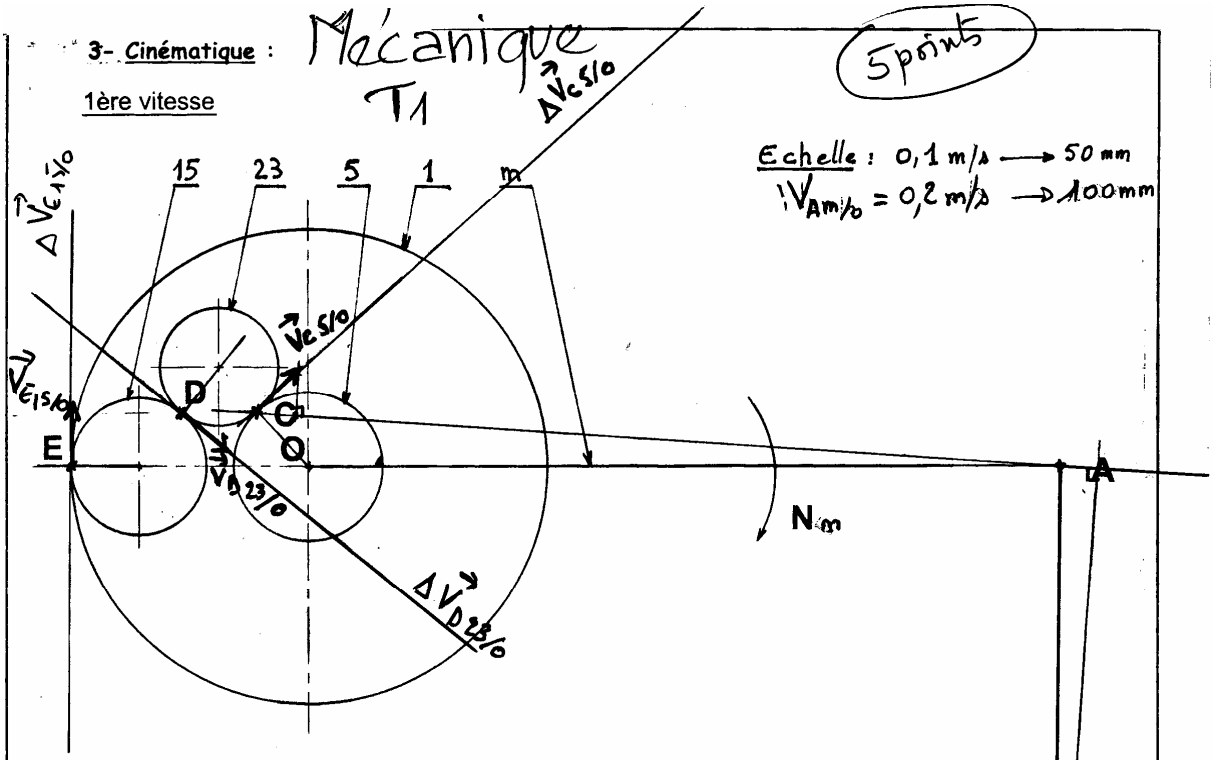
3- Cinématique : Mécanique T1 (5 points)

1ère vitesse



Echelle : 0,1 m/s ⟶ 50 mm

$V_{Am/0}$ = 0,2 m/s ⟶ 100 mm

0,1 m/s ⟶ 50 mm

$V_{C5/0}$ ⟶ 10 mm ⇒ $V_{C5/0} = \frac{10 \times 0,1}{50} = 0,02$ m/s

3.1 Placer le vecteur $\vec{V}_{Am/0}$ (0,5 pt)

3.2- Equiprojectivité sur (AC) $\boxed{V_{C5/0} = 0,02 \text{ m/s}}$ (2 pts)

3.3- Pas de glissement entre 23 et 5 en C donc $\boxed{V_{C23/0} = V_{C5/0} = 0,02 \text{ m/s}}$ 0,5 pt

$V_{D23/0} = V_{C23/0} = 0,02$ m/s

3.4- Pas de glissement entre 15 et 23 en D donc $V_{D23/0} = V_{D15/0}$

(0,5 pt) $\boxed{V_{D15/0} = 0,02 \text{ m/s}}$ $\boxed{V_{E15/0} = V_{D15/0} = 0,02 \text{ m/s}}$

3.5- $\boxed{V_{E1/0} = V_{E15/0} = 0,02 \text{ m/s}}$ (0,5 pt)

3.6- $R_1 = \frac{\frac{V_{E1/0}}{r_1}}{\frac{V_{Am/0}}{r_m}} \Rightarrow \boxed{R_1 = \frac{r_m V_{E1/0}}{r_1 V_{Am/0}}}$ AN : $R_1 = \frac{250 \times 0,02}{80 \times 0,2} = 0,31$

$\boxed{R_1 = 0,31}$ (1 pt)

4- Dynamique : (5pts)

4.1- $P = CW = A_1 \times r_m \times \frac{V_A}{r_m} \Rightarrow P = A_1 \times V_A \Rightarrow \boxed{A_1 = \frac{P}{V_A}}$

(1pt) $A_1 = \frac{80}{0,2} = 400N$ $\boxed{A_1 = 400N}$

4.2- $\eta = 1 \Rightarrow P = C_1 w_1 = C_5 \cdot w_5 \Rightarrow C_1 = C_5 \times \frac{w_5}{w_1} \Rightarrow \boxed{C_1 = \frac{C_5}{R_1}}$ (1)

(1,5pt) $C_1 = T_1 \cdot r_e$

$C_5 = A_1 \cdot r_m$

(1) $\Rightarrow T_1 \cdot r_e = \frac{A_1 \cdot r_m}{R_1} \Rightarrow \boxed{T_1 = \frac{A_1 \cdot r_m}{R_1 \cdot r_e}}$

4.3- AN: $T_1 = \frac{400 \times 250}{0,31 \times 60} = 5376,34N$ $\boxed{T_1 = 5376,34N}$

(1,5) $T_2 = \frac{A_2 \cdot r_m}{R_2 \cdot r_e} \Rightarrow \boxed{A_2 = \frac{T_2 \times R_2 \times r_e}{r_m}}$

4.4- AN: $A_2 = \frac{15.000 \times 0,1 \times 60}{250} = 360N$ $\boxed{A_2 = 360N}$

(1pt) $\frac{T_2}{A_2} = \frac{15000}{360} = 41,67$. L'effort fournit a été multiplié par à peu près 42.

5- Statique : (5pts)

5.1- $\sum \overrightarrow{M_O}(\overrightarrow{F_{ext}}) = \overrightarrow{0} \Rightarrow \overrightarrow{M_O}(\overrightarrow{I}) + \overrightarrow{M_O}(\overrightarrow{A_{H/m}}) = \overrightarrow{0}$

(1,5pt) $0 = -I\cos\alpha \times R_6 + A_{H/m} \cdot r_m \Rightarrow \boxed{I = \frac{A_{H/m} \cdot r_m}{R_6 \cdot \cos\alpha}}$

AN: $I = \frac{400 \times 250}{15 \times \cos 20^\circ} = 7094,52N$ $\boxed{I = 7094,52N}$

5.2-

(1,5pt) $M_t = I\cos\alpha \cdot R_6 = 7094,52 \times \cos 20^\circ \times (15.10^{-3}) = 100Nm$

$\boxed{M_t = 100N.m}$

5.3- $\begin{cases} \sum \overrightarrow{F_{ext}} = \overrightarrow{0} \\ \sum \overrightarrow{M_K}\overrightarrow{F_{ext}} = \overrightarrow{0} \end{cases} \Rightarrow \begin{cases} I + K_{11/6} + L_{11/6} + M = 0 \\ 0 - 88I + 112 L_{11/6} + 134M = 0 \end{cases}$

(2pts) $\Rightarrow L_{11/6} = \frac{88I - 134M}{112} = \frac{88 \times 7094,52 - (134 \times 400)}{112}$

$\boxed{L_{11/6} = 5095,69N}$

$K_{11/6} = -I - L_{11/6} - M = -7094,52 - 5095,69 - 400$

$\boxed{K_{11/6} = -12590,21N}$

6- Résistance des matériaux : (5 points)

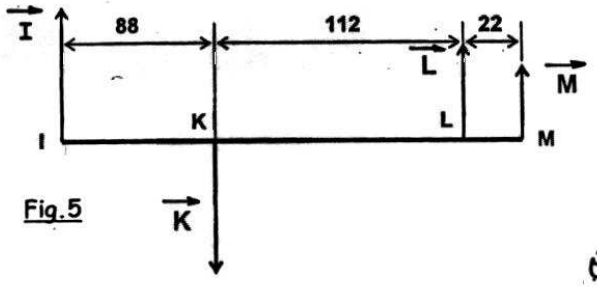


Fig.5

On donne :

$||\vec{I}|| = 7.000$ N. $||\vec{M}|| = 400$ N.

$||\vec{K}|| = 12420$ N. $||\vec{L}|| = 5020$ N.

Equation des T(x)

En I $T_I = 7000$N

$0 < x < 88$ $T_x = 7000$N

En K $T_K = 7000 - 12420$

$= -5420$N

Tronçon KL

$T_x = -5420$N

En L $T_L = I - K + L$ (1pt)

$= -400$N

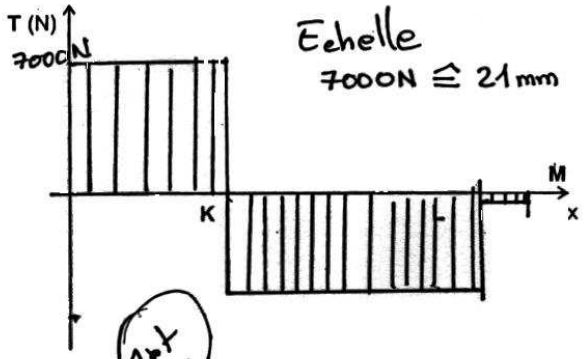
Tronçon LM

$T_x = -400$N

En M $T_M = I - K + L + M$

$= 0$N

6.2-



Echelle

7000N ≙ 21mm

1pt

Equation de Mf_x (1pt)

En I $mf_I = 0$Nmm

Tronçon IK

$mf_{(x)} = -I_x = -7000x$

En K $mf_K = -7000 \times 88$

$= 616.000$Nmm

Tronçon KL

$mf_{(x)} = -I_x + K(x-88)$

$= 5420x - 1092960$

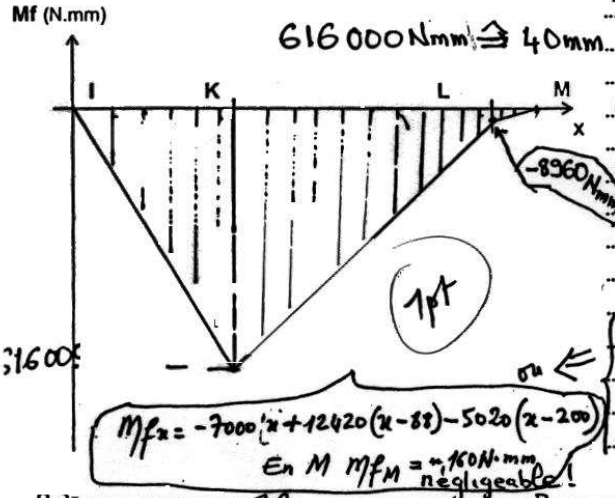
En L $mf_L = -200L + 112K$

$= -8960$Nmm

Tronçon LM

$mf_x = -400(222-x)$

En M $mf_M = 0$ Nmm



616 000Nmm ≙ 40mm

1pt

ou ⇐

$Mf_x = -7000x + 12420(x-88) - 5020(x-200)$

En M $Mf_M = -1,76$N.mm négligeable !

6.3-

$$\sigma_M = \frac{Mf_M}{\frac{I_{GZ}}{V}} = \frac{616.10^3 \times 32}{\pi d^3} = 114,34 \text{ N/mm}^2$$

(0,5pt)

6.4- **Conclusion :**

$\sigma < R_{pe} \Rightarrow$ La poutre résiste (0,5pt)