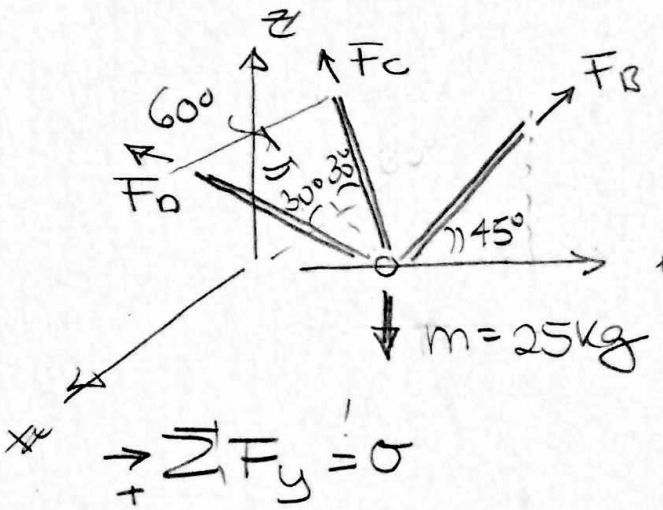
ENGR 14 - STATICS VII TUE, 01/26/16

PRECISE WEEK

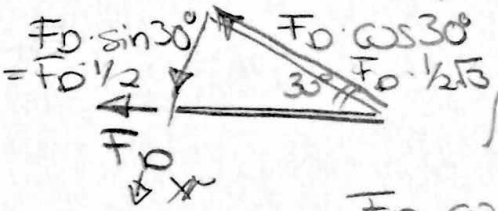
PROBLEM 3-56 ... 3D FORCE EQUILIBRIUM

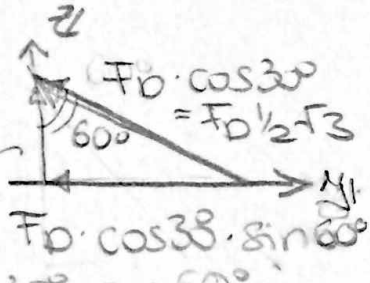


$\overset{+}{\leftarrow} \sum F_x = 0$

$+F_D \cdot \sin 30° - F_C \cdot \sin 30° = 0$

$\rightsquigarrow \boxed{F_D = F_C}$





$\overset{+}{\rightarrow} \sum F_y = 0$

$-2F_D \cdot \cos 30° \cdot \sin 60° + F_B \cdot \cos 45° = 0$

$\rightsquigarrow -2F_D \cdot 1/2\sqrt{3} \cdot 1/2\sqrt{3} + F_B \cdot 1/2\sqrt{2} = 0$

$\boxed{F_D = \frac{\sqrt{2}}{3} F_B}$

$\cos 60° = \sin 30° = 1/2$	$\sqrt{1}$	
$\cos 45° = \sin 45° = 1/2$	$\sqrt{2}$	
$\cos 30° = \sin 60° = 1/2$	$\sqrt{3}$	

$+\uparrow \sum F_z = 0$

$-W + F_B \cdot \sin 45° + 2F_D \cdot \cos 30° \cdot \cos 60° = 0$

$\frac{1}{2}\sqrt{2} F_B + 2 \cdot \frac{\sqrt{2}}{3} F_B \cdot \frac{1}{2}\sqrt{3} \cdot \frac{1}{2} = W$

$\left[\frac{1}{2}\sqrt{2} + \frac{1}{2}\frac{\sqrt{3}}{3}\sqrt{2}\right] F_B = W$

$W = m \cdot g$

$= 25kg \cdot 9.81 \frac{N}{kg}$

$\boxed{W \approx 245.25N}$ ✓

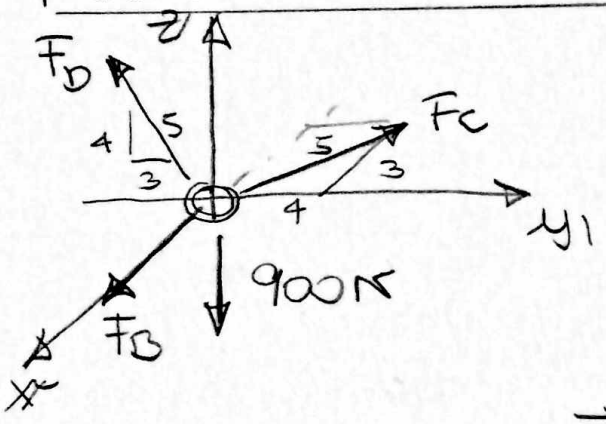
1.1154

$F_B = 245.25N \,/\, \left[\frac{1}{2}\sqrt{2}\left[1 + \frac{\sqrt{3}}{3}\right]\right]$

$\boxed{F_B \approx 220N}$

$\boxed{F_C = F_D = 104N}$

PROBLEM F3-8 ... 3D FORCE EQUILIBRIUM



$+\uparrow \Sigma F_z = 0$

$-900N + \frac{4}{5} F_D = 0$

$\boxed{F_D = \frac{5}{4} 900N = 1,125N}$

$\rightarrow + \Sigma F_y = 0$

$-\frac{3}{5} F_D + \frac{4}{5} F_C = 0$

$\boxed{F_C = +\frac{3}{4} F_D = 843.75N}$

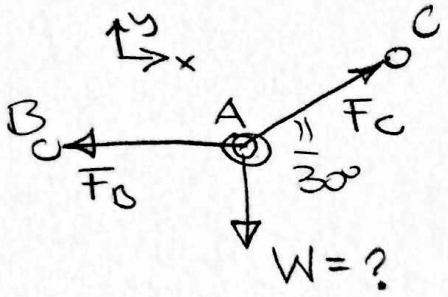
$F_{Cy} = 675N = F_{Dy}$

$\swarrow + \Sigma F_x = 0$

$+F_B - \frac{3}{5} F_C = 0$

$\boxed{F_B = +\frac{3}{5} F_C = 506.25N}$

PROBLEM R3-2 ... 2D EQUILIBRIUM - REPHRASED



DETERMINE W^{max} SUCH THAT $F_B \leq 450\,lb$ AND $F_C \leq 480\,lb$!

$$+\uparrow \sum_i F_y = 0 : \quad -W + F_C \sin 30° = 0$$

$$\rightsquigarrow F_C = +W / \sin 30°$$

$$\boxed{F_C = 2W}$$

$$\overset{+}{\rightarrow} \sum_i F_x = 0 : \quad -F_B + F_C \cdot \cos 30° = 0$$

$$F_B = F_C \cdot \cos 30°$$

$$\boxed{F_B = \tfrac{1}{2}\sqrt{3} \cdot 2 \cdot W = \sqrt{3}W}$$

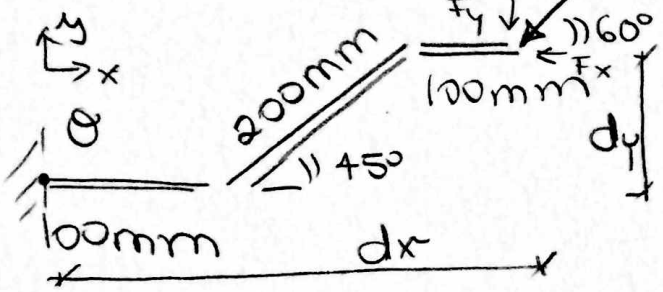
$F_B \leq 450\,lb \rightsquigarrow W \leq \frac{1}{\sqrt{3}} F_B \leq \frac{1}{\sqrt{3}} 450\,lb \leq 260\,lb$

$F_C \leq 480\,lb \rightsquigarrow W \leq \frac{1}{2} F_C \leq \frac{1}{2} 480\,lb \leq 240\,lb$

CRITICAL CONDITION IN CABLE (A) - (C)

$$\boxed{W^{max} = 240\,lb}$$

PROBLEM F 4-4 50N ... MOMENT IN 2D



DETERMINE THE MOMENT OF THE FORCE ABOUT O!

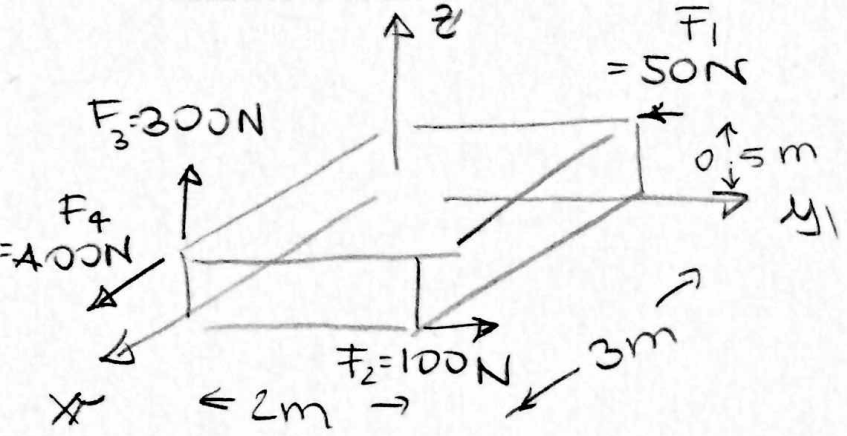
$$\circlearrowleft_+ \sum M_O = +F_x \cdot d_y - F_y \cdot d_x$$

$$= +50N \cdot \cos 60° \cdot 200mm \cdot \sin 45° - 50N \cdot \sin 60° \cdot [100mm + 200mm \cdot \cos 45° + 100mm]$$

$$= +50N \cdot \tfrac{1}{2} \cdot 200mm \cdot \tfrac{1}{2}\sqrt{2} - 50N \cdot \tfrac{1}{2}\sqrt{3} \cdot [100 + 200 \cdot \tfrac{1}{2}\sqrt{2} + 100]mm$$

$$\boxed{\circlearrowleft_+ \sum M_O = 11248\,Nmm = 11.2\,Nm}$$

PROBLEM P4-3... MOMENT ON 3D



DETERMINE THE MOMENT ABOUT THE x, y1, AND z AXES!

$$+\circlearrowleft \Sigma M_x = +F_1 \cdot 0.5m + F_2 \cdot 0m + F_3 \cdot 0m + F_4$$

(F_2: $=0$; F_3: $=0$; $F_4 \parallel x$)

$$= +50N \cdot 0.5m = 25Nm$$

$$\circlearrowright_+ \Sigma M_{y_1} = F_1 - F_2 - F_3 \cdot 3m + F_4 \cdot 0.5m$$

($F_1 \parallel y_1$; $F_2 \parallel y$)

$$= -300N \cdot 3m + 400N \cdot 0.5m$$

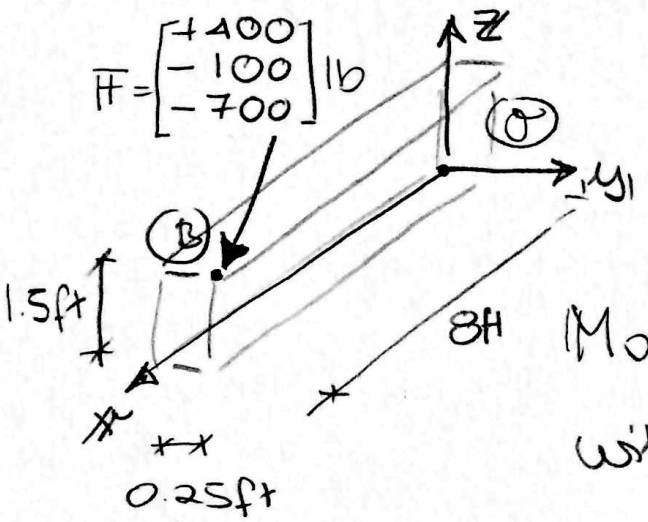
$$= [-900 + 200]Nm = -700Nm$$

$$+\updownarrow \Sigma M_z = F_1 \cdot 0m + F_2 \cdot 3m + F_3 + F_4 \cdot 0m$$

($F_3 \parallel z$)

$$= +100N \cdot 3m = +300Nm$$

PROBLEM 4-29 ... MOMENT IN 3D



DETERMINE THE MOMENT OF F ABOUT POINT O!

$$M_O = r_{OB} \times F$$

with $r_{OB} = \begin{bmatrix} +8 \\ +0.25 \\ +1.5 \end{bmatrix}$ ft $\quad F = \begin{bmatrix} +400 \\ -100 \\ -700 \end{bmatrix}$ lb

$$M_O = \begin{bmatrix} 8 & 400 & x \\ 0.25 & -100 & y_1 \\ 1.5 & -700 & z \end{bmatrix} = -800z + 600y_1 - \frac{700}{4}x - \frac{400}{4}z - (-3600y_1) - (-150x)$$

$$= -900z + 6200y - 25x$$

$$M_O = \begin{bmatrix} -25 \\ +6200 \\ -900 \end{bmatrix}$$