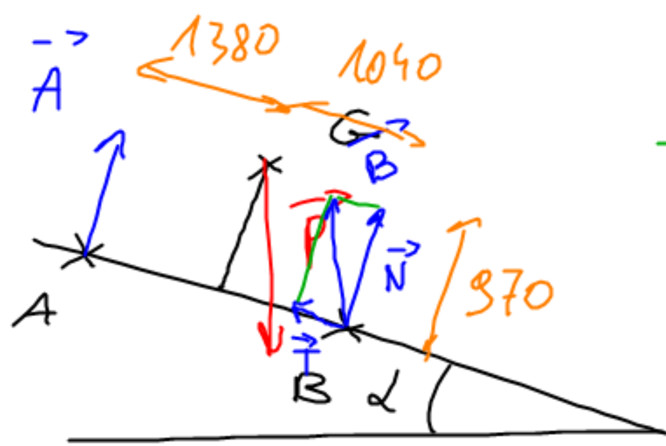
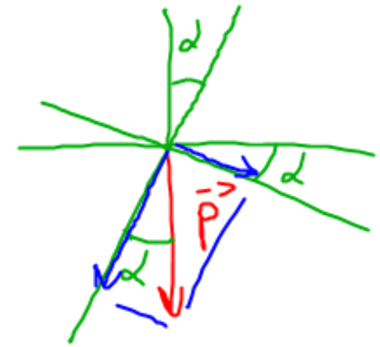
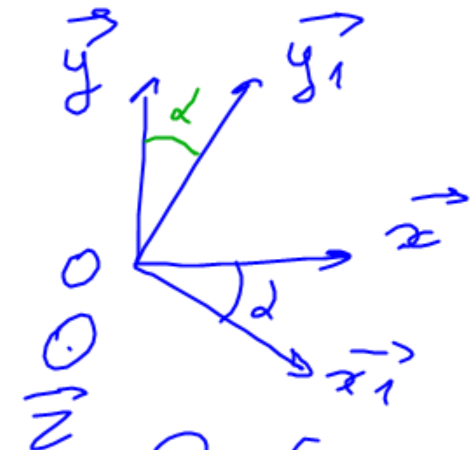
$$\vec{u} \wedge \vec{v} = \|\vec{u}\| \|\vec{v}\| . \sin(\vec{u},\vec{v}) . \vec{w}$$

SI:







$R : \{O, \vec{x}, \vec{y}, \vec{z}\}$

$R_1 : \{O, \vec{x_1}, \vec{y_1}, \vec{z}\}$

BAME:

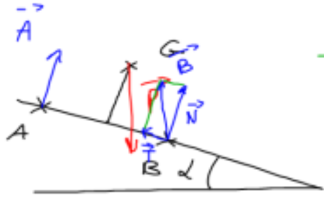
$$\overrightarrow{A_{0\to1}} = \begin{pmatrix} 0 \\ Y_A \\ 0 \end{pmatrix}_{R_1} = Y_A . \vec{y_1}$$

$$\overrightarrow{B_{0\to1}} = \begin{pmatrix} -T_B \\ N_B \\ 0 \end{pmatrix}_{R_1} = -T_B . \vec{x_1} + N_B . \vec{y_1}$$

$$\overrightarrow{P_{pes\to1}} = \begin{pmatrix} 0 \\ -13350 \\ 0 \end{pmatrix}_{R} = -13350 . \vec{y} = \begin{pmatrix} 13350 \sin\alpha \\ -13350 \cos\alpha \\ 0 \end{pmatrix}_{R_1} = 13350 \sin\alpha . \vec{x_1} - 13350 \cos\alpha . \vec{y_1}$$

$\vec{u} \wedge \vec{v} = \|\vec{u}\| \|\vec{v}\| . \sin(\vec{u}, \vec{v}) . \vec{w}$

SI:



$R : \{O, \vec{x}, \vec{y}, \vec{z}\}$

$R_1 : \{O, \vec{x_1}, \vec{y_1}, \vec{z}\}$

BAME:

$$\overrightarrow{A_{0 \to 1}} = \begin{pmatrix} 0 \\ Y_A \\ 0 \end{pmatrix}_{R_1} = Y_A . \vec{y_1}$$

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$$\overrightarrow{P_{pes \to 1}} = \begin{pmatrix} 0 \\ -13350 \\ 0 \end{pmatrix}_{R} = -13350 . \vec{y} = \begin{pmatrix} 13350 \sin\alpha \\ -13350 \cos\alpha \\ 0 \end{pmatrix}_{R_1} = 13350 \sin\alpha . \vec{x_1} - 13350 \cos\alpha \, \vec{y_1}$$

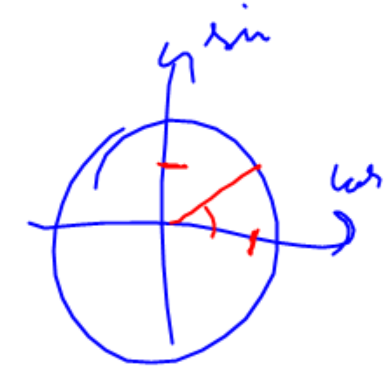
PFS:

$$\sum \vec{F} . \vec{x_1} = 0 \; : \; -T + 13350 \sin\alpha = 0$$

$$\left(Y_A \vec{y_1} - T_B \vec{x_1} + N \vec{y_1} + 13350 \sin\alpha \, \vec{x_1} - 13350 . \cos\alpha \, \vec{y_1} \right) . \vec{x_1} = 0$$

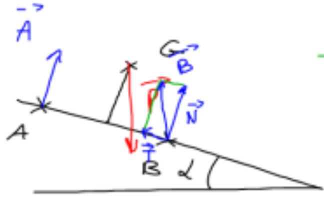
$$\vec{y_1} . \vec{x_1} = \|\vec{y_1}\| . \|\vec{x_1}\| . \cos(\vec{y_1}, \vec{x_1})$$
$$= 1 . 1 . 0 = 0$$

$$\vec{x_1} . \vec{x_1} = 1 . 1 . 1 = 1$$



$$\vec{u}\wedge\vec{v} = \|\vec{u}\|\|\vec{v}\|.\sin(\vec{u},\vec{v}).\vec{w}$$

SI:



$R : \{O, \vec{x}, \vec{y}, \vec{z}\}$

$R_1 : \{O, \vec{x_1}, \vec{y_1}, \vec{z}\}$

BAME:

$$\vec{A}_{0\to 1} = \begin{pmatrix} 0 \\ Y_A \\ 0 \end{pmatrix}_{R_1} = Y_A.\vec{y_1}$$

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$$\vec{P}_{pes\to 1} = \begin{pmatrix} 0 \\ -13350 \\ 0 \end{pmatrix}_{R} = -13350.\vec{y} = \begin{pmatrix} 13350\sin\alpha \\ -13350\cos\alpha \\ 0 \end{pmatrix}_{R_1} = 13350\sin\alpha.\vec{x_1} - 13350\cos\alpha.\vec{y_1}$$

PFS:

$$\sum \vec{F}.\vec{x_1} = 0 : -T_B + 13350\sin\alpha = 0 \quad (1)$$

$$\sum \vec{F}.\vec{y_1} = 0 : Y_A + N_B - 13350\cos\alpha = 0 \quad (2)$$

$$T_B = f.N_B$$

$$N_B = \frac{T_B}{f} \quad (1) : N_B = \frac{13350\sin\alpha}{f}$$

donc $Y_A = 13350\cos\alpha - \dfrac{13350\sin\alpha}{f}$

$$\boxed{Y_A = 13350\left(\cos\alpha - \frac{\sin\alpha}{f}\right)}$$

$$\sum \vec{M_B F}.\vec{z} = 0 : -Y_A.2{,}42 + 13350\left(-\sin\alpha.0{,}97 + \cos\alpha.1{,}04\right) = 0 \quad (3)$$

$$Y_A = 13350\left(\cos\alpha - \frac{\sin\alpha}{f}\right)$$

$$\sum \vec{M}_B^F \cdot \vec{z} = 0:\ -Y_A \cdot 2{,}42 + 13350\left(-\sin\alpha \cdot 0{,}97 + \cos\alpha \cdot 1{,}04\right) = 0 \quad (3)$$

$$-13350\left(\cos\alpha - \frac{\sin\alpha}{f}\right)\cdot 2{,}42 \quad + 13350\left(-\sin\alpha\, 0{,}97 + \cos\alpha\, 1{,}04\right) = 0$$

$$13350\left[- \ \cdots\cdot \right] = 0$$

$$-2{,}42\left(\cos\alpha - \frac{\sin\alpha}{f}\right) + \left(-\sin\alpha\, 0{,}97 + \cos\alpha\, 1{,}04\right) = 0$$

$$-2{,}42\cos\alpha + 2{,}42\frac{\sin\alpha}{f} - \sin\alpha \cdot 0{,}97 + \cos\alpha \cdot 1{,}04 = 0$$

$$\cos\alpha \cdot \left(-2{,}42 + 1{,}04\right) + \sin\alpha \cdot \left(\frac{2{,}42}{f} - 0{,}97\right) = 0$$

$$a \cdot b + a \cdot c = 0$$

$$a(b + c) = 0$$

$$b + c = \frac{0}{a}$$

$$b + c = 0$$

$$-2{,}42\cos\alpha + 2{,}42\frac{\sin\alpha}{f} - \sin\alpha \cdot 0{,}97 + \cos\alpha \cdot 1{,}04 = 0$$

$$\cos\alpha \cdot (-2{,}42 + 1{,}04) + \sin\alpha \cdot \left(\frac{2{,}42}{f} - 0{,}97\right) = 0$$

$$\sin\alpha \cdot \left(\frac{2{,}42}{f} - 0{,}97\right) = \cos\alpha \cdot (2{,}42 - 1{,}04)$$

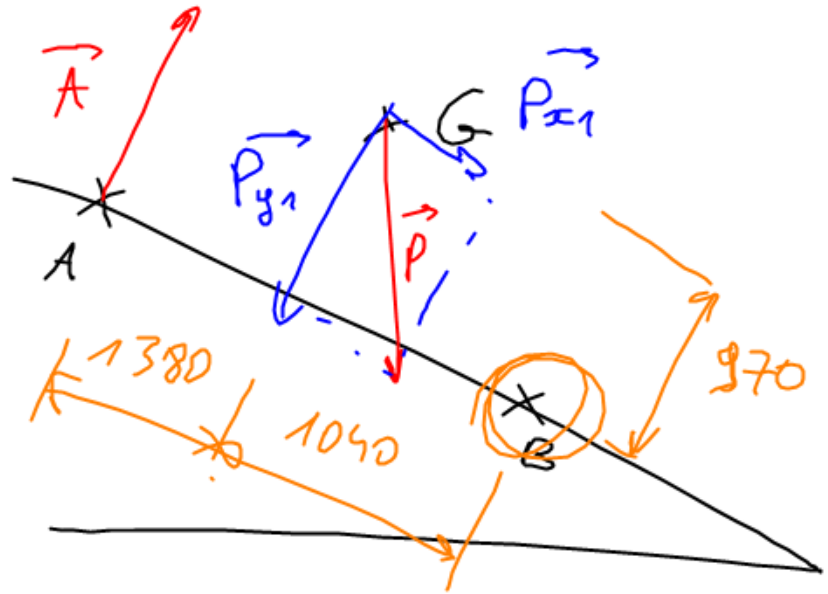
$$\tan\alpha = \frac{\sin\alpha}{\cos\alpha} = \frac{2{,}42 - 1{,}04}{\left(\frac{2{,}42}{f} - 0{,}97\right)}$$

$$\boxed{\alpha = \tan^{-1}\left(\frac{1{,}38}{\frac{2{,}42}{f} - 0{,}97}\right)}$$

$$\boxed{\alpha = \tan^{-1}\left(\frac{1{,}38}{\frac{2{,}42}{f} - 0{,}97}\right)}$$

$$\alpha_g = \tan^{-1}\left(\frac{1{,}38}{\frac{2{,}42}{0{,}6} - 0{,}97}\right) \simeq 24°$$

à la limite au glissement



$$\vec{\mathcal{M}_B A} = \begin{pmatrix} 0 \\ 0 \\ -Y_A \cdot 2{,}42 \end{pmatrix}$$

$$\vec{\mathcal{M}_B P} = \begin{pmatrix} 0 \\ 0 \\ -13350 \sin\alpha \cdot 0{,}97 + 13350 \cos\alpha \cdot 1{,}04 \end{pmatrix}$$

$\sum \overrightarrow{M_B F} \cdot \vec{z} = 0 : \; \underbrace{-Y_A \cdot 2{,}42}_{=0} + \cancel{13350}\left(-\sin\alpha \cdot 0{,}97 + \cos\alpha \cdot 1{,}04\right) = 0$ (3)

$$\sin\alpha \cdot 0{,}97 = \cos\alpha \cdot 1{,}04$$

$$\frac{\sin\alpha}{\cos\alpha} = \frac{1{,}04}{0{,}97}$$

$$\boxed{\alpha_b = \tan^{-1}\left(\frac{1{,}04}{0{,}97}\right) \simeq 47^\circ}$$

à la limite au basculement

$\alpha_g < \alpha_b$ donc il y a glissement avant basculement