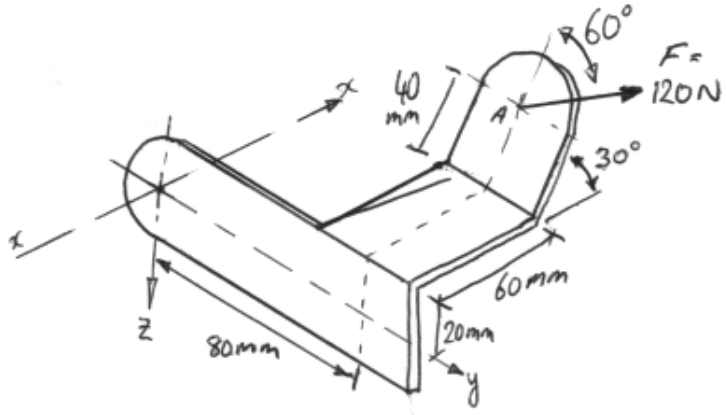
Summer 2003 Q.1

find moment of force about x axis

find y & z coords of A



$A_z = -20\,mm - 40\,mm\,(\sin 30°)$
$= -40\,mm$

$A_y = 80\,mm$

$A_x = 60\,mm + 40\cos(30°) = 94.6\,mm$

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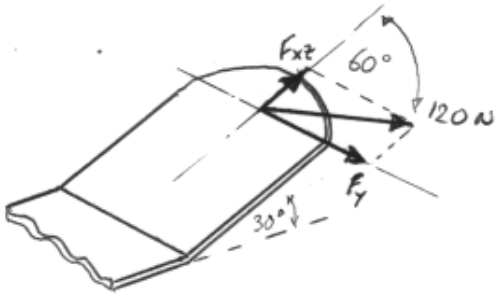
next, need to find $\hat{i}, \hat{j}, \hat{k}$ components of force $\vec{F}$

this part is more confusing, so it is helpful to do it in two steps.

FIRST look in plane of the surface containing A

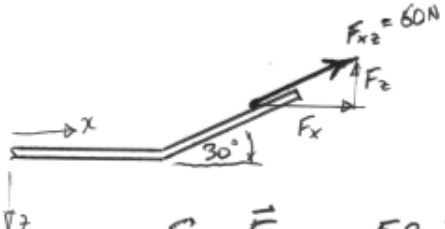
break F into F_y & F_{xz}



$F_y = (120)(\sin(60°)) = \underline{103.92\ N}$ ($\hat{j}$ component)

$F_{xz} = (120)(\cos(60°)) = 60\ N$

Second break F_{xz} into x & z ($\hat{i}$ & $\hat{k}$) components



$F_z = -F_{xz}\sin(30°)$
$= -60\sin(30°) = \underline{-30N}$

$F_x = F_{xz}\cos(30°)$
$= 60\cos(30°) = \underline{52N}$

So $\underline{\vec{F} = 52\hat{i} + 103.9\hat{j} - 30\hat{k}\ \ N}$

If you calculate $\|F\| = \text{SQRT}(52^2 + 103.9^2 + 30^2)$ you get 120N as expected.

finally ... to find moment about x axis ...

~~Either~~ calc $\vec{r} \times \vec{F}$ & look only at $\hat{i}$ component of result ...

$$\vec{r}\times\vec{F} = \begin{Vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 94.6 & 80.0 & -40.0 \\ 52 & 103.9 & -30 \end{Vmatrix} = \hat{i}\left((80)(-30) - (-40)(103.9)\right) + \ldots$$ Don't need rest!..

moment about x axis is $-2400 + 4156 = 1756\ Nmm = \underline{1.756\ Nm}$