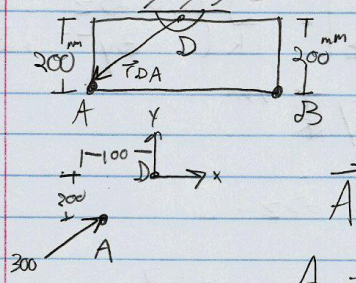
Recitation 3

3.3 a) $\vec{M}_{DA} = ?$

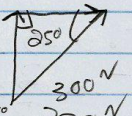


$\vec{r}_{DA}$: $r_{DA_x} = A_x - D_x = -100 - 0$ mm

$r_{DA_y} = A_y - D_y = -200 - 0$ mm

$\vec{r}_{DA} = \langle -.1, -.2, 0 \rangle$ m

$\vec{A}$:



$A_x = \cos 25° \cdot 300\,N = 272\,N$

$A_y = \sin 25° \cdot 300\,N = 127\,N$

$$\vec{M}_{DA} = \vec{r}_{DA} \times \vec{A} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -.1 & -.2 & 0 \\ 272 & 127 & 0 \end{vmatrix}$$

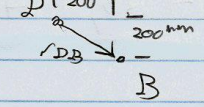
$\vec{i}$: $\vec{i} \cdot \begin{vmatrix} -.2 & 0 \\ 127 & 0 \end{vmatrix} = 0 - 0$

$\vec{j}$: $-\vec{j} \cdot \begin{vmatrix} -.1 & 0 \\ 272 & 0 \end{vmatrix} = 0 - 0$

$\vec{k}$: $\vec{k} \cdot \begin{vmatrix} -.1 & -.2 \\ 272 & 127 \end{vmatrix} = \vec{k}(-12.7 - -54.4) = \boxed{41.7\,\vec{k}\ N\text{mm}}$

$$\boxed{\vec{M}_{DA} = \langle 0, 0, 41.7 \rangle\ N\text{mm}}$$

b) $\vec{M}_{DB} = \vec{M}_{DA}$



$\vec{r}_{DB} = \langle .2, -.2, 0 \rangle$ m

$\vec{B} = \langle B_x, B_y, B_z \rangle$

3.3 6)

$$\vec{M}_{DB} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ .2 & -.2 & 0 \\ B_x & B_y & B_z \end{vmatrix} = \vec{i}(-.2B_z - 0B_y) - \vec{j}(.2B_z - 0B_x) + \vec{k}(.2B_y - -.2B_x)$$

$\vec{M}_{DA} = \vec{M}_{DB} = 41.7\,\vec{k}$ N·m

x: $0 = -.2B_z$ $\quad B_z = 0$

y: $0 = -.2B_z$

z: $41.7 = .2B_y + .2B_x \Rightarrow \frac{41.7}{.2} = B_y + B_x$

$B_x = 208.5 - B_y$

$|B| = \sqrt{B_x^2 + B_y^2 + B_z^2}$ ($B_z = 0$)

$|B|$ is minimum @ critical pt ($|B|' = 0$)

$|B|^2 = B_x^2 + B_y^2$

↳ $(208.5 - B_y)^2 = 43472.25 - 417B_y + B_y^2$

$(|B|^2 = 2B_y^2 - 417B_y + 43472.25)\frac{d}{dB_y}$

$|B'|^2 = B'$ if $B' = 0$

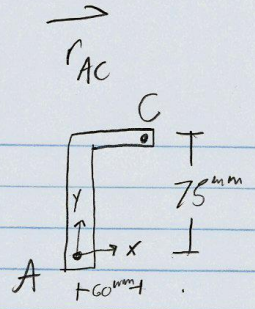
$B' = 4B_y - 417$

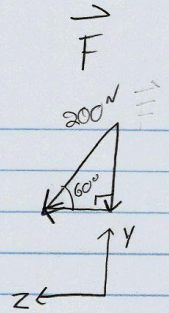
$B' = 0$ @ $B_y = 104.25$ N

$B_x = 208.5 - B_y \Rightarrow B_x(104.25) = 104.25$ N

Smallest force $\vec{B} = \langle 104.25, 104.25, 0 \rangle$ N

3.21





$\vec{r}_{AC} = \langle 60, 75, 0 \rangle^{mm}$

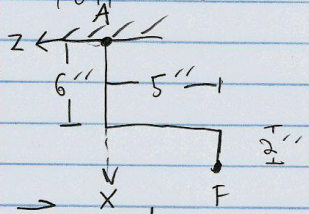
$F_z = \cos 60 \cdot |F|$
$= 100^N$
$F_y = -(\sin 60 \cdot 200)$
$= -173^N$
$\vec{F} = \langle 0, -173, 100 \rangle^N$

$\vec{M}_{AC} = \vec{r}_{AC} \times \vec{F}$

$$\vec{M}_{AC} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 60 & 75 & 0 \\ 0 & -173 & 100 \end{vmatrix}^{mm}_{N} = \vec{i}(75 \cdot 100 - -173 \cdot 0) - \vec{j}(60 \cdot 100 - 0 \cdot 0) + \vec{k}(60 \cdot -173 - 75 \cdot 0)$$

$$\vec{M}_{AC} = 7500\,\vec{i} + -6000\,\vec{j} + -10380\,\vec{k}\ ^{N\,mm}$$

3-80, 81, 82: $\vec{F} = \langle F_x, F_y, F_z \rangle^{lbf}$



$\vec{r}_{AF} = \langle 8, 0, -5 \rangle''$

$$\vec{M}_{AF} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 8 & 0 & -5 \\ F_x & F_y & F_z \end{vmatrix}^{''}_{lbf} = \vec{i}(0 \cdot F_z - -5 \cdot F_y) - \vec{j}(8 F_z - -5 F_x) + \vec{k}(8 F_y - 0 F_x)$$

$$\vec{M}_{AD} = 5F_y\,\vec{i} + (-8F_z - 5F_x)\,\vec{j} + 8F_y\,\vec{k}\ ^{lbf\cdot in}$$

$\vec{M}_{AD}(\vec{F} = \langle 0, 200, 0 \rangle) = 1000\,\vec{i} + 1600\,\vec{k}\ ^{lbf\cdot in}$

$\vec{M}_{AD}(\vec{F} = \langle 0, 175, 100 \rangle) = 875\,\vec{i} + -800\,\vec{j} + 1400\,\vec{k}\ ^{lbf\cdot in}$

$\vec{M}_{AD}(\vec{F} = \langle 75, -200, 100 \rangle) = -1000\,\vec{i} - 1175\,\vec{j} - 1600\,\vec{k}\ ^{lbf\cdot in}$