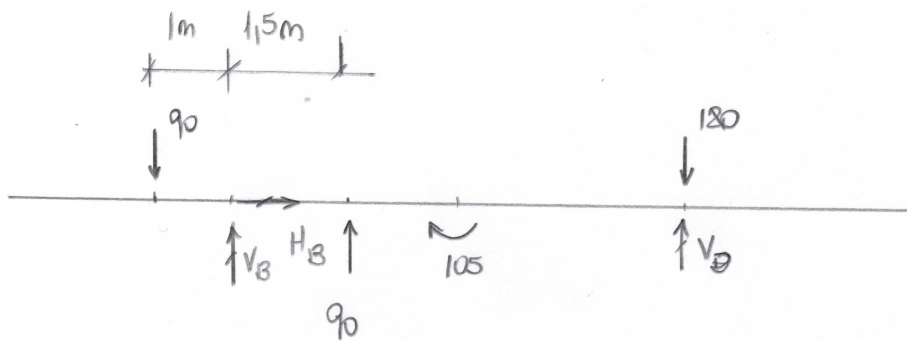


DCU



$$\sum F_H = 0: \underline{H_B = 0}$$

$$\sum F_V = 0: V_B + V_D - 90 + 90 - 180 = 0 \Rightarrow V_B + V_D = 180$$

$$\curvearrow + \sum M_B = 0: 90 \cdot 1 + 90 \cdot 1,5 - 105 - 180 \cdot 6 + V_D \cdot 6 = 0$$

$$6V_D + 90 + 135 - 105 - 1080 = 0 \Rightarrow 6V_D - 960 = 0$$

$$\underline{V_D = 160 \text{ kN}} \Rightarrow \underline{V_B = 20 \text{ kN}}$$

Diagramas.

AB ($0 < x < 3\text{m}$).

$$q(x) = 20x$$

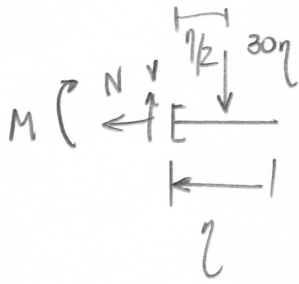
$$\frac{dV}{dx} = -20x \Rightarrow V = -10x^2 + C_1 \quad \text{como } V(0) = 0, C_1 = 0.$$

$$\therefore \underline{V(x) = -10x^2}$$

$$\frac{dM}{dx} = V(x) = -10x^2 \Rightarrow M(x) = -\frac{10}{3}x^3 + C_2 \quad \text{como } M(0) = 0, C_2 = 0$$

$$\therefore \underline{M(x) = -\frac{10}{3}x^3}$$

DE ($0 < \eta < 3\text{m}$):

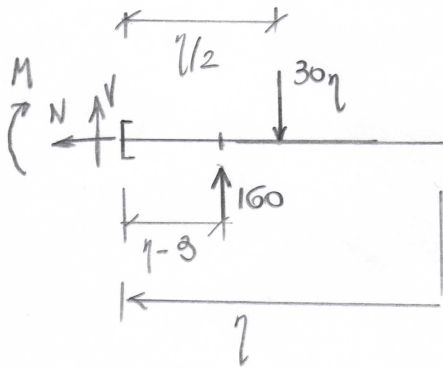


$$N = 0$$

$$V = 30\eta$$

$$M = -30\eta \cdot \frac{\eta}{2} = -15\eta^2$$

CD ($3 < \eta < 6\text{m}$):

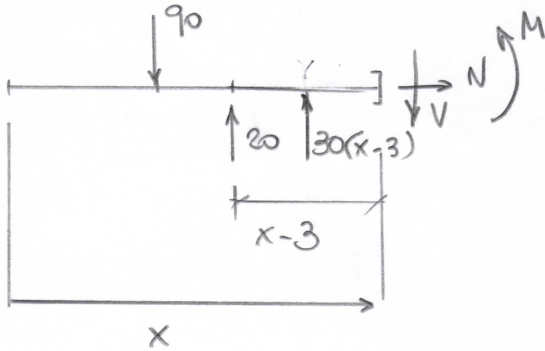


$$N = 0$$

$$V = 30\eta - 160$$

$$M = -15\eta^2 + 160(\eta - 3) = -480 + 160\eta - 15\eta^2$$

BC ($0 < x < 6\text{m}$):



$$N = 0$$

$$V = 30(x-3) + 20 - 90 = -160 + 30x$$

$$M = \frac{30(x-3)^2}{2} + 20(x-3) - 90(x-2)$$

$$M = 15(x^2 - 6x + 9) + 20x - 60 - 90x + 180$$

$$M = 15x^2 - 160x + 255$$

PEF – 3202 – Introdução à Mecânica dos Sólidos P1 (19/04/2017)

Nome: _____ nUSP: _____

Questão 1 (5,0 pontos)

Para a barra abaixo, trace os diagramas de esforços solicitantes (em kN e kN.m), fornecendo os valores em todos os pontos característicos. Mostre claramente os ressaltos, concavidades e pontos de inflexão.

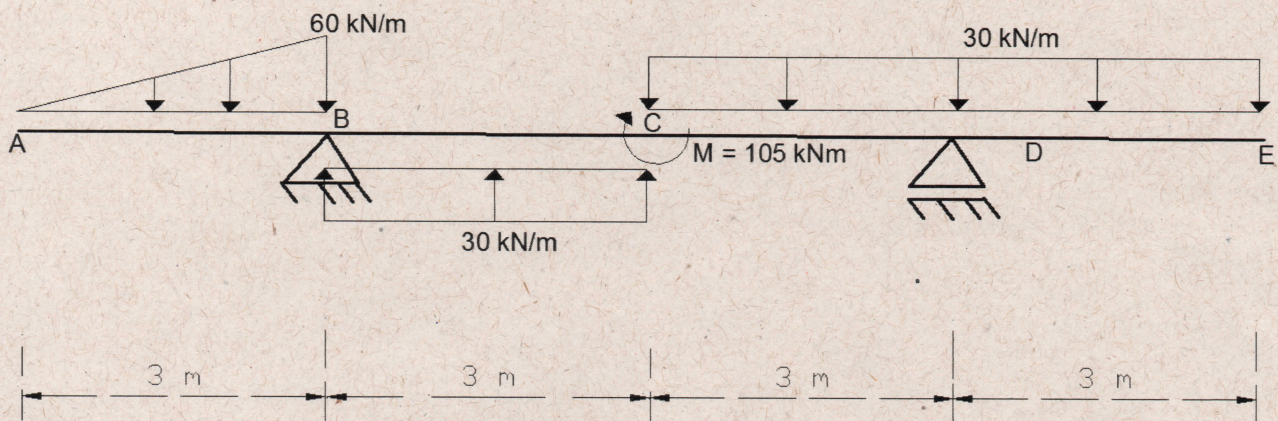
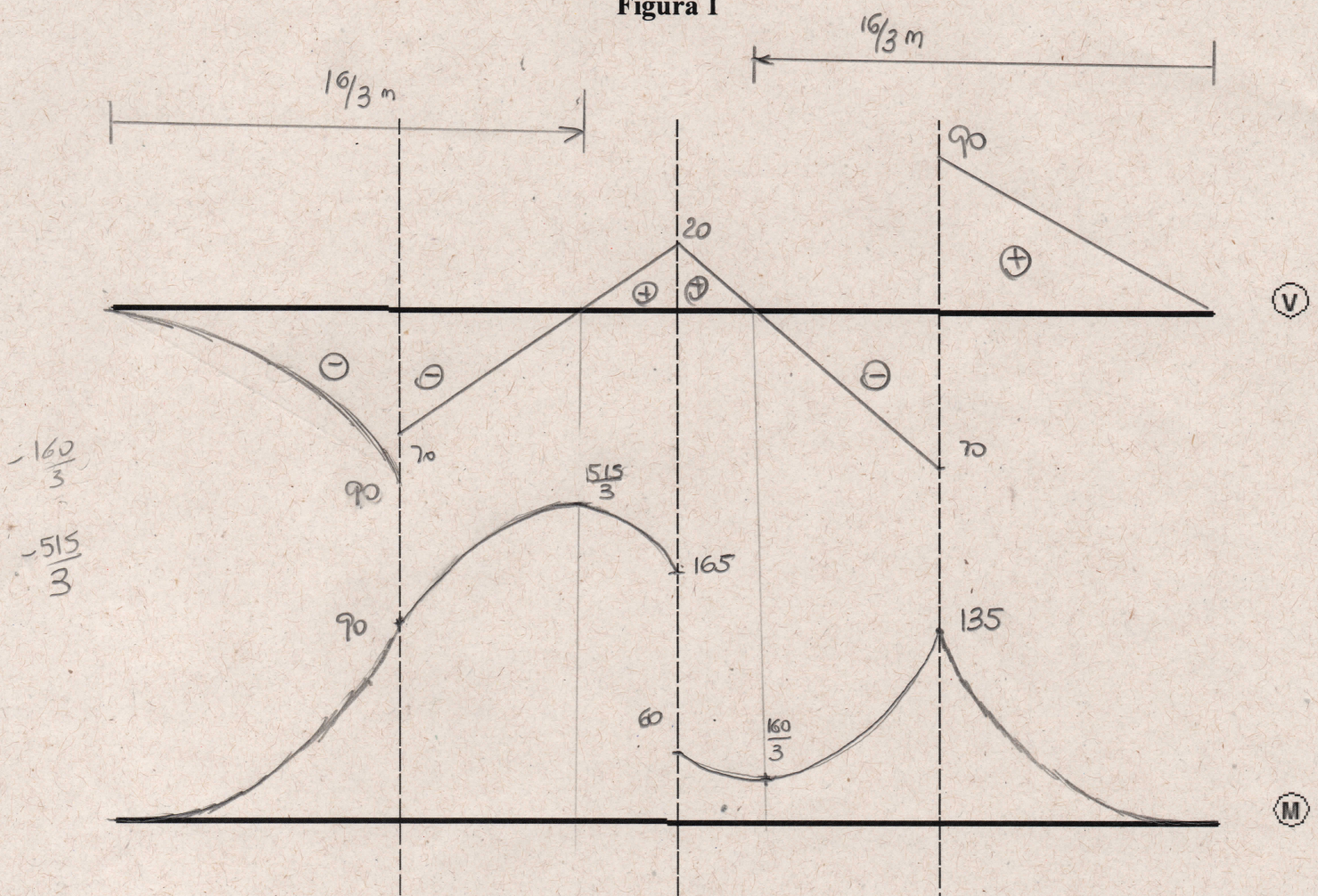
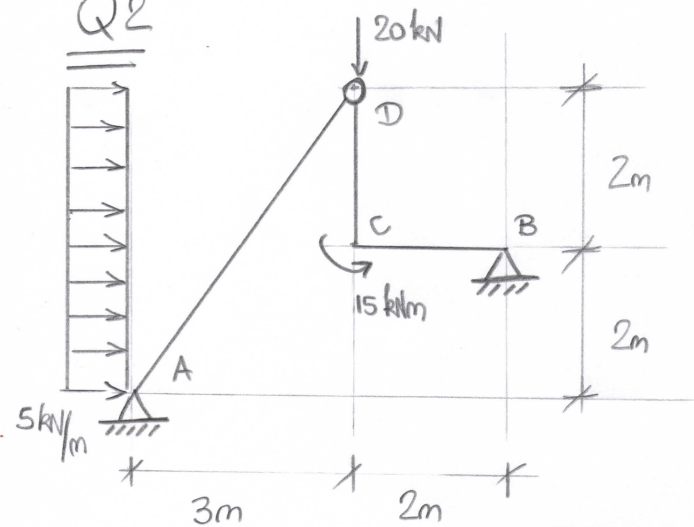
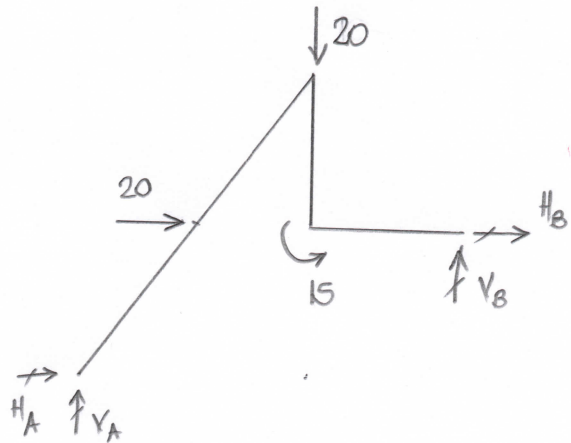


Figura 1



Q2

DCL

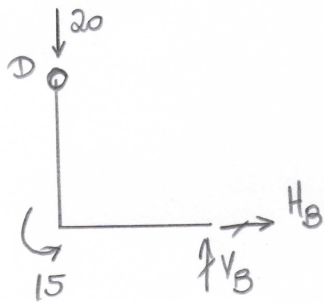
$$\sum F_H = 0: H_A + H_B + 20 = 0$$

$$\sum F_V = 0: V_A + V_B = 20$$

$$\sum M_A = 0: -20 \cdot 2 - 20 \cdot 3 + 15 + V_B \cdot 5 - H_B \cdot 2 = 0$$

$$5V_B - 2H_B = 85$$

Fazendo um corte em D:



$$\sum M_D = 0: 15 + 2V_B + 2H_B = 0$$

$$2V_B + 2H_B = -15$$

Logo:

$$\begin{cases} 5V_B - 2H_B = 85 \\ 2V_B + 2H_B = -15 \end{cases}$$

$$7V_B = 70$$

$$\therefore \underline{V_B = 10 \text{ kN}}$$

$$V_A = 20 - V_B \Rightarrow \underline{V_A = 10 \text{ kN}}$$

$$H_B = -\frac{1}{2}(85 - 5V_B) \Rightarrow \underline{H_B = -17,5 \text{ kN}}$$

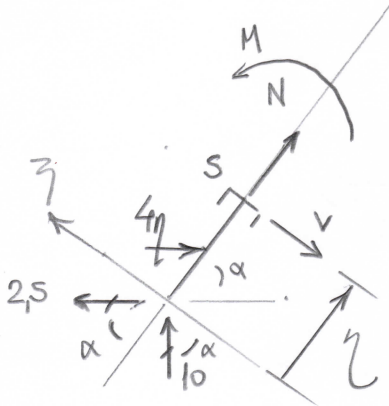
$$H_A = -20 - H_B \Rightarrow \underline{H_A = -2,5 \text{ kN}}$$

~~0,6 nas reações~~

0,6 nas reações

Diagramas:

$$F = 5 \cdot \eta \cdot \sin \alpha = 4\eta$$



$$\sin \alpha = 4/5$$

$$\cos \alpha = 3/5$$

$$\sum F_z = 0: N - 2.5 \cdot \cos \alpha + 10 \sin \alpha + 4\eta \cos \alpha = 0$$

$$N - 2.5 \cdot 3/5 + 10 \cdot 4/5 + 4\eta \cdot 3/5 = 0$$

$$\boxed{N = -6.5 - 2.4\eta}$$

$$\sum F_z = 0: -V + 2.5 \sin \alpha + 10 \cos \alpha - 4\eta \sin \alpha = 0$$

$$V = 2.5 \cdot 4/5 + 10 \cdot 3/5 - 4\eta \cdot 4/5$$

$$\boxed{V = 8 - 3.2\eta}$$

$$\sum M_S = 0: M - 2.5 \sin \alpha \cdot \eta - 10 \cos \alpha \cdot \eta + 4\eta \sin \alpha \cdot \frac{\eta}{2} = 0$$

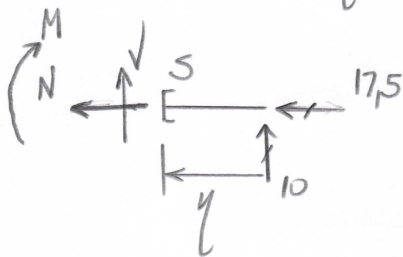
$$\boxed{M = 8\eta - 1.6\eta^2}$$

($0 < \eta < 5m$)

Barra AD

Q2 cada

Barra BC ($0 < \eta < 2m$):



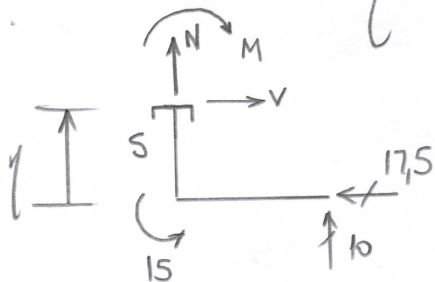
$$\sum F_H = 0: N = -17.5 \text{ kN}$$

$$\sum F_V = 0: V = -10 \text{ kN}$$

$$\sum M_B = 0: M = 10\eta$$

Q2 cada

Barra CD ($0 < \eta < 2m$):



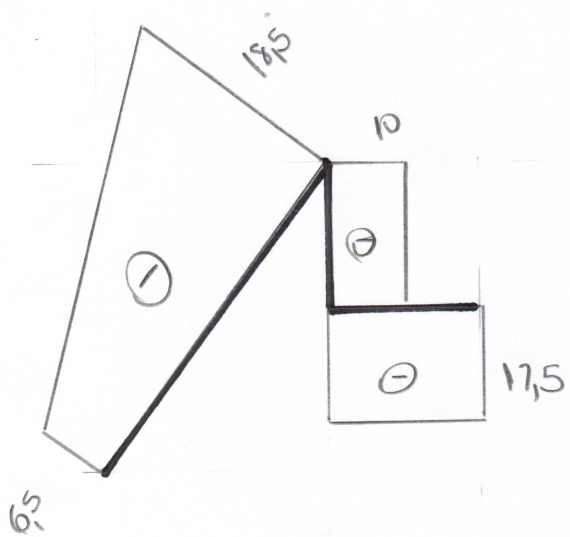
$$\sum F_H = 0: V = 17.5 \text{ kN}$$

$$\sum F_V = 0: N = -10 \text{ kN}$$

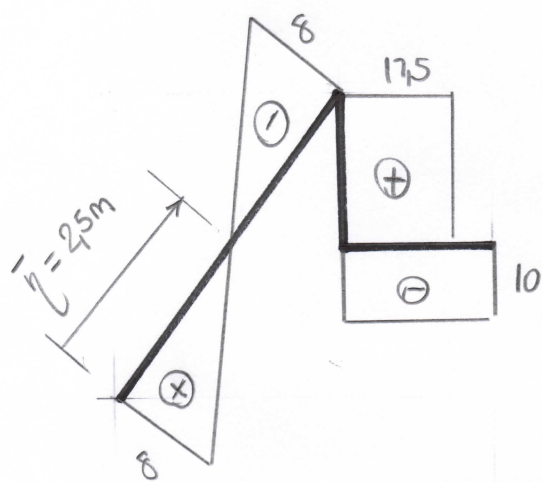
$$\sum M_S = 0: -M + 15 + 10 \cdot 2 - 17.5 \cdot \eta = 0$$

$$\boxed{M = 35 - 17.5\eta}$$

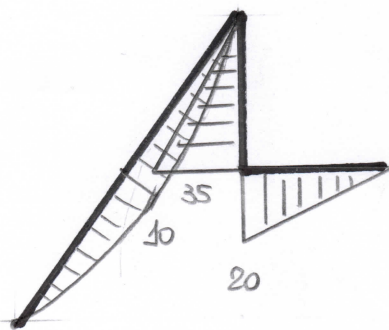
Q2 cada



$N [kN]$

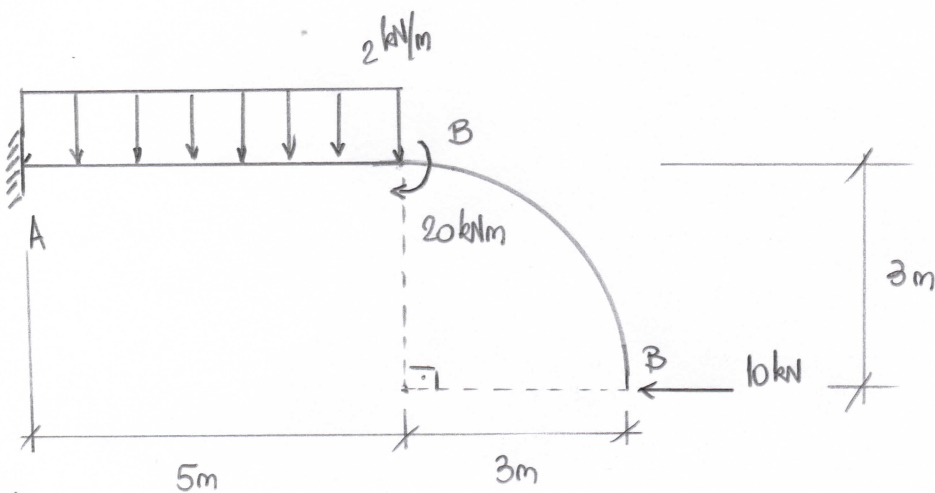


$V [kN]$

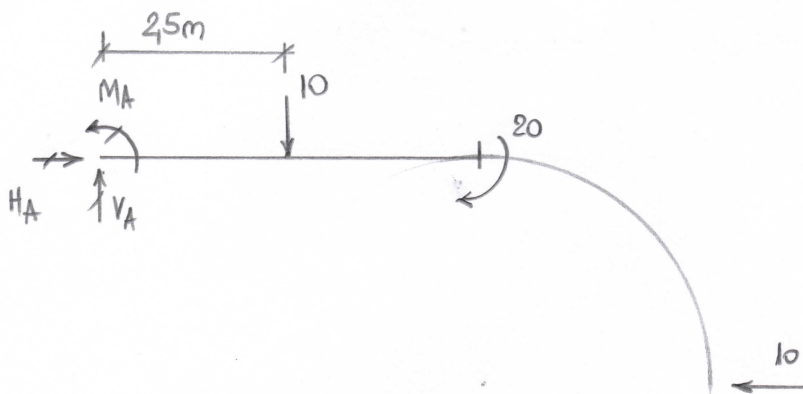


$M [kNm]$

Q3



DCL



$$\sum F_H = 0: \underline{H_A = 10 \text{ kN}}$$

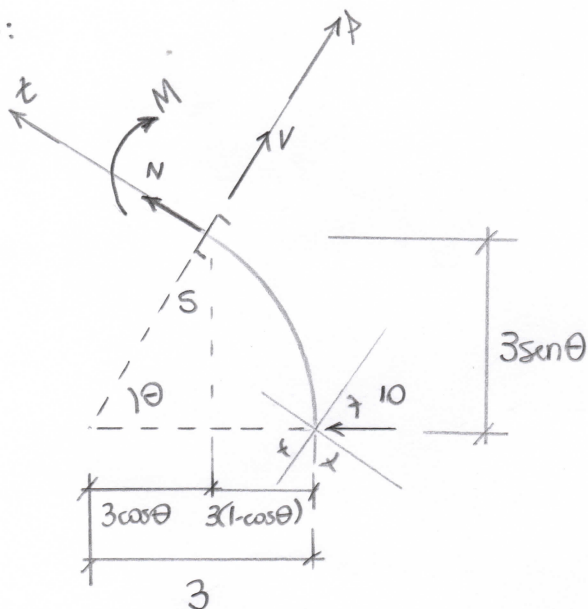
$$\sum F_V = 0: \underline{V_A = 10 \text{ kN}}$$

$$\sum M_A = 0: M_A - 10 \cdot 2.5 - 20 - 10 \cdot 3 = 0$$

$$M_A = 25 + 20 + 30 \Rightarrow \underline{M_A = 75 \text{ kN}}$$

reactions: 0,3 no total

Diagramas:



$$\sum F_z = 0: N + 10 \sin \theta = 0 \Rightarrow \underline{N = -10 \sin \theta}$$

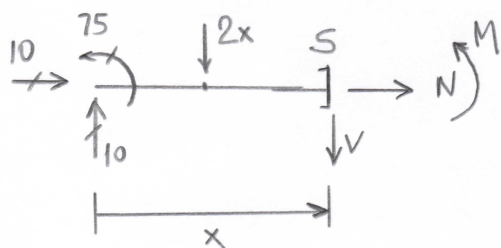
$$\sum F_A = 0: V - 10 \cos \theta = 0 \Rightarrow \underline{V = 10 \cos \theta}$$

$$(0 < \theta < \pi/2)$$

$$\sum M_S = 0: -M - 10 \cdot 3 \sin \theta = 0 \Rightarrow \underline{M = -30 \sin \theta}$$

0,3 por equação

Barra AC ($0 < x < 5m$):



$$\sum F_x = 0: N = \underline{-10 \text{ kN}}$$

0,2

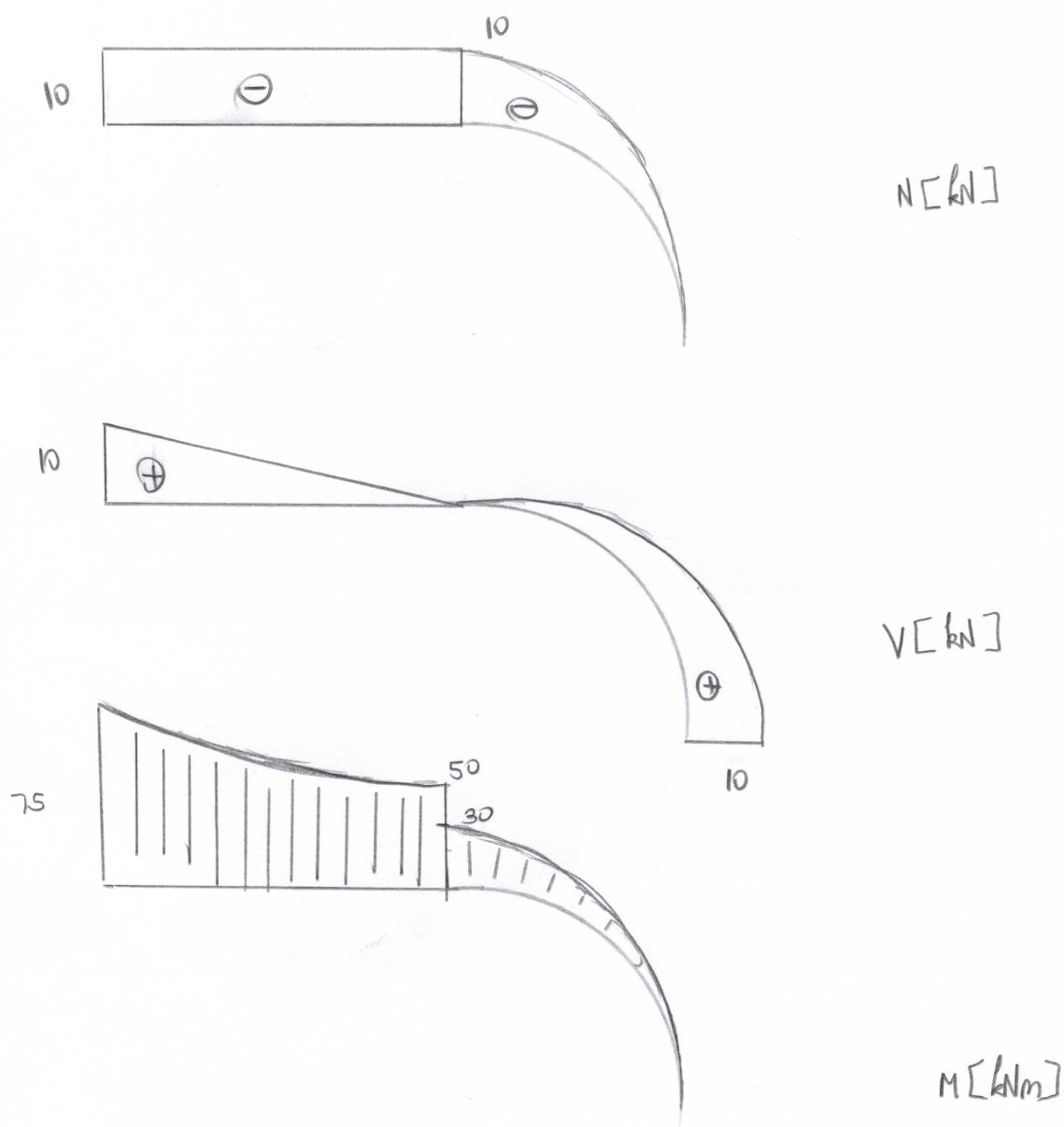
$$\sum F_y = 0: V = \underline{10 - 2x}$$

0,3

$$\sum M_S = 0: -M - 75 + 10x - 2x \cdot x/2 = 0$$

$$\underline{M = 10x - x^2 - 75}$$

0,3



*Observação: os diagramas nos arcos são ilustrativos e não fazem parte da nota, somente a equação obtida anteriormente.