Question 1:

$$\{T_{ai\to 4}\} = \begin{Bmatrix} F & 0 \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_{O_0, R_0} \quad \text{avec} \quad F = PS = 6\times 10^{-1} \times \frac{\pi(157^2 - 45^2)}{4}$$

$$F = 10661\,N$$

(comme dans la question 8:)

$$= \begin{Bmatrix} X_{ai} & 0 \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_{O_0, R_0}$$

Question 2:

$$\{T_{i\to 4}\} = \begin{Bmatrix} X_{i4} & 0 \\ 0 & \Pi_{i4} \\ 0 & N_{i4} \end{Bmatrix}_{A, R_i'} = \begin{cases} \vec{X}_i' = \cos\alpha\,\vec{X}_1 + \sin\alpha\,\vec{Y}_1 \\ \vec{Y}_i' = -\sin\alpha\,\vec{X}_1 + \cos\alpha\,\vec{Y}_1 \\ \vec{Z}_i' = \vec{Z}_1 \end{cases}$$

$$= \begin{Bmatrix} \cos\alpha X_{i4} & -\sin\alpha\Pi_{i4} \\ \sin\alpha X_{i4} & \cos\alpha\Pi_{i4} \\ 0 & N_{i4} \end{Bmatrix}_{A_1, R_1} = \begin{Bmatrix} \cos\alpha X_{i4} \\ \sin\alpha X_{i4} \\ 0 \end{Bmatrix} \begin{pmatrix} -\sin\alpha\Pi_{i4} \\ \cos\alpha\Pi_{i4} \\ N_{i4} \end{pmatrix} + \begin{pmatrix} 0 \\ e+f \\ 0 \end{pmatrix} \wedge \begin{pmatrix} \cos\alpha X_{i4} \\ \sin\alpha X_{i4} \\ 0 \end{pmatrix} \Bigg\}_{O_0, R_1}$$

$$= \begin{Bmatrix} \cos\alpha X_{i4} & -\sin\alpha_i \Pi_{i4} \\ \sin\alpha X_{i4} & \cos\alpha\Pi_{i4} \\ 0 & \underbrace{N_{i4} - (e+f)\cos\alpha X_{i4}}_{N} \end{Bmatrix}_{O_0, R_1}$$

$$\begin{cases} \vec{X}_1 = \vec{X}_0 \\ \vec{Y}_1 = \cos\beta_i\,\vec{Y}_0 + \sin\beta_i\,\vec{Z}_0 \\ \vec{Z}_1 = -\sin\beta\,\vec{Y}_0 + \cos\beta\,\vec{Z}_0 \end{cases}$$

Question 3:

$$\{T_{i\to 4}\} = \begin{Bmatrix} \cos\alpha X_{i4} & -\sin\alpha_i\Pi_{i4} \\ \sin\alpha X_{i4}\cos\beta_i & \cos\alpha\Pi_{i4}\cos\beta_i - \sin\beta_i N \\ \sin\alpha X_{i4}\sin\beta_i & \cos\alpha\Pi_{i4}\sin\beta_i + \cos\beta_i N \end{Bmatrix}_{O_0, R_0}$$

$$\Sigma\{T_{i\to 4}\} = \begin{Bmatrix} 3\cos\alpha X_{i4} & -3\sin\alpha_i\Pi_{i4} \\ 0 & 0 \\ 0 & 0 \end{Bmatrix}_{O_0, R_0}$$

Question 4:

$$\Rightarrow \begin{cases} X_{\Sigma \mathcal{L}_{0\to 4}} = 3\cos\alpha X_{i4} \\ L_{\Sigma \mathcal{L}_{0\to 4}} = -3\sin\alpha_i\Pi_{i4} \end{cases}$$

Question 5:

$$\{T_{0\to 4}\} = \begin{Bmatrix} 0 & \\ Y_{04} & \Pi_{04} \\ Z_{04} & N_{04} \end{Bmatrix}_{O_0, R_0}$$

Question 6:

Isole 4 : BAN $\quad 0\to 4,\ ai\to 4,\ \Sigma_{i\to 4}$

$$\begin{cases} 3\cos\alpha X_{i4} + F = 0 \\ Y_{04} = 0 \\ Z_{04} = 0 \\ -3\sin\alpha_i\Pi_{i4} = 0 \\ \Pi_{04} = 0 \\ N_{04} = 0 \end{cases}$$

Question 7:

$$\{T_{0\to 4}\} = \{0\}_{O_0, R_0}$$

Question 8:

$$\Pi_{i4} = 0$$

$$X_{i4} = -\frac{F}{3\cos\alpha} = \boxed{-\frac{X_{ai}}{3\cos\alpha} = X_{i4}}$$

Question 9:

$$\{T_{0\to1}\} = \begin{Bmatrix} X_{01} & L_{01} \\ 0 & M_{01} \\ Z_{01} & N_{01} \end{Bmatrix}_{O_0, R_0}$$

Question 10:

$$\begin{cases} X_{01} + \cos\alpha X_{14} = 0 \\ Y_{01} - \sin\alpha X_{14} = 0 \\ Z_{01} = 0 \\ L_{01} + L_{S\to1} = 0 \\ M_{01} = 0 \\ N_{01} + N_{14} - (e+f)\cos\alpha X_{14} = 0 \end{cases}$$

(Erreur dans le sujet)

$$\{T_{S\to1}\} = \begin{Bmatrix} 0 & L_{S\to1} \\ Y_{S\to1} & 0 \\ 0 & 0 \end{Bmatrix}_{P, R_0}$$

Question 11: $Y_{S\to1} = \sin\alpha X_{air}$ il faut prendre $\alpha = 60°$

Question 12: $Y_{S\to1} = 0,8 \times 10\,000 = 8000$ N

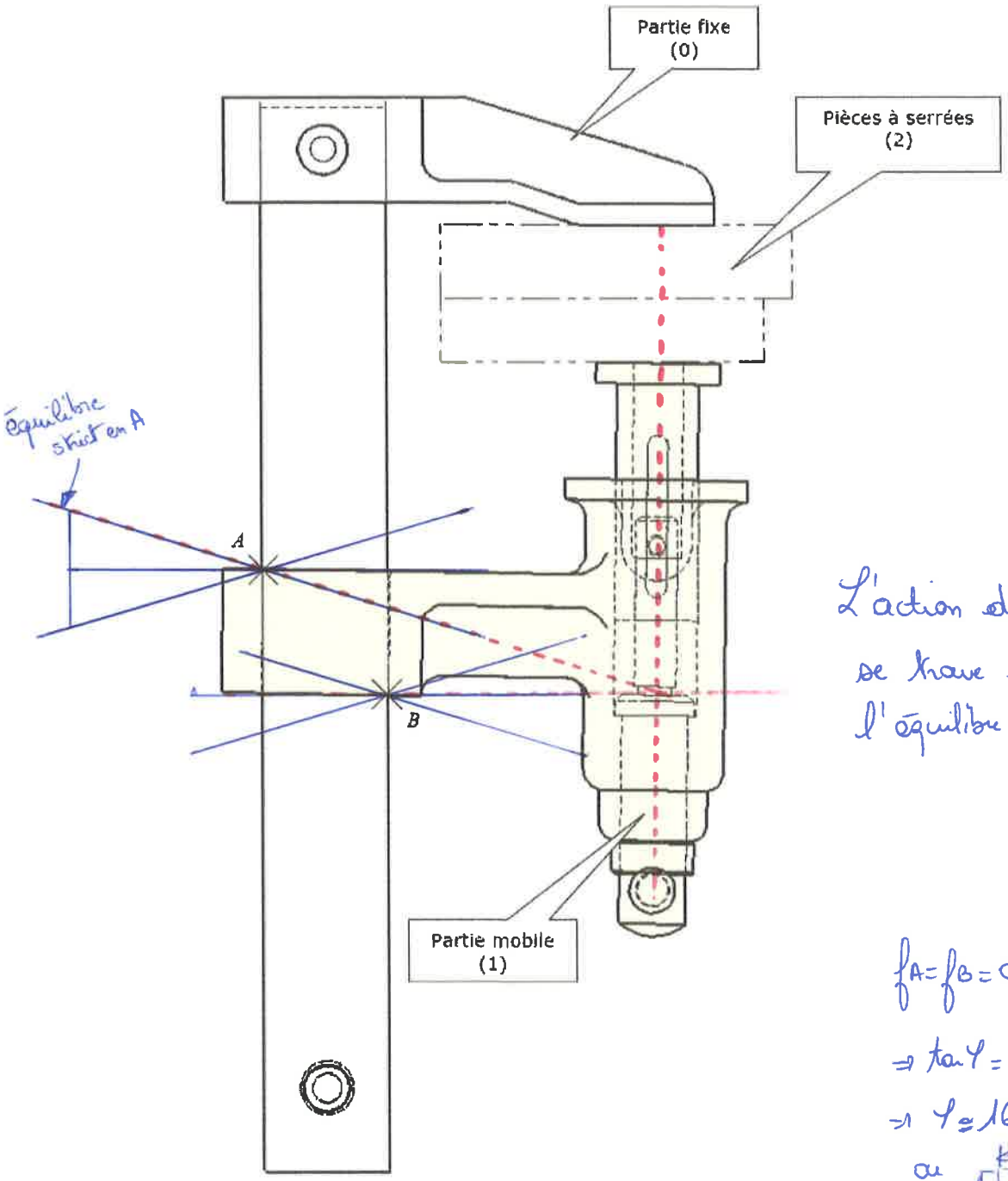
C'est bon, il faut changer la valeur dans l'énoncé.

Question 11:

$$Y_{S\to1} = \sin\alpha X_{14} = -\frac{\sin\alpha}{3\cos\alpha} X_{air} = -\frac{\tan\alpha}{3} X_{air} \qquad \alpha = 60°$$

$$Y_{S\to1} = -\frac{\tan 60}{3} \times 10661 = -6155 \text{ N}$$

Question 12: Il faut changer l'énoncé et dire que l'effort dérodé est de 6000 N, j'ai dû oublier le /3 quand j'ai rédigé l'énoncé.



L'action de 0→1 en B se trouve dans le cône, l'équilibre est respecté.

$f_A = f_B = 0{,}3$

$\Rightarrow \tan\varphi = 0{,}3$

$\Rightarrow \varphi \approx 16{,}7°$

ou