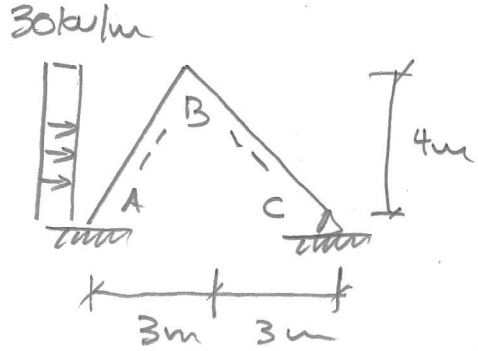
BITNA09061




⇒ APLICAÇÃO MF CONSIDERANDO SOMENTE EFEITOS DE FLEXÃO;

⇒ $EI = 1\,kNm^2$ P/ TODAS AS BARRAS

⇒ REDUNDANTES HIPERESTÁTICAS

$H1 \Rightarrow H_A$

$H2 \Rightarrow M_B$

PEDE-SE:

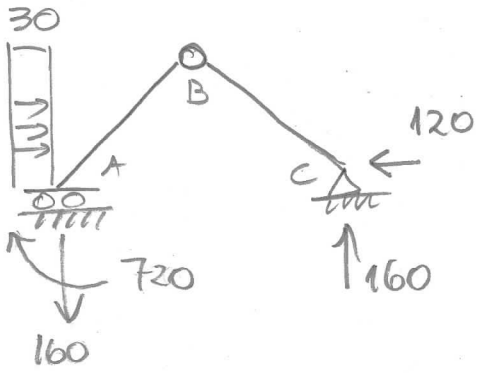
Q01) $f_{11}$ EM MÓDULO ["m" e "kN"]

Q02) $f_{12}$ EM MÓDULO ["m" e "kN"]

Q03) REAÇÃO $H_A$ [⊕ P/ DIREITA]

Q04) REAÇÃO $M_A$ [⊕ SENTIDO HORÁRIO]

CASO 0




$\sum M_B^{ESQ} = 0 \quad \curvearrowright ⊕$

$V_A \times 3 + M_A - 30 \times 4^2/2 = 0$

$\sum M_C = 0 \quad \curvearrowright ⊕$

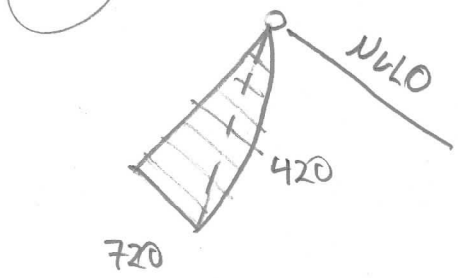
$V_A \times 6 + M_A + 30 \times 4^2/2 = 0$

$\begin{cases} 3V_A + M_A = 240 \\ 6V_A + M_A = -240 \end{cases}$

$V_A = -160\,kN$

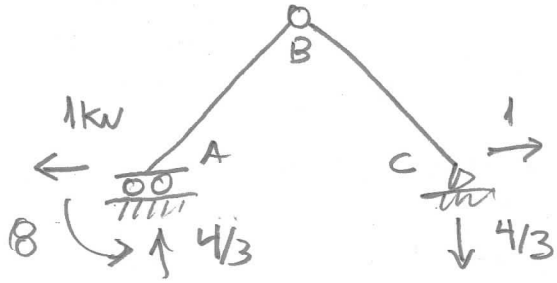
$M_A = +720\,kN$

$M_0$

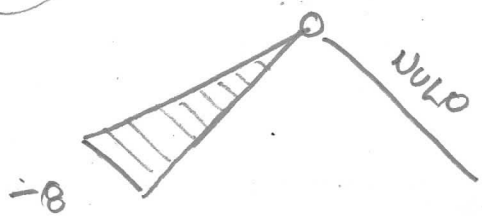



$\frac{720}{2} + \frac{30 \times 4^2}{8} = 420$

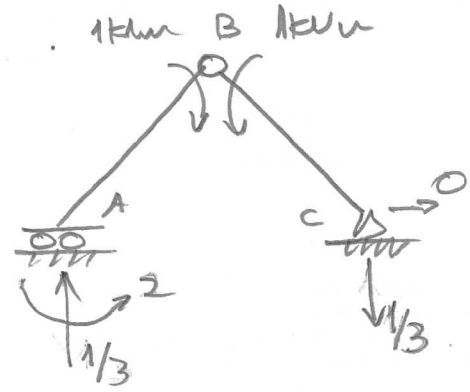
CASO 1




$M_1$



CASO 2




$\Sigma M_B^{ESQ} = 0 \curvearrowright (+)$

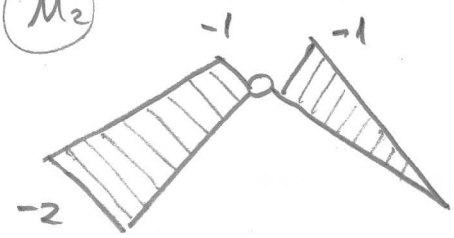
$V_A \times 3 + M_A + 1 = 0$

$\Sigma M_C = 0 \curvearrowright (+)$

$V_A \times 6 + M_A = 0$

$$\begin{cases} 3V_A + M_A = -1 \\ 6V_A + M_A = 0 \end{cases} \qquad \begin{aligned} V_A &= +1/3 \\ M_A &= -2 \end{aligned}$$

$M_2$




$\delta_{10} = \frac{1}{6} L k (2j_2 + j_3) = \frac{1}{6} \times 5 (-8)(2 \times 420 + 720) = -10400$

$\delta_{20} = \frac{1}{6} L [j_1 k_1 + 2j_2(k_1 + k_2) + j_3 k_2] =$

$\frac{1}{6} 5 [720 \times (-2) + 2 \times 420 (-2 - 1)] = -3300$

$f_{11} = \frac{1}{3} L j k = \frac{1}{3} 5 (-8)(-8) = 320/3 = \underline{106{,}67}$ $\boxed{Q01}$

$f_{22} = \frac{1}{6} L [j_1 (2k_1 + k_2) + j_2 (k_1 + 2k_2)]$

$\frac{1}{6} 5 [-2(2(-2) + (-1)) + (-1)(-2 + 2(-1))] = 35/3$

$+$

$\frac{1}{3} L j k = \frac{1}{3} 5 \times (-1)(-1) = 5/3$

$= 40/3$

$f_{12} = \frac{1}{6} L j (2k_1 + k_2) = \frac{1}{6} \times 5 (-8)(2(-2) - 1) = 100/3 = \underline{33{,}333}$ $\boxed{Q02}$

$\boxed{Q03}$

$$\begin{bmatrix} 320/3 & 100/3 \\ 100/3 & 40/3 \end{bmatrix} \begin{Bmatrix} H_A \\ M_B \end{Bmatrix} = \begin{Bmatrix} 10400 \\ 3300 \end{Bmatrix}$$

$H_A = \underline{92{,}143 \text{ kN} \leftarrow (-)}$

$M_B = 17{,}143 \text{ kNm} \curvearrowright \curvearrowleft$

$M_A = +720 - 8(92{,}143) + 2(17{,}143) = \underline{-51{,}43 \text{ kNm}}$ $\boxed{Q04}$