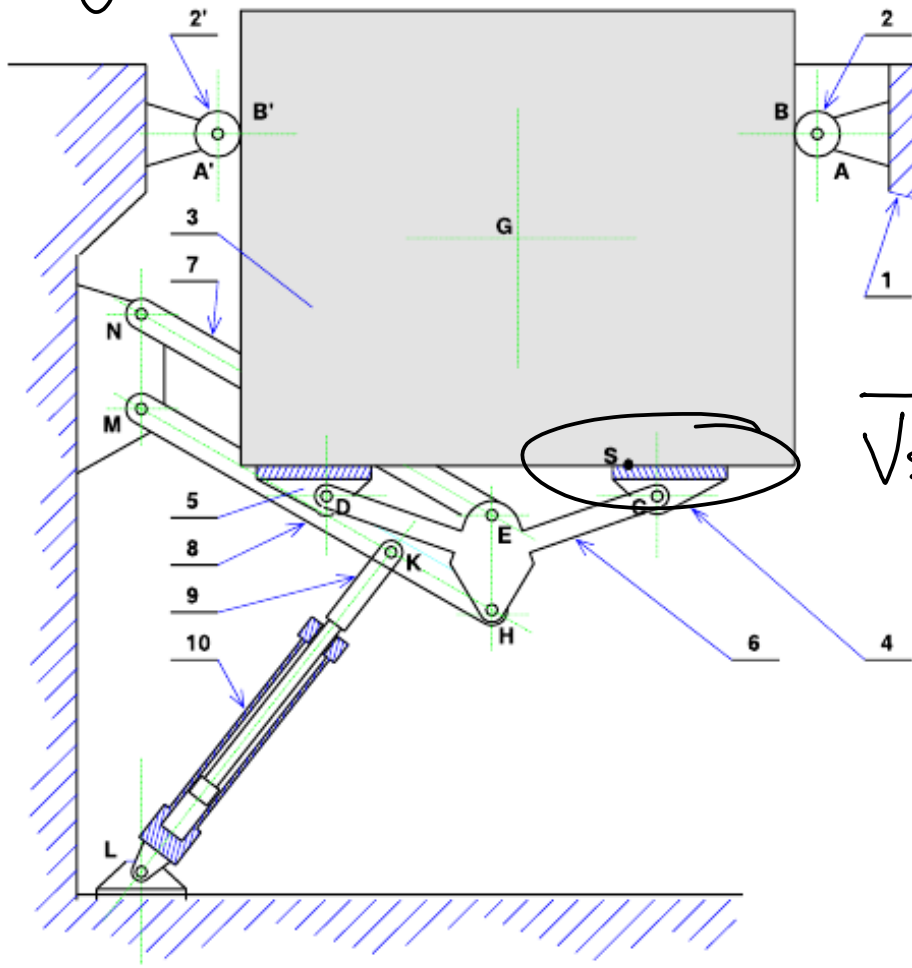
d'où :  $\mu_{30} = (R \sin \theta \text{ and } \tan \theta) \omega_1 / b$

cinématique / linéaire

géométrique  $\theta \mapsto (R \tan \theta) \sin \theta$



Reve-glace



$\vec{v}_{S, 4/3} \rightarrow ?$

$\times \left\{ \vec{v}_{6/1} \right\} ?$

$\times \vec{v}_{6,3/1} \rightarrow$  sachant  $\| \vec{v}_{K, 5/10} \| = 5 \text{ mm} \cdot \text{s}^{-1}$