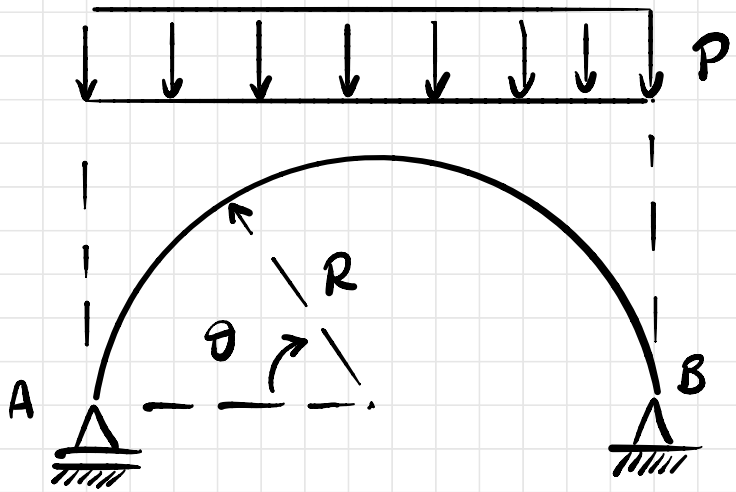
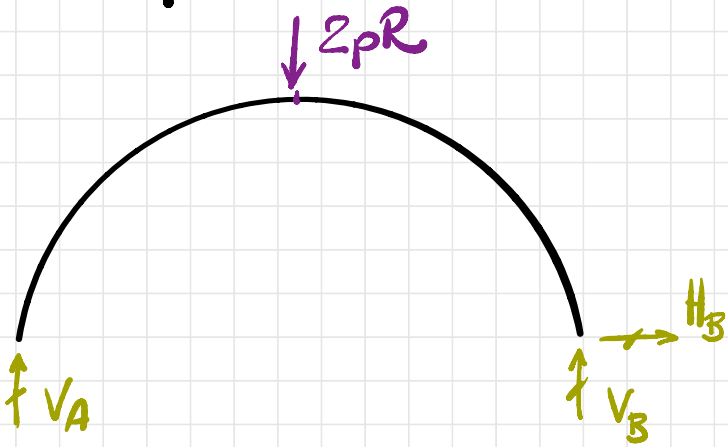
(50)



Reações de apoio:

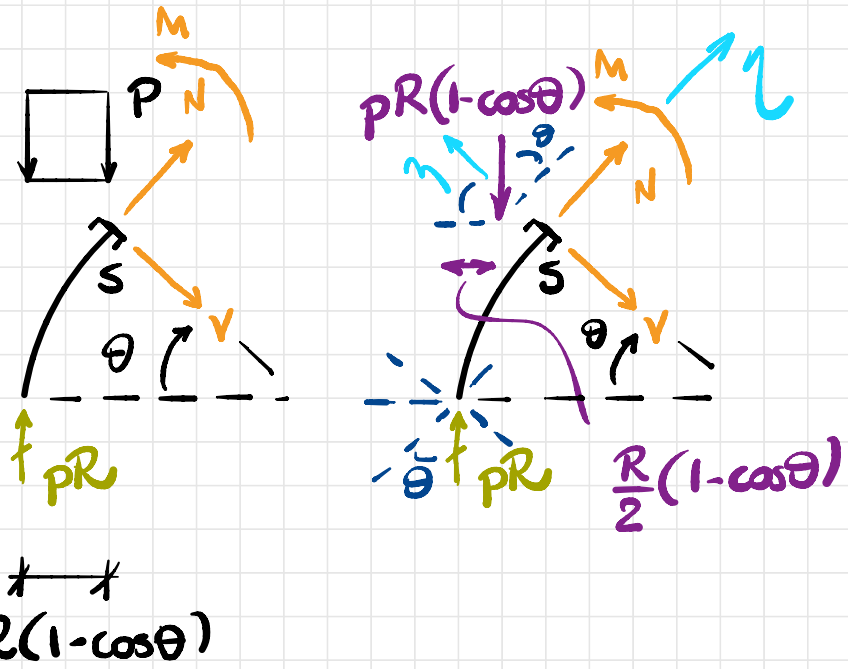


$\Sigma F_H = 0$: $\boxed{H_B = 0}$

$\Sigma F_V = 0$: $V_A + V_B = 2pR$

$\circlearrowleft(+)\ \Sigma M_A = 0$: $-2pR \cdot R + V_B \cdot 2R = 0$

$\boxed{V_B = pR} \Rightarrow \boxed{V_A = pR}$



$$\sum F_y = 0: \quad N + pR\cos\theta - pR(1-\cos\theta)\cdot\cos\theta = 0$$

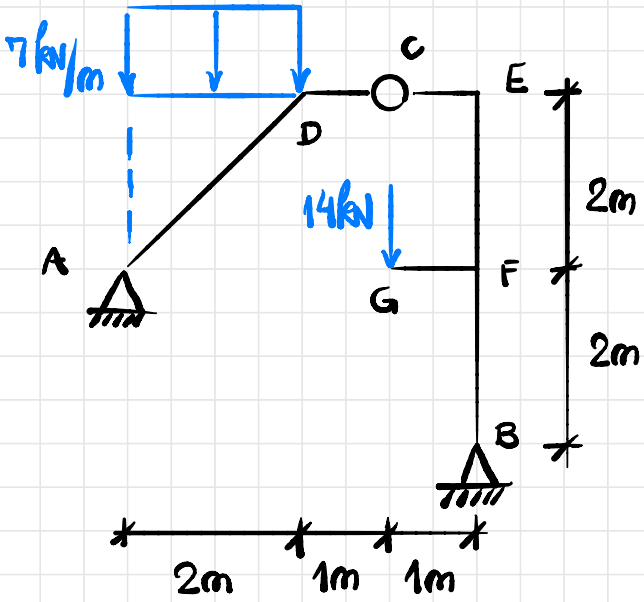
$$\boxed{N = -pR\cos^2\theta}$$

$$\sum F_z = 0: \quad -V + pR\operatorname{sen}\theta - pR(1-\cos\theta)\cdot\operatorname{sen}\theta = 0$$

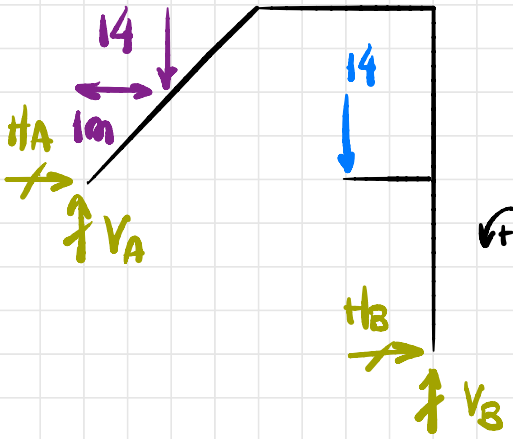
$$\boxed{V = pR\operatorname{sen}\theta\cos\theta}$$

$$\circlearrowleft + \sum M_S = 0: \quad M - pR\cdot R(1-\cos\theta) + pR\cdot\frac{R}{2}(1-\cos\theta)^2 = 0$$

$$\boxed{M = pR^2\operatorname{sen}^2\theta}$$



Reações de apoio:



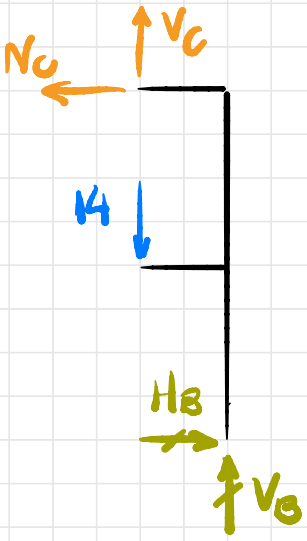
$$\sum F_H = 0: \quad H_A + H_B = 0$$

$$\sum F_V = 0: \quad V_A + V_B = 28$$

$$(+) \sum M_A = 0: \quad -14.1 - 14.3 + H_B.2 + V_B.4 = 0$$

$$H_B + 2V_B = 28$$

Fazendo um corte em C:



$$\curvearrowleft (+) \sum M_C = 0 : H_B \cdot 4 + V_B \cdot 1 = 0$$

$$\therefore V_B = -4H_B$$

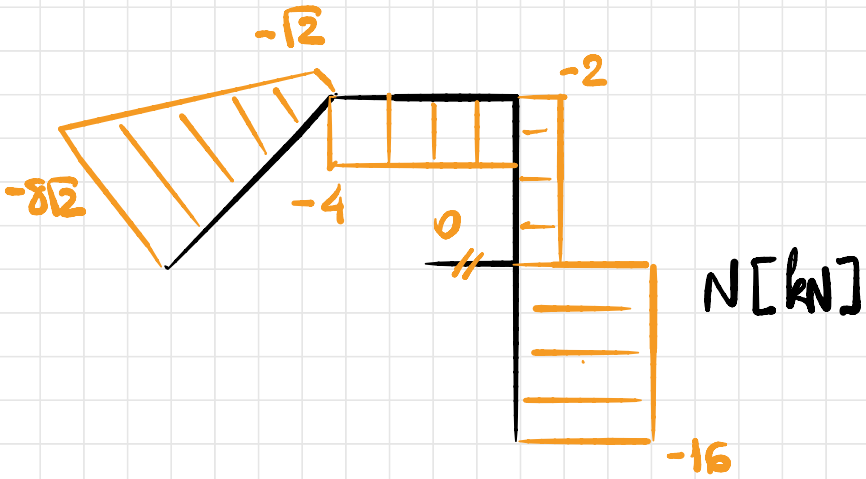
Assim:

$$H_B + 2(-4H_B) = 28 \Rightarrow \boxed{H_B = -4\,kN}$$

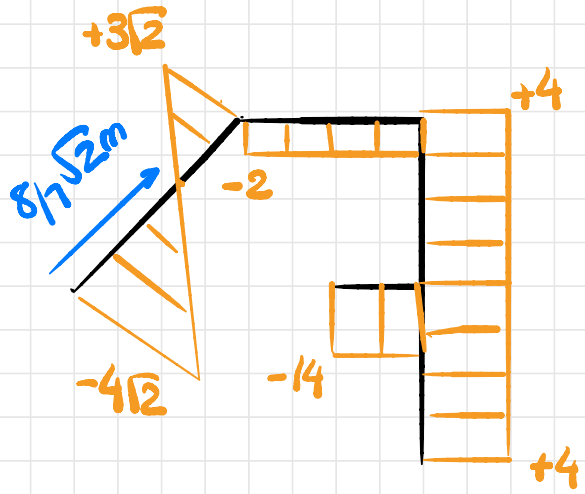
$$V_B = -4(-4) \Rightarrow \boxed{V_B = 16\,kN}$$

$$H_A = -H_B \Rightarrow \boxed{H_A = 4\,kN}$$

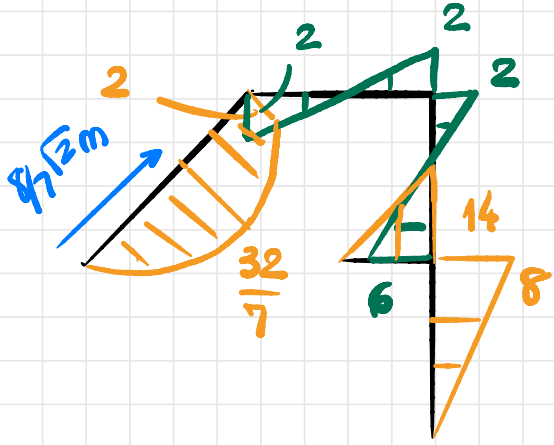
$$V_A = 28 - V_B \Rightarrow \boxed{V_A = 12\,kN}$$



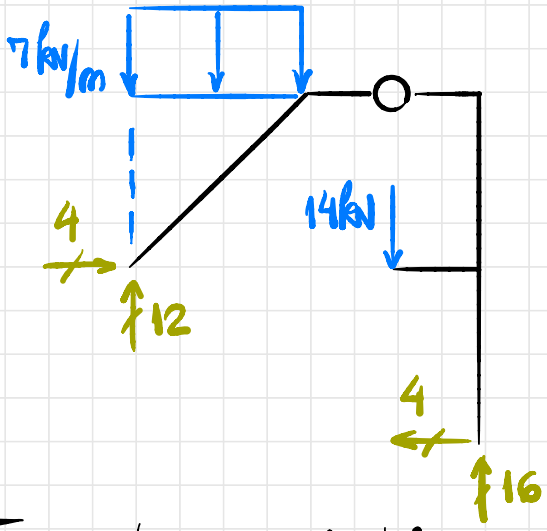
N[kN]



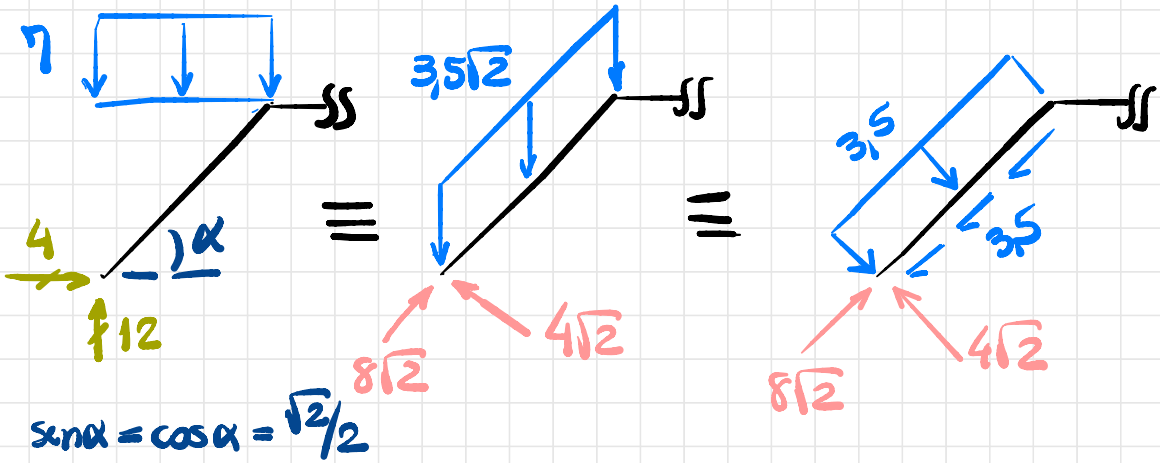
V[kN]



M[kNm]



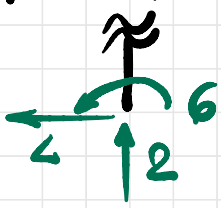
Fazendo as projeções na viga inclinada:

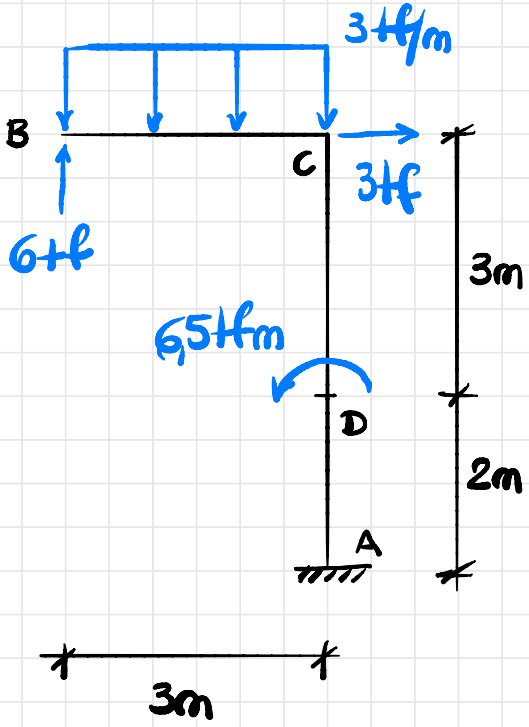


$\sin\alpha = \cos\alpha = \sqrt{2}/2$

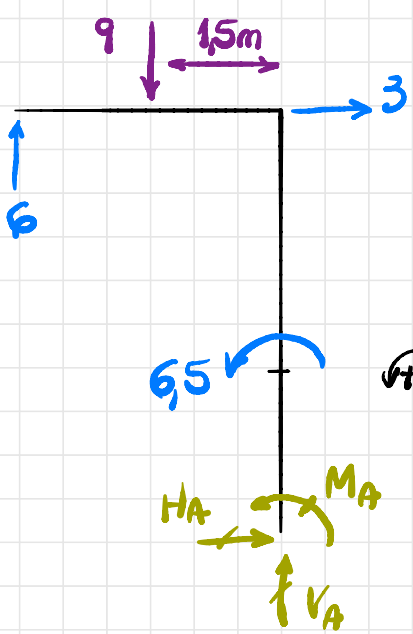
Transporte para D:

Transporte para F:





Reações do apoio:



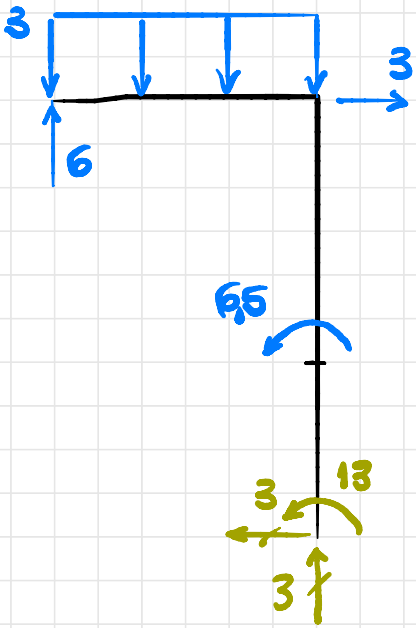
$\Sigma F_H = 0$: $H_A + 3 = 0$ $\boxed{H_A = -3tf}$

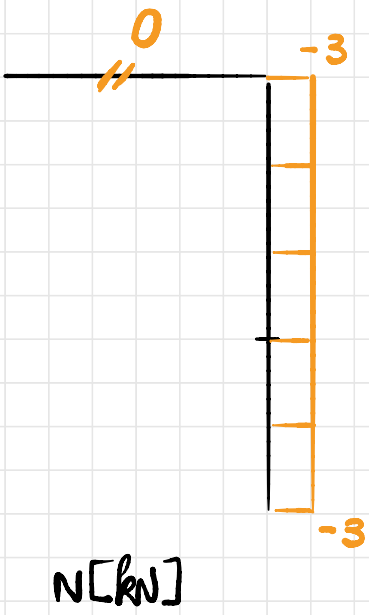
$\Sigma F_V = 0$: $V_A + 6 - 9 = 0$

$\boxed{V_A = 3tf}$

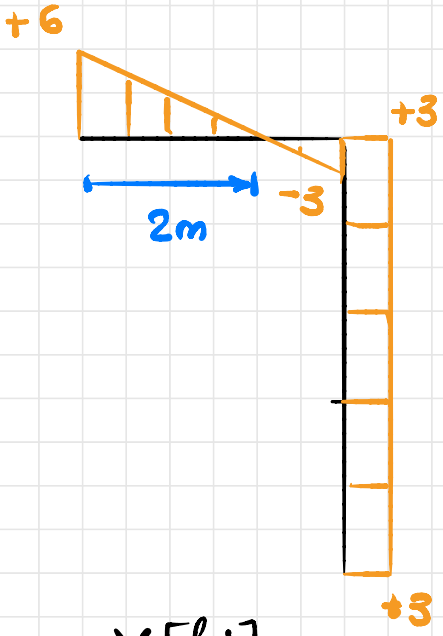
(+) $\Sigma M_{(A)} = 0$: $M_A + 6{,}5 - 3.5 + 9.1{,}5 - 6.3 = 0$

$\boxed{M_A = 13tfm}$

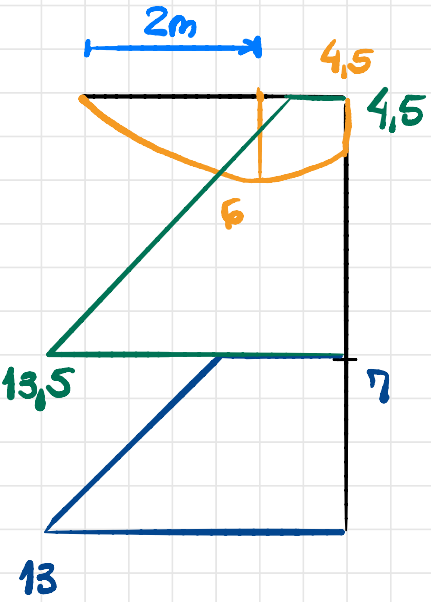




N[kN]

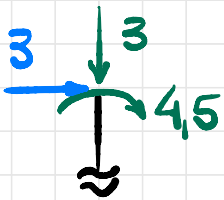


V [kN]

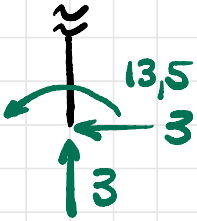


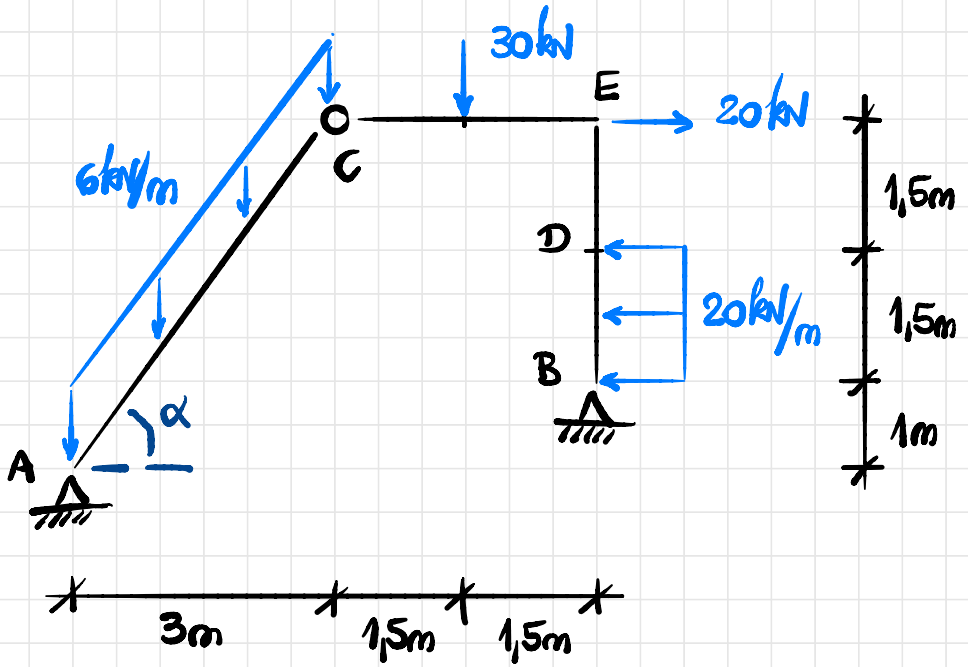
M [kNm]

Transporte para C:



Transporte para D:

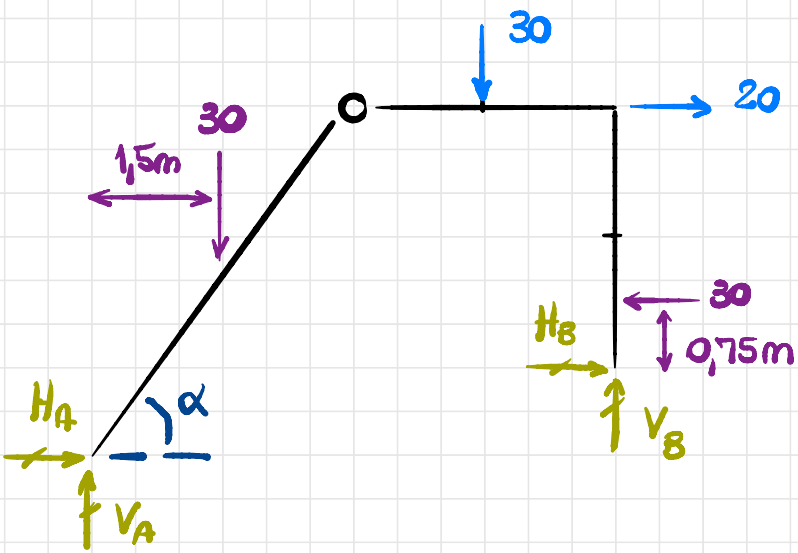




$\sin\alpha = 4/5$

$\cos\alpha = 3/5$

Reações de apoio:



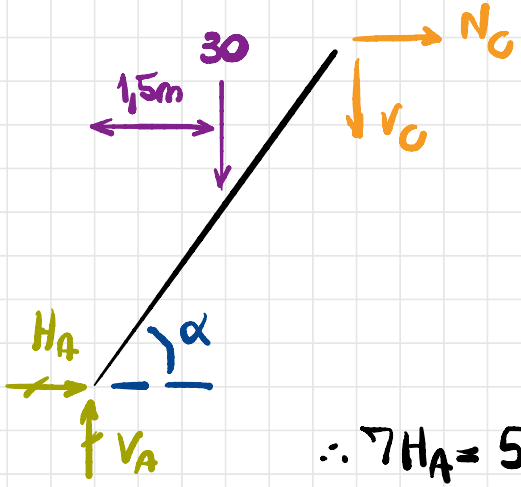
$\Sigma F_H = 0$: $H_A + H_B + 20 - 30 = 0 \rightarrow H_A + H_B = 10$

$\Sigma F_V = 0$: $V_A + V_B - 30 - 30 = 0 \rightarrow V_A + V_B = 60$

$\curvearrowleft \Sigma M_B = 0$: $30.0{,}75 - 20.3 + 30.1{,}5 + 30.4{,}5 + H_A.1 - V_A.6 = 0$

$6V_A - H_A = 142{,}5$

Fazendo um corte em C:



$\curvearrowleft \Sigma M_C = 0$: $30.1{,}5 + H_A.4 - V_A.3 = 0$

$4H_A - 3V_A + 45 = 0$

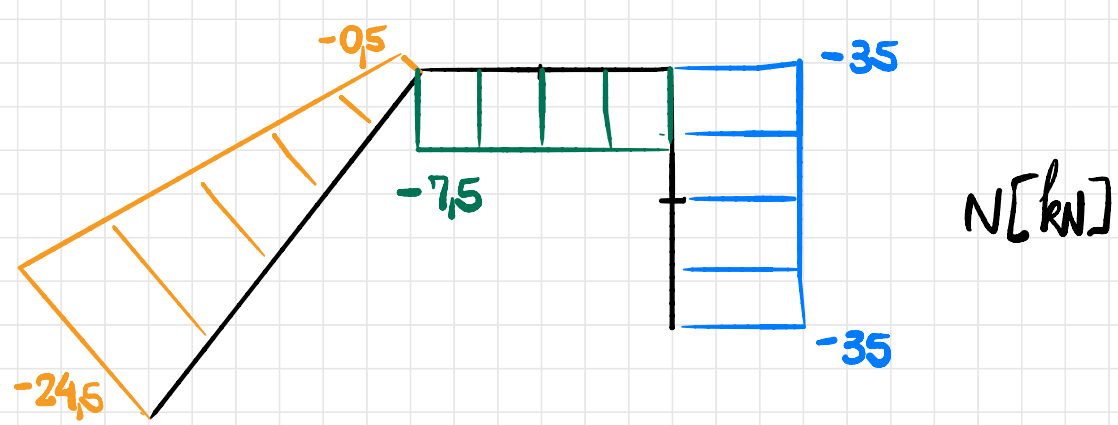
$-6V_A + 8H_A = -90$

$\therefore 7H_A = 52{,}5 \rightarrow \boxed{H_A = 7{,}5\,kN}$

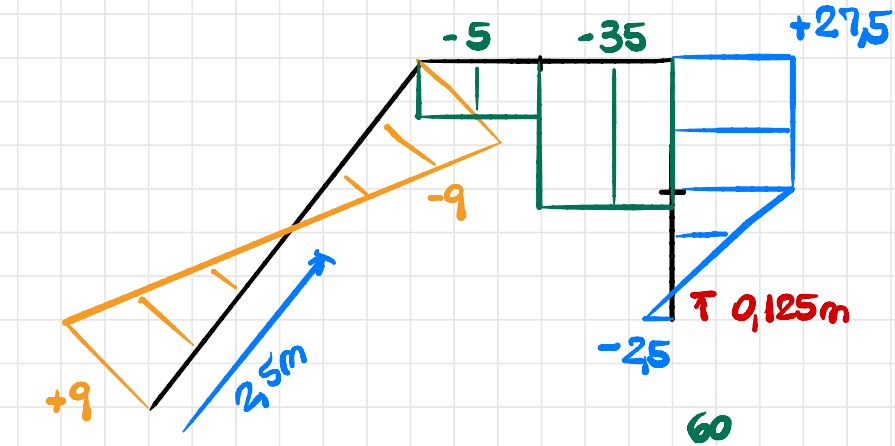
$6V_A = 142{,}5 + H_A \rightarrow \boxed{V_A = 25\,kN}$

$\boxed{V_B = 35\,kN}$

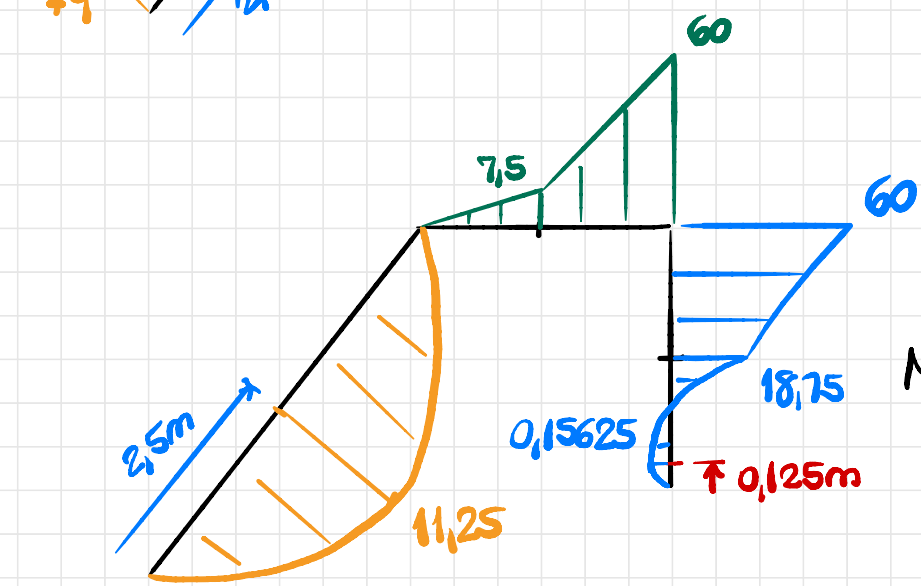
$\boxed{H_B = 2{,}5\,kN}$


-0,5
-35
-7,5
-24,5
-35

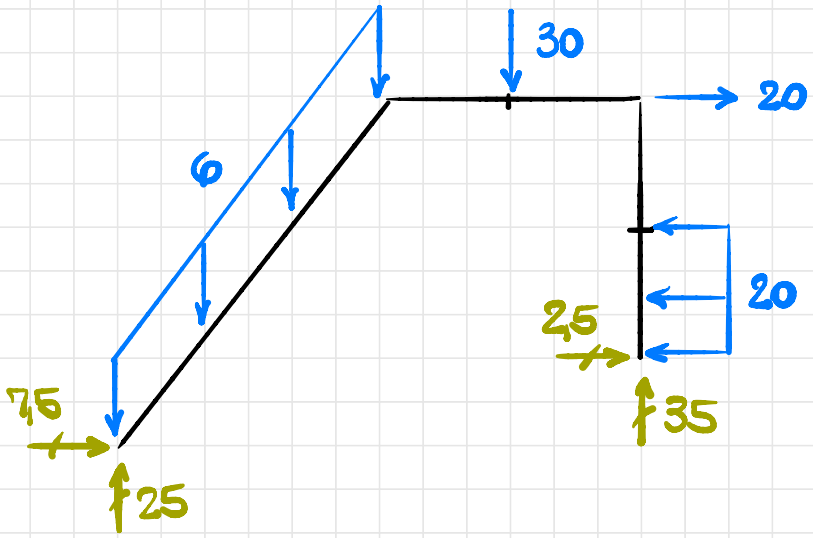
N[kN]


-5
-35
+27,5
-9
+9
2,5m
T 0,125m
-25

V[kN]


60
7,5
60
2,5m
18,75
0,15625
T 0,125m
11,25

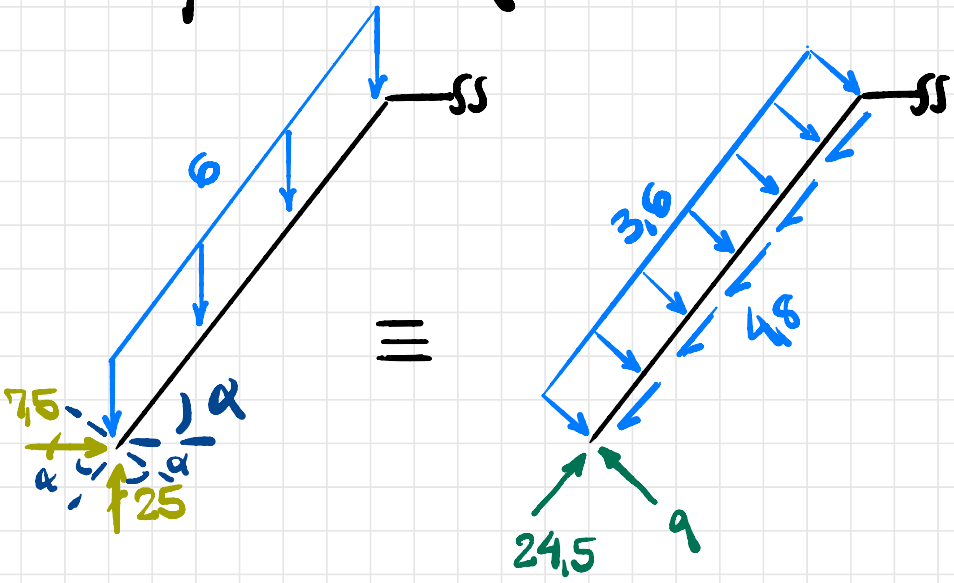
M[kNm]



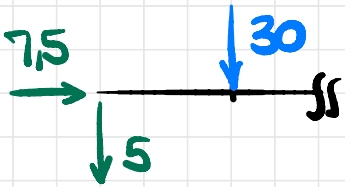
$\sin\alpha = 4/5$

$\cos\alpha = 3/5$

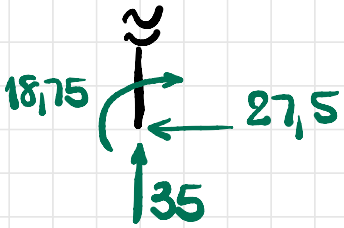
Decompondo as forças:



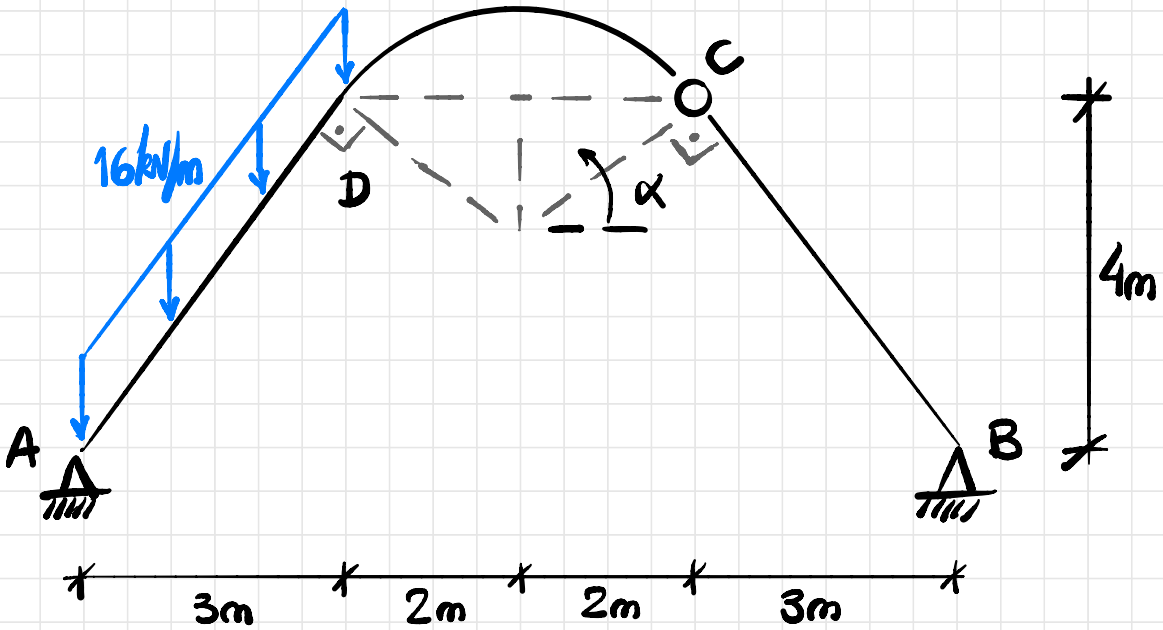
Transporte para C:



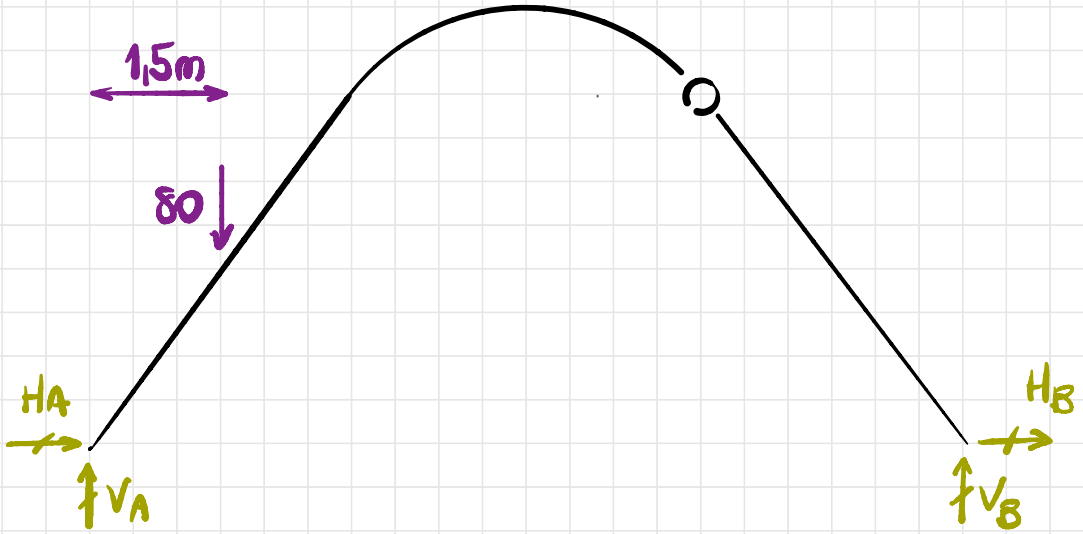
Transporte para D:



Obter as expressões no arco em função de α.



Reações de apoio:

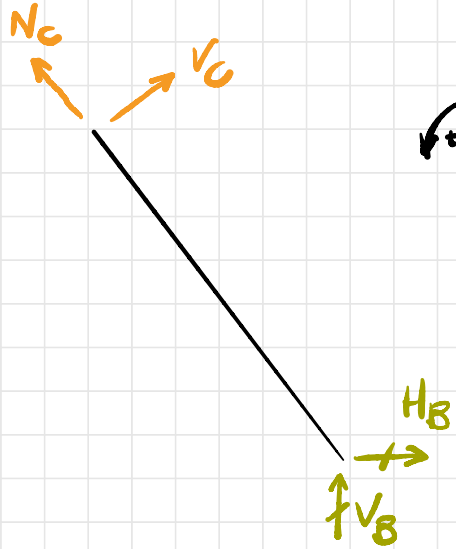


$$\sum F_H = 0: \quad H_A + H_B = 0 \rightarrow H_A = -H_B$$

$$\sum F_V = 0: \quad V_A + V_B = 80$$

$$\circlearrowleft + \sum M_A = 0: \quad -80 \cdot 1{,}5 + V_B \cdot 10 = 0 \Rightarrow \boxed{V_B = 12\,kN}$$

Fazendo um corte na articulação S:

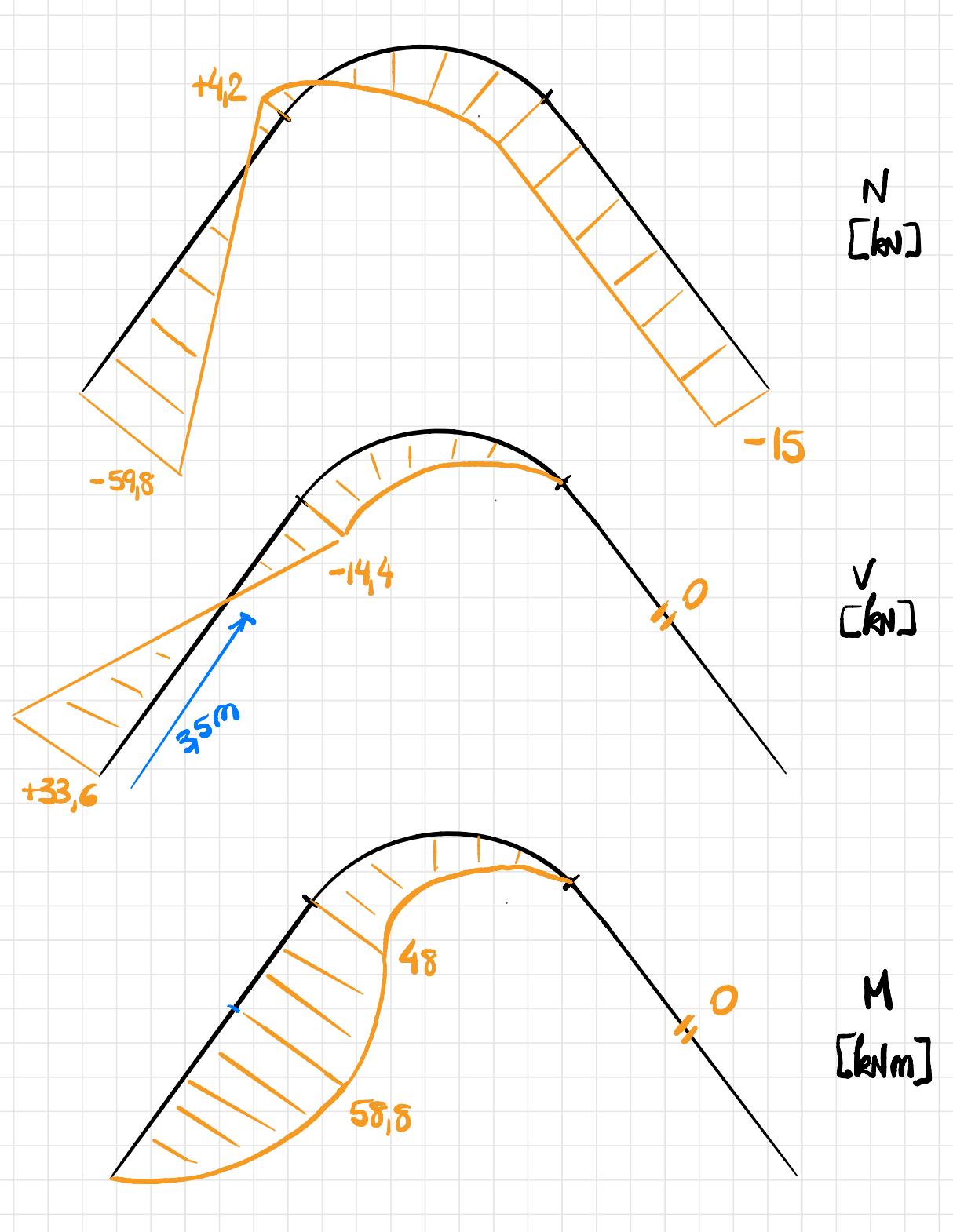


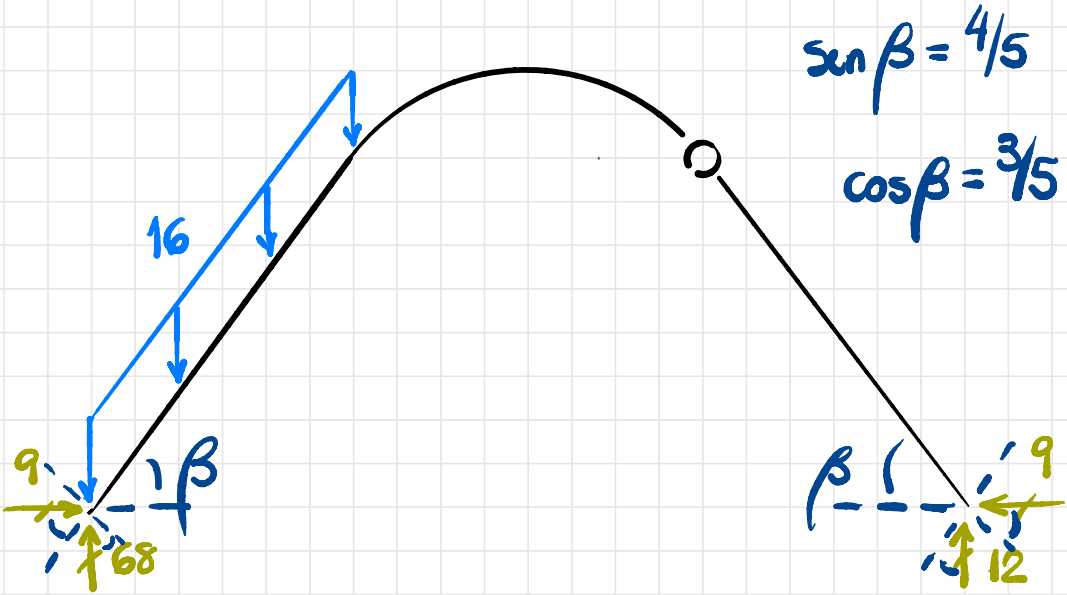
$$\circlearrowleft + \sum M_C = 0: \quad V_B \cdot 3 + H_B \cdot 4 = 0$$

$$H_B = -\frac{3}{4} V_B \rightarrow \boxed{H_B = -9\,kN}$$

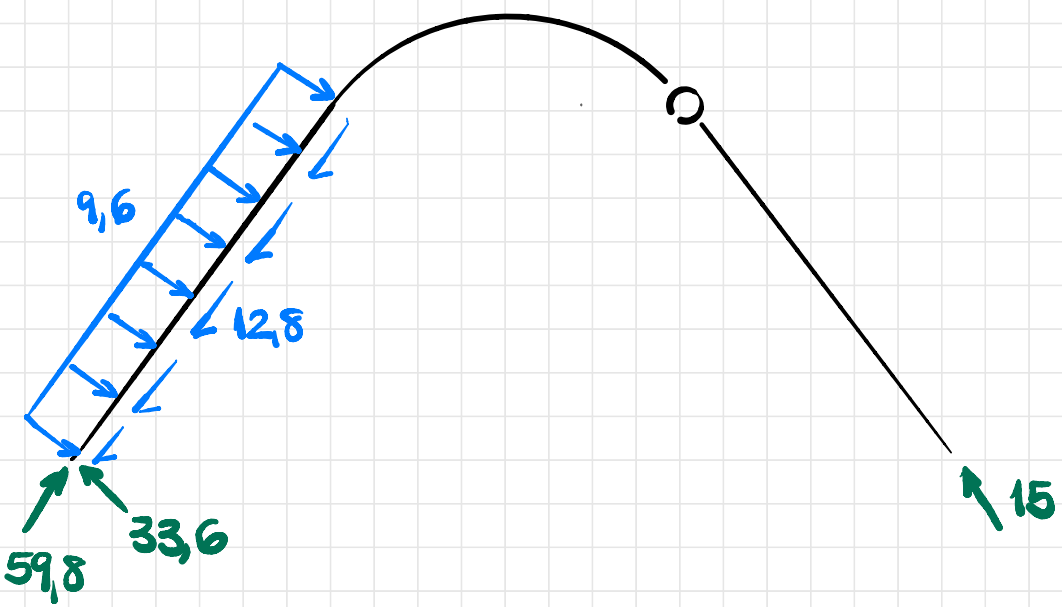
$$\boxed{V_A = 68\,kN}$$

$$\boxed{H_A = 9\,kN}$$

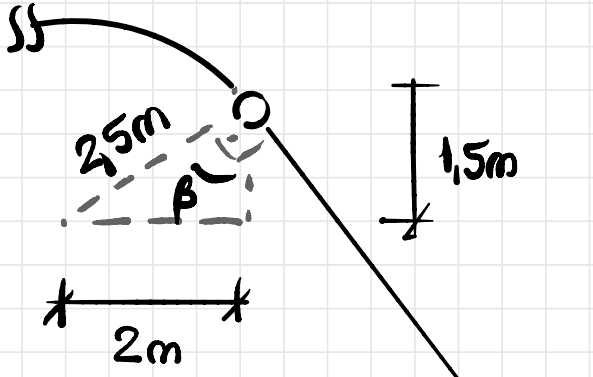

+4,2
-59,8
-15
N
[kN]
-14,4
0
3,5m
+33,6
V
[kN]
48
0
58,8
M
[kNm]

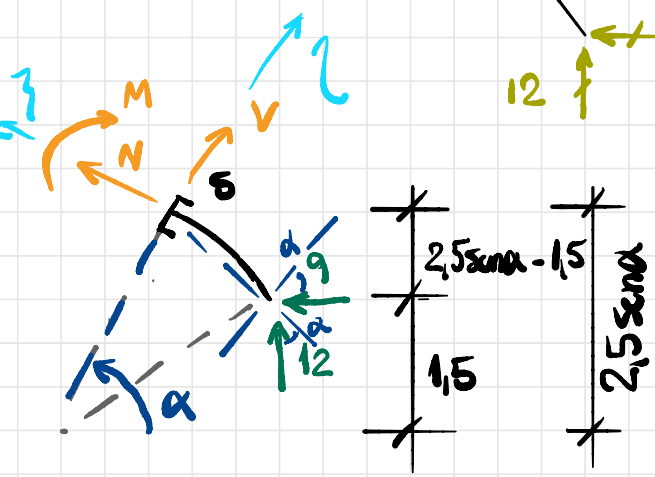


Decompondo as forças:



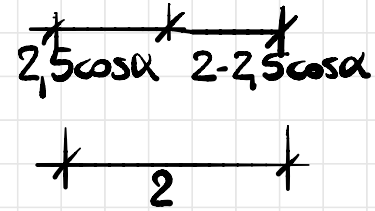
Equações do trecho curvo:





$$\sum F_\eta = 0: \; V - 9\cos\alpha + 12\operatorname{sen}\alpha = 0$$

$$\therefore \boxed{V = 9\cos\alpha - 12\operatorname{sen}\alpha}$$

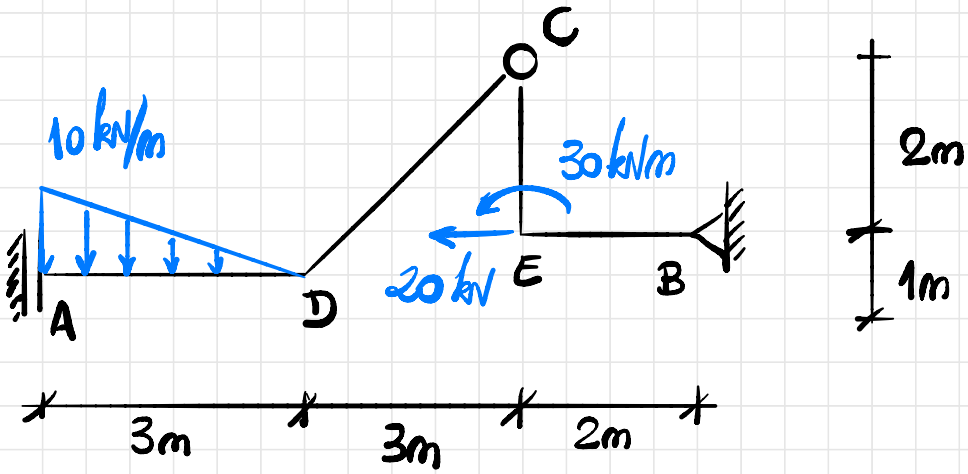


$$\sum F_\xi = 0: \; N + 9\operatorname{sen}\alpha + 12\cos\alpha = 0$$

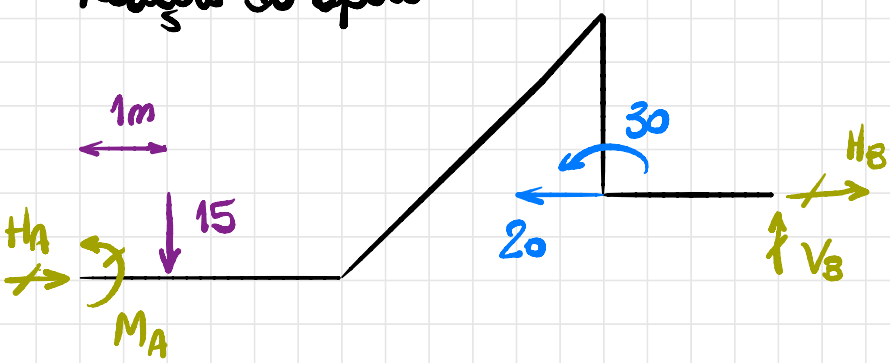
$$\therefore \boxed{N = -9\operatorname{sen}\alpha - 12\cos\alpha}$$

$$\curvearrowleft + \sum M_S = 0: \; -M + 12(2 - 2{,}5\cos\alpha) - 9(2{,}5\operatorname{sen}\alpha - 1{,}5) = 0$$

$$\therefore \boxed{M = -22{,}5\operatorname{sen}\alpha - 30\cos\alpha + 37{,}5}$$



Reações do apoio:



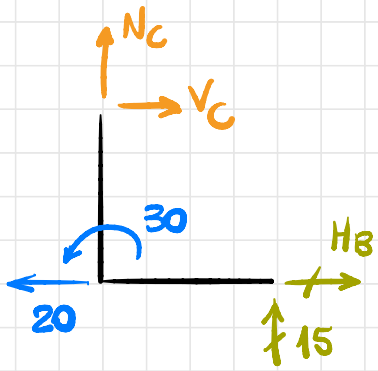
$$\sum F_H = 0: \quad H_A + H_B = 20$$

$$\sum F_V = 0: \quad \boxed{V_B = 15\,kN}$$

$$\circlearrowleft \sum M_{(A)} = 0: \quad M_A - 15.1 + 20.1 + 30 + V_B.8 - H_B.1 = 0$$

$$M_A - H_B - 15 + 20 + 30 + 120 = 0 \Rightarrow M_A - H_B = -155$$

Fazendo um corte em C:

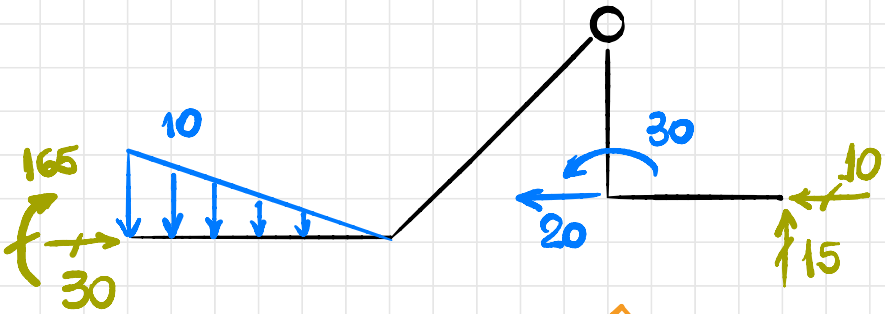


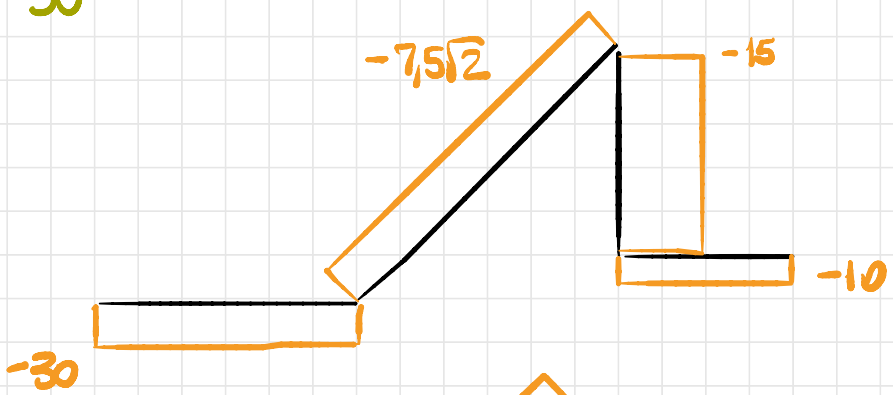
$$\curvearrowleft \sum M_C = 0: \; 30 - 20.2 + 15.2 + H_B.2 = 0$$

$$2H_B + 30 - 40 + 30 = 0 \Rightarrow \boxed{H_B = -10\,kN}$$

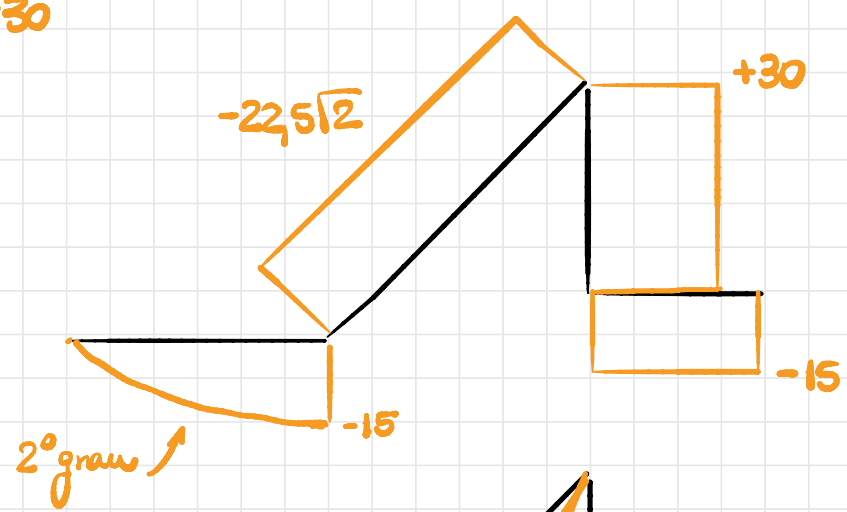
$$M_A = -155 + H_B \Rightarrow \boxed{M_A = -165\,kNm}$$

$$H_A = 20 - H_B \Rightarrow \boxed{H_A = 30\,kN}$$

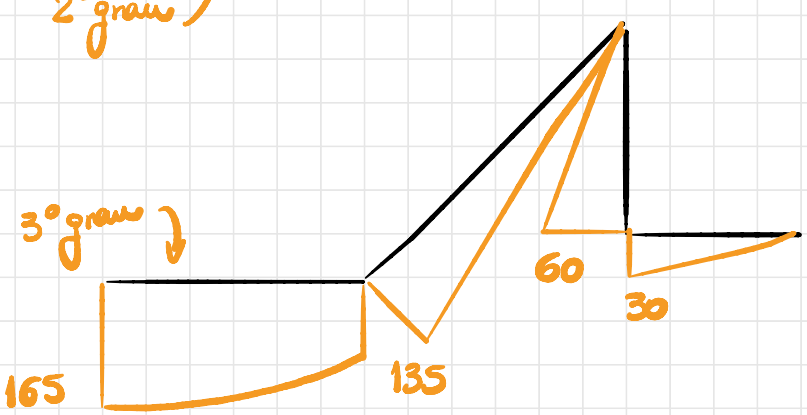

10
165
30
30
20
10
15


-7,5√2
-15
-10
-30

N[kN]


-22,5√2
+30
-15
-15
2° grau

V[kN]


3° grau
60
30
165
135

M[kNm]

Barra AD:

$$\begin{cases} V(0) = 0 \\ M(0) = 165 \end{cases}$$

$$q(x) = 10 - \frac{10}{3}x$$

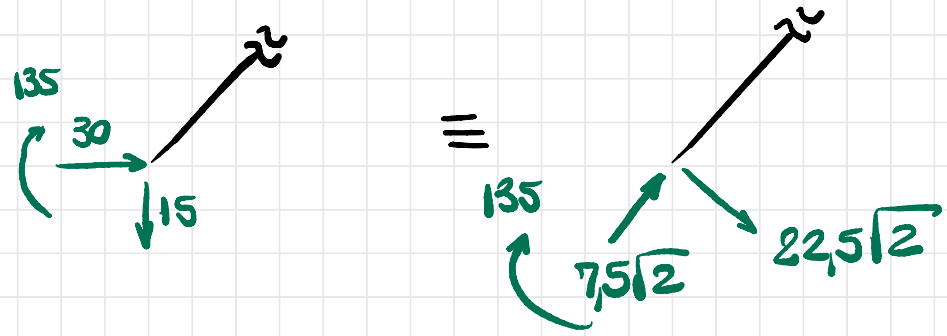
$$\frac{dV}{dx} = \frac{10}{3}x - 10 \rightarrow \boxed{V(x) = \frac{5}{3}x^2 - 10x}$$

$$\frac{dM}{dx} = \frac{5}{3}x^2 - 10x \rightarrow \boxed{M(x) = \frac{5}{9}x^3 - 5x^2 + 165}$$

$$V(x) = 0 \rightarrow x\left(\frac{5}{3}x - 10\right) = 0$$

$$\therefore \bar{x} = 0 \text{ ou } \bar{x} = 6\,m \text{ (fora do intervalo)}$$

Transporte para D:



Transporte para E: