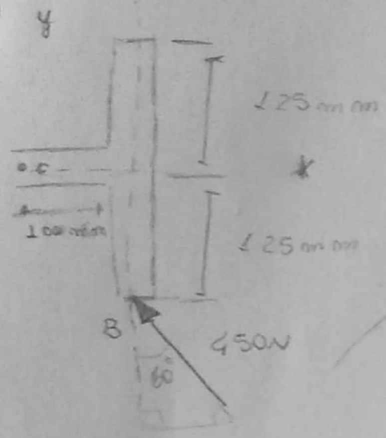
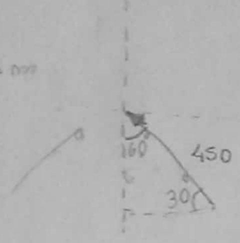
(3.8) momento em C?





$F_x = 450 \cdot \cos 30°(-\hat{i}) = -389,71\,\hat{i}$

$F_y = +450 \cdot \text{sen } 30(\hat{j}) = +225\,\hat{j}$

$d = (100\,\hat{i} - 0125\,\hat{j}) \quad (0,1\,\hat{i} - 0,125\,\hat{j})$

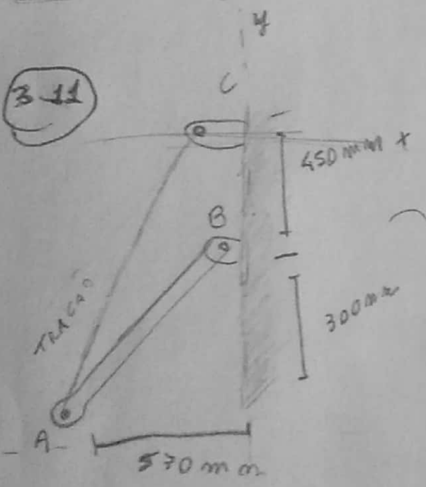
$M_C = r \times F$

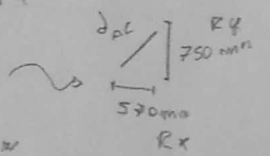
$= (0,1\,\hat{i} - 0,125\,\hat{j}) \times (-389,71\,\hat{i} + 225\,\hat{j})$

$= 22,5\,k - 48,71\,\hat{k}$

$= -26,21\,\hat{k} \longrightarrow = 26,21\ N.m$

(3.11)





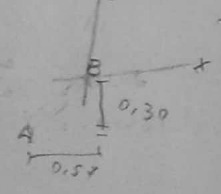
$d_{AC} = \sqrt{750^2 + 570^2} = 0,942\ m$

$\alpha = \text{arc tg}\left(\frac{Ry}{Rx}\right) = 52,76°$

$F = \text{corda} = (1350 \cdot \cos\alpha\,\hat{i} + 1350\ \text{sen}\,\alpha\,\hat{j})$

$= 817\,\hat{i} + 1075\,\hat{j}$

a) M_B em A



$-0,57\hat{i} - (-0,30)\hat{j}$
$-0,57\hat{i} + (0,30)$

$\vec{r}_{ba} = -0,57\,\hat{i} - 0,30\,\hat{j}$

$M_B = r \times F$

$= (-0,57\,\hat{i} + 0,30\,\hat{j}) \times (817\,\hat{i} + 1075\,\hat{j})$

$= +245,15\,\hat{k} - 612,75\,\hat{k}$

$= -367,65\ N.m$

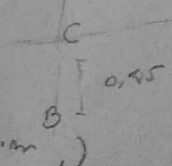
$= 367,65\ N.m$

b) M_B em B

$r_{BC} = 0,45\,\hat{j}$

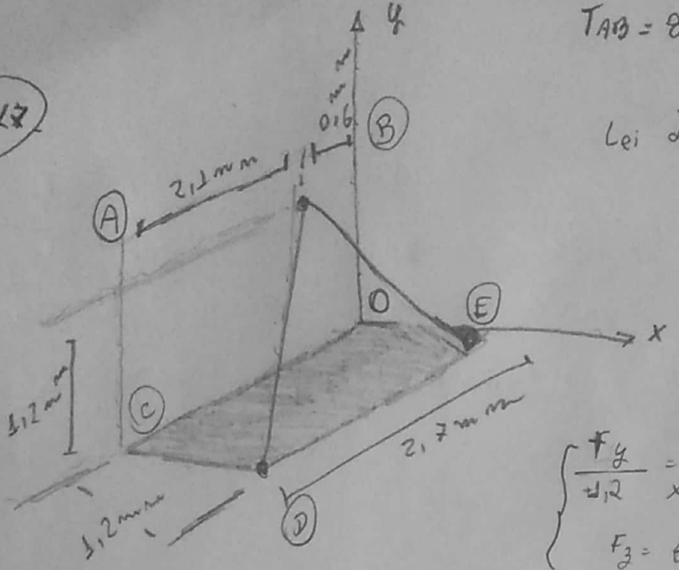
$M_B = (-0,45\,\hat{j}) \times (817\,\hat{i} + 1075\,\hat{j})$

$= -367,65\ N.m$



$= 367,65\ N.m$

3.27



$T_{AB} = 8100 N$

Lei dos senos

$$\frac{sen\,\alpha}{a} = \frac{sen\,\beta}{b} = \frac{sen\,\theta}{p} \Rightarrow \frac{F}{AB}$$

F_x, F_y, F_z

$$x_B - x_A \qquad y_B - y_A \qquad z_B - z_A$$

$$\begin{cases} \dfrac{F_y}{1,2} = \dfrac{8100}{2,7} \\ F_z = \dfrac{8100 \cdot 1,2}{2,7} = 3600 \end{cases}$$

$$\begin{cases} \dfrac{8100}{2,7} = \dfrac{F_x}{-1,2} \\ F_x = -3600 \end{cases}$$

$$\begin{cases} \dfrac{F_z}{-2,1} = \dfrac{8100}{2,7} \end{cases} \Rightarrow F_z = -6300$$

a)

Momento sobre O.

$$M_O = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1,2 & 0 & 2,7 \\ -3600 & 3600 & -6300 \end{vmatrix} \begin{matrix} \hat{i} & \hat{j} \\ 1,2 & 0 \\ -3600 & 3600 \end{matrix}$$

$$-(2,7 \cdot 3600)\hat{i} + (6300 \cdot 1,2)\hat{j} - (3600 \cdot 2,7)\hat{j} + (1,2 \cdot 3600)\hat{k}$$

$$-9720\hat{i} - 5400\hat{j} + 4320\hat{k}$$

b) Momento sobre D

$$M_D = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1,2 & 0 & 0 \\ -3600 & 3600 & -6300 \end{vmatrix} \begin{matrix} \hat{i} & \hat{j} \\ 1,2 & 0 \\ -3600 & 3600 \end{matrix}$$

$$-(1,2 \cdot -6300)\hat{j} + (1,2 \cdot 3600)\hat{k}$$

$$7560\hat{j} + 4320\hat{k}$$

$BC = 2,8m$

$\vec{BA} = -2,4\hat{i} - 1,8\hat{j}$

$\vec{BC} = 2,4\hat{i} + 0,8\hat{j} + 1,2k$

3.27

a) $\vec{B.A} \cdot \vec{B.C}$

$= (BA)(BC)\cos\alpha$:

$\cos\alpha = \dfrac{\vec{BA} \cdot \vec{BC}}{(BA)(BC)} = 0,5143$

$\to 59,05°$

$\vec{BA} = \sqrt{2,4^2 + 1,8^2} = 3$

$\vec{BC} = \sqrt{2,4^2 + 0,8^2 + 1,2^2} = 2,8$

b) $P_{AB} = (1400\ N) \cdot \cos(59.05)$

$= 1400 \cdot (0,5143)$

$= 720$

3.29

$AB : 0,7\hat{i} + 1,125 \cdot 10^{-3}\hat{j}$

$\vec{AD} : -0,65\hat{i} + 1,125 \cdot 10^{-3}\hat{j} + 0,45\hat{k}$

$AB = \sqrt{0,7^2 + (1,125 \cdot 10^{-3})^2} \cong$

$CB = \sqrt{0,65^2 + (1,125 \cdot 10^{-3})^2 + 0,45^2}$

sendo $\vec{AB} \cdot \vec{AD}$

$= (AB)(AD) \cdot \cos\alpha$

$= \dfrac{(0,7\hat{i} + 1,125 \cdot 10^{-3}\hat{j}) \cdot (-0,65\hat{i} + 1,125 \cdot 10^{-3}\hat{j} + 0,45\hat{k})}{(AB)(AD)} = 11,30$

e $\alpha = 63.6°$

3.31

a) $\vec{CA} = 275\hat{i} - 300\hat{j} + 600k$ $\Big\}$ $CA = 725$

$\vec{CB} = 775\hat{i} - 300\hat{j} + 600k$ $CB = 1025$

$$\cos\theta \quad \frac{\vec{CA}\cdot\vec{CB}}{(CA)(CB)} = \frac{(275\hat{i} - 300\hat{j} + 600k)\cdot(775\hat{i} - 300\hat{j} + 600k)}{(725)\cdot(1025)}$$

$\cos\theta = 0,89235 \longrightarrow \boxed{\theta = 26,8^\circ}$

b) Lei dos cossenos $\rightarrow R^2 = P^2 + Q^2 \cdot 2 \cdot P \cdot Q \cdot \cos\beta$

$(AB)^2 = (CA)^2 + (CB)^2 \cdot 2 \cdot CA \cdot CB \cdot \cos\theta$

$(500)^2 = (725^2) + (1025^2) \cdot 2 \cdot 725 \cdot 1025 \cdot \cos\theta$

$$\cos\theta = \frac{(725^2 + (1025^2) - (500^2))}{2(725)\cdot(1025)} = 0,89235$$

$\boxed{\theta = 26,8}$

3.43

$\vec{BE} = -0,2\hat{j} + 0,15\hat{k}$

$BE = \sqrt{0,2^2 + 0,15^2}$

$= 0,25$

?

$P = \dfrac{\vec{BE}}{BE}$.

$= \dfrac{122.(0,2\hat{j} + 0,15\hat{k})}{0,25} = 97,6\hat{j} + 73,2\hat{k}$

a) momento CF

$\vec{CB} = -0,3\hat{i}$

$\vec{CF} = 0,2\hat{j} + 0,225\hat{k}$

$CF = \sqrt{0,2^2 + 0,225^2} = 0,3$

$\lambda = \dfrac{\vec{CF}}{CF} \rightarrow \dfrac{(0,2\hat{j} - 0,225\hat{k})}{0,3} = \dfrac{(0,225)(-0,3)(97,6) - (73,2).(-0,2)}{0,3} =$

$$= \begin{array}{ccc|cc} \hat{i} & \hat{j} & \hat{k} & \hat{i} & \hat{j} \\ 0 & -0,2 & 0,225 & 0 & -0,2 \\ -0,3 & 0 & 0 & 0,-3 & 0 \\ 0 & 97,6 & 73,2 & 0 & 97,6 \end{array}$$

0 0 0 0 0 0

(0,225)(-0,3)(97,6) $\hat{k}$

(73,2) . -0,2 $\hat{i}$

$\boxed{= -21,228 \text{ Nm}}$

B)

$\vec{CB} = -0,3\hat{i}$

$\vec{OC} = 0,3\hat{i} + 0,2 + 0,225$

$OC = \sqrt{0,3^2 + 0,2^2 + 0,225^2}$

$= 0,425$

$Mo = \dfrac{\lambda}{OC} . (A_r . P) = \dfrac{1}{0,425}$

$$\begin{array}{ccc|cc} 0,2 & 0,2 & 0,225 & 0,2 & 0,2 \\ -0,2 & 0 & 0 & -0,2 & 0 \\ 0 & 97,6 & 73,2 & 0 & 97,6 \end{array}$$

$= \dfrac{(0,2.0,2.73,6) - (0,225.0,2.97,6)}{0,425}$

0 0 0 0 0

$-(-(0,2).(0,2).73,6) + (0,225)(-0,2)(97,6)$

$= -3,407 \text{ Nm}$

Digitalizado com CamScanner

3.45

$$M_{AB} = \lambda_{AB} \cdot (\Delta_r \times F)$$

$$\frac{\vec{AB}}{AB} = \frac{(300)\vec{i} - 100\vec{j} + 150\vec{k}}{350\,mm}$$

$$= \frac{1}{7}\left(6\vec{i} - 2\vec{j} + 3\vec{k}\right)$$

$$\Delta_r = \vec{AD} = (0{,}15)\vec{j}$$

$$CD = \sqrt{300^2 + 125^2} = 325$$

$$*F \cdot \frac{\vec{CD}}{CD} = 650 \cdot \left(\frac{-300\vec{i} + 125\vec{j}}{325}\right) = 600\vec{i} + 250\vec{j}$$

$$M_{AB} = \lambda_{AB} \cdot \Delta_r \cdot F$$

$$M_{AB} = \frac{1}{7} \cdot \left(\begin{array}{ccc|cc} 6 & -2 & 3 & 6 & -2 \\ 0 & 0{,}15 & 0 & 0 & 0{,}5 \\ 600 & 250 & 0 & 600 & 250 \end{array}\right) = \frac{-3 \cdot 0{,}15 \cdot 600}{7} = 38{,}57$$

? 0 0 0 0 0 0

3.56

$$M = \sqrt{M_y^2 + M_z^2}$$
$$= \sqrt{16{,}2^2 + 6{,}8^2}$$
$$= 17{,}57 \ N.m$$

$$tg\,\theta = \frac{M_1}{M_2} = \frac{16{,}2}{6{,}8} = 2{,}4^\circ$$

$$arc\ tg\,\theta\,(2{,}4) = 67{,}23^\circ$$

$$\theta_z = 90 - \theta$$
$$= 90 - 67{,}23^\circ$$
$$= 22{,}77^\circ$$

$$\left.\begin{array}{l} M = 17{,}57\ N.m \\ \theta = 67{,}23^\circ \\ \theta_y = 90^\circ \\ \theta_z = 22{,}77^\circ \end{array}\right\}$$

Digitalizado com CamScanner

3.67

$$M_{AG} = \left[-(30)\hat{i} + 60\hat{k}\right] \text{mm}$$

$M_G = r \times P$

$= \left[-30\,\hat{i} + 60k\right] \text{mm} \times \left[-250\,N\,\hat{j}\right]$

$= \left[7500k + 1500\,\hat{i}\right] N \cdot m$

$\Rightarrow 1500\,\hat{i}\ N\cdot mm + 7500\,\hat{k}\ N\cdot mm$

$M_G = r \times P$

$= [-30\,\hat{i} + 60\,k]\,mm \times [-250\,N\,\hat{j}]$

$= [7500\,k + 1500\,\hat{i}]\ N \cdot m$

3.69

$\vec{BC} = -(3.6)\,\hat{i} + 1{,}4\,\hat{j} - 2{,}4\,k$ e $BC = \sqrt{3{,}6^2 + 1{,}4^2 + 2{,}4^2}$

$= 4{,}55\ m$

$F = 2565 \cdot \frac{\vec{BC}}{BC}$

$= 2565 \frac{(-3{,}6\,\hat{i} + 1{,}4\,\hat{j} - 2{,}4\,k)}{4{,}55}$

$F = -2029{,}45\,\hat{i} + 789{,}23\,\hat{j} - 1352{,}97\,\hat{k}$

$M_A = r \times F$

$= 3{,}6\,\hat{i} \cdot [-2029{,}45\,\hat{i} + 789{,}23\,\hat{j} - 1352{,}97\,\hat{k}]$

$= 7306{,}02\,\hat{k} + 4870{,}69\,\hat{j}$

$$\left.\begin{array}{l} F = -(2029{,}45\,\hat{i}) + (789{,}23\,\hat{j}) - 1352{,}97\,k \\ M = 4870{,}69\,\hat{j} + 7306{,}02\,\hat{k} \end{array}\right\} \text{são equivalentes}$$

3.77

a) $1\,m = a$

$M = 8.(1) - 2 = 6$ //

$d = \dfrac{6}{10} = 0,6\,m$

b) $a = 1,5\,m$

$M = 8.(1,5) - 2 = 10$

$d = \dfrac{10}{10} = 1m$

c) $a = 2,5$

$M = 8.(2,5) - 2 = 18$

$d = \dfrac{18}{10} = 1,8\,m$

$\curvearrowleft d = \dfrac{M}{R}$

$R = -4kN - 8kN + 2kN$
$= -10kN$

$M = \underbrace{(2kN)(3)}_{2kN} - 4kN(1) - 8(a)$

$= 2kN - 8kN(a)$

$= (-8a + 2)$ } TROCA o sentido

$= (8a - 2)$

45°
3.79

a) ←

$R_x = 787{,}5$

↓ $R_y = 8425$

$M = (787{,}5)(7{,}2) - (1125 \cdot 2{,}1)$

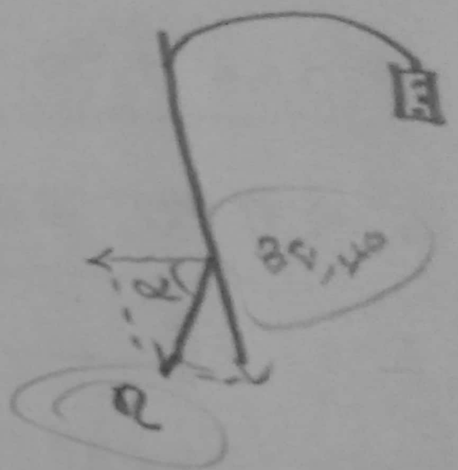
$M = 5670 - 23625$

$M = 3307{,}5$ } EQUIVALENTE

$B = \dfrac{3307{,}5}{787{,}5} = 4{,}2$

↑

ponto de interseção é
4,2 acima de A



?

3.85

$\vec{AC} = 1{,}2\hat{i} - 0{,}9\hat{j}$ $\qquad AC = \sqrt{1{,}2^2 + 0{,}9^2} = 1{,}5$

$\vec{BD} = 0{,}9\hat{i} - 1{,}8\hat{j} - 0{,}6m$ $\qquad BD = \sqrt{0{,}9^2 + 1{,}8^2 + 0{,}6^2} = 2{,}1$

$F_{AC} = 3150 \dfrac{\vec{AC}}{AC}$

$= \dfrac{3150}{1{,}5} \cdot (1{,}2\hat{i} - 0{,}9\hat{j}) =$

$= 2520\hat{i} - 1890\hat{j}$

$=$

$F_{BD} = 3150 \dfrac{\vec{BD}}{BD}$

$= \dfrac{3150}{2{,}1} \cdot (0{,}9\hat{i} - 1{,}8\hat{j} - 0{,}6\hat{k})$

$1350\hat{i} - 2700\hat{j} - 900\hat{k}$

$R = 3870\hat{i} - 4590\hat{j} - 900\hat{k}$

$M = \sum r \times F$

$= r_A \times F_A + r_B \times F_B$

$= 0{,}9(2520\hat{i} - 1890\hat{j}) + 1{,}8 \times (1350\hat{i} - 2700\hat{j} - 900\hat{k})$

$= 2268\hat{i} - 1701\hat{j} + 2430\hat{i}$

$= 4698\hat{i} - 6561\hat{j} - 1620\hat{k} = M_0$