Echelle pompiers

Question 4

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \vec{0}$$
$$\begin{pmatrix} AB\cos(\alpha) \\ AB\sin(\alpha) \end{pmatrix} + \begin{pmatrix} BC_x \\ -BC_y \end{pmatrix} + \begin{pmatrix} CA_x \\ CA_y \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 3{,}3\cos(\alpha) \\ 3{,}3\sin(\alpha) \end{pmatrix} + \begin{pmatrix} BC_x \\ -BC_y \end{pmatrix} + \begin{pmatrix} -4{,}32 \\ 2{,}14 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$BC_x = 4{,}32 - 3{,}3\cos(\alpha)$$
$$BC_y = 2{,}14 + 3{,}3\sin(\alpha)$$

$$BC^2 = BC_x^2 + BC_y^2 = (4{,}32 - 3{,}3\cos(\alpha))^2 + (2{,}14 + 3{,}3\sin(\alpha))^2$$
$$BC^2 = 4{,}32^2 + 3{,}3^2\cos^2(\alpha) - 2\cdot 4{,}32\cdot 3{,}3\cdot\cos(\alpha)$$
$$+2{,}14^2 + 3{,}3^2\sin^2(\alpha) + 2\cdot 2{,}14\cdot 3{,}3\cdot\sin(\alpha)$$
$$BC^2 = 34{,}132 - 28{,}512\cdot\cos(\alpha) + 14{,}124\cdot\sin(\alpha)$$
$$34{,}132 - BC^2 = 28{,}512\cdot\cos(\alpha) - 14{,}124\cdot\sin(\alpha)$$
$$34{,}132 - BC^2 = \sqrt[2]{28{,}512^2 + 14{,}124^2}\cdot\left(\frac{28{,}512}{\sqrt[2]{28{,}512^2 + 14{,}124^2}}\cdot\cos(\alpha) - \frac{14{,}124}{\sqrt[2]{28{,}512^2 + 14{,}124^2}}\cdot\sin(\alpha)\right)$$
$$\cos(\theta) = \frac{28{,}512}{\sqrt[2]{28{,}512^2+14{,}124^2}} \text{ donc } \theta = 26{,}352°$$

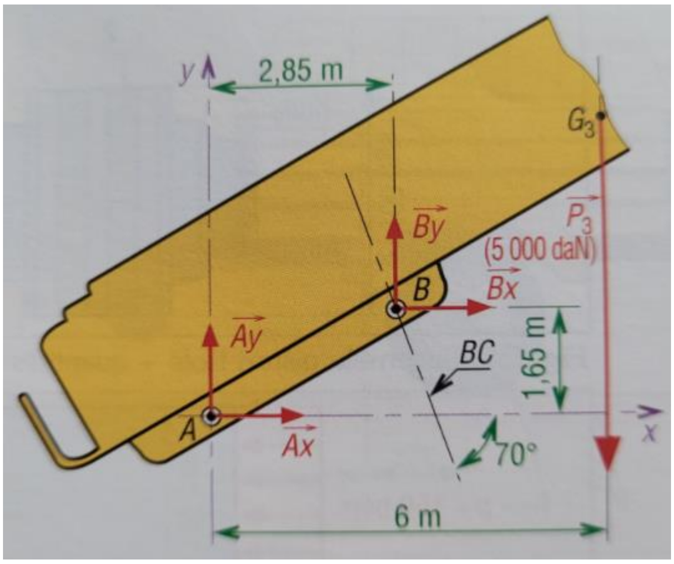
$$34{,}132 - BC^2 = 31{,}8185\cdot(\cos(\alpha)\cdot\cos(\theta) - \sin(\alpha)\cdot\sin(\theta)) \text{ soit}$$

$$34{,}132 - BC^2 = 31{,}8185\cdot\cos(\alpha + 26{,}352°) \text{ soit } \cos(\alpha + 26{,}352°) = \frac{34{,}132 - BC^2}{31{,}8185}.$$

$$\alpha_{MAX} \to BC = 2\cdot CE = 2\cdot 2{,}37\ ;\ \cos(\alpha_{MAX} + 26{,}352°) = \frac{34{,}132 - 4{,}74^2}{31{,}8185}$$
$$\alpha_{MAX} + 26{,}352° = 68{,}49°\ donc\ \boxed{\alpha_{MAX} = 42{,}138°}$$

$\alpha = 0\ ;\ BC_x = 4{,}32 - 3{,}3\ ;\ BC_y = 2{,}14, BC = 2{,}37.$
$\alpha_{MAX} = 42{,}138°\ ;\ BC_x = 1{,}873;\ BC_y = 4{,}354, BC = 4{,}74\ m$

La course est de 2m37. En 30s la vitesse sera de 79 mm. s-1.



Le théorème du moment résultant en A donne :
$$\overrightarrow{M_A(A_{2/3})} + \overrightarrow{M_A(B_{4/3})} + \overrightarrow{M_A(P_{T/3})} = \vec{0}$$

$$\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 2{,}85\ B_y - 1{,}65\ B_x \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ -6\cdot 50\ 000 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$2{,}85\ B_y - 1{,}65\ B_x = 300\ 000$$

Le théorème de la résultante donne :
$A_x + B_x = 0,$
$A_y + B_y = 50\ 000$

$A_x + B_x = 0,$
$B_y + A_y = 50000$
$2{,}85\ B_y - 1{,}65\ B_x = 300\ 000$
$2{,}85\ B \sin(110°) - 1{,}65\ B \cos(110°) = 300\ 000$. $2{,}678$ B+$0{,}564$B = 300 000
Soit $B_{4/3}$=92 535,47 N.

P = 3 x $B_{4/3}$ x $V_{4/5}$

P=3x92 535,47 x 0,079 = 21 930 W.

1) On considère 5 classes d'équivalence :
1 {châssis 1} ; 2 {tourelle 2} ; 3 {échelle 3} ; 4 {tige du vérin} ;
5 {Corps du vérin}

Graphe de liaisons

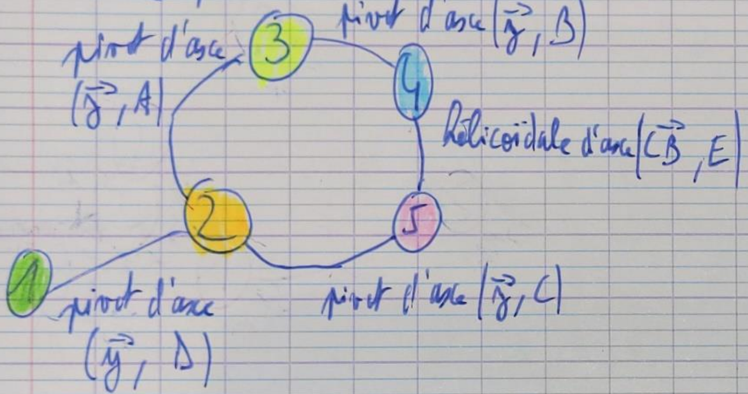


Schéma cinématique