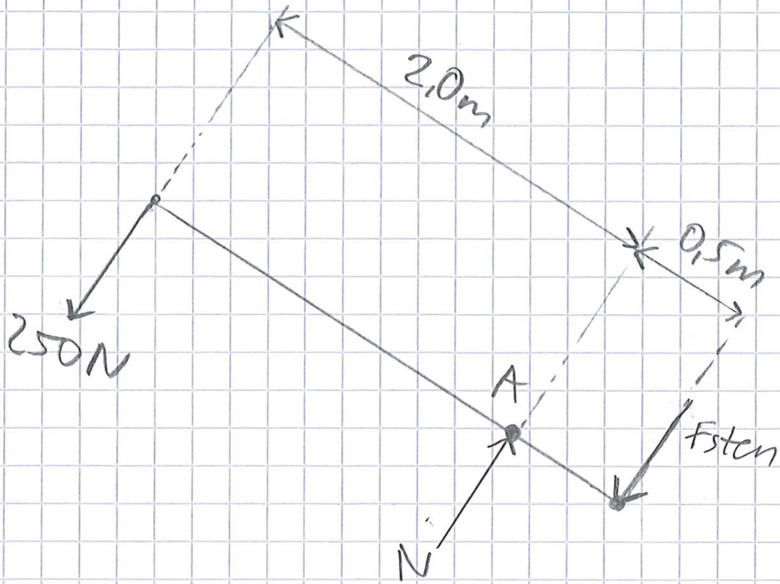
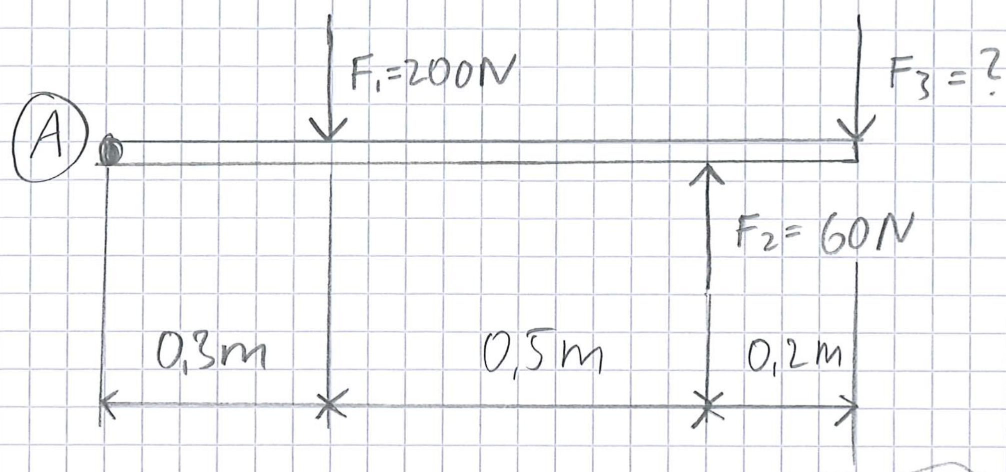
(5)




$\overset{\curvearrowright}{A}$: $F_{sten} \cdot 0{,}5 - 250 \cdot 2{,}0 = 0$

$$F_{sten} = \frac{250 \cdot 2{,}0}{0{,}5} = 1000\ N = \underline{\underline{1{,}0\ kN}}$$

(6)




Inget moment runt A.

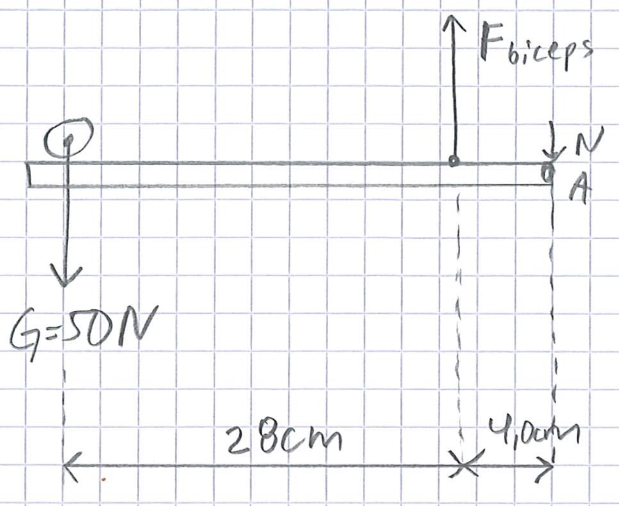
$\overset{\curvearrowright}{A}: F_1 \cdot 0{,}3 + F_3 \cdot 1{,}0 - F_2 \cdot 0{,}8 = 0$

$$F_3 = \frac{F_2 \cdot 0{,}8 - F_1 \cdot 0{,}3}{1{,}0} = \frac{60 \cdot 0{,}8 - 200 \cdot 0{,}3}{1{,}0} = -12N$$

Kraften $F_3$ har riktningen uppåt med storleken 12N

$\uparrow F_3 = 12N$

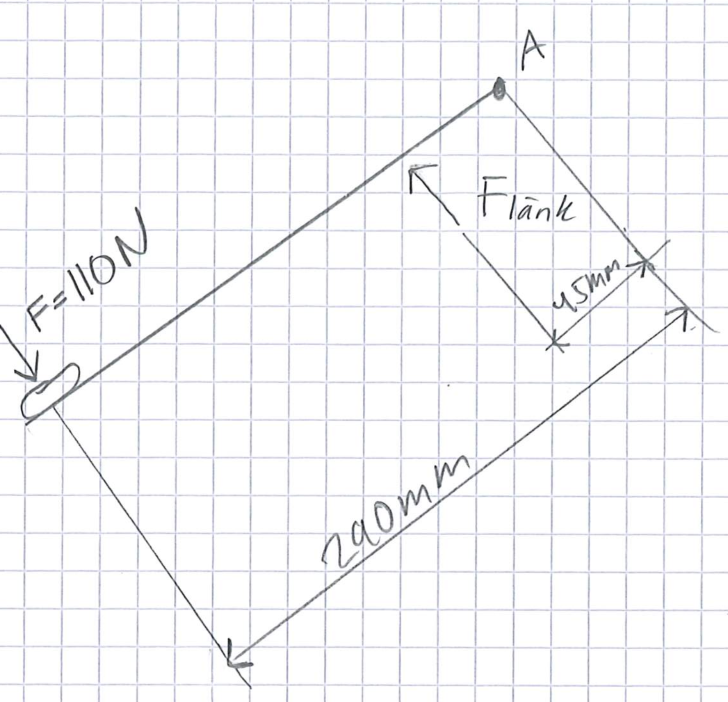
7




$$A: \; F_{biceps} \cdot 4{,}0 - G \cdot 32 = 0$$

$$F_{biceps} = \frac{32 \cdot G}{4{,}0} = \frac{32 \cdot 50}{4{,}0} = \underline{\underline{400\,N}}$$

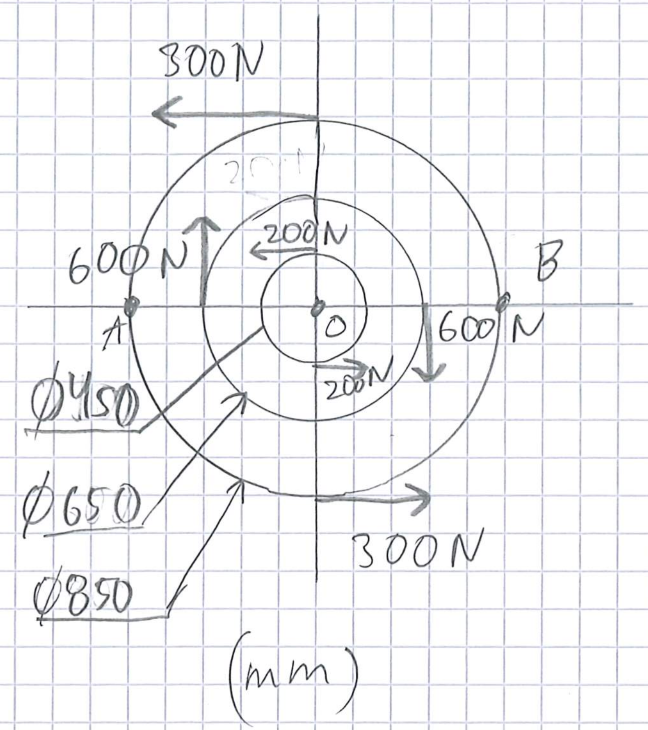
(8)



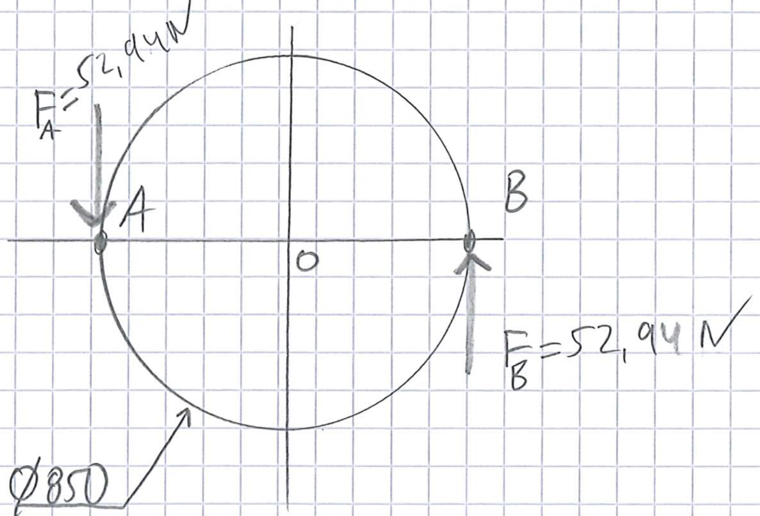

$\overset{\curvearrowright}{A}$: $F_{länk} \cdot 45 - 110 \cdot 290 = 0$

$F_{länk} = \frac{110 \cdot 290}{45} \approx \underline{\underline{709\ N}}$

(9)




$\curvearrowright M_0: 600 \cdot 650 - 200 \cdot 450 - 300 \cdot 850 = 45\,000 \text{ Nmm}$



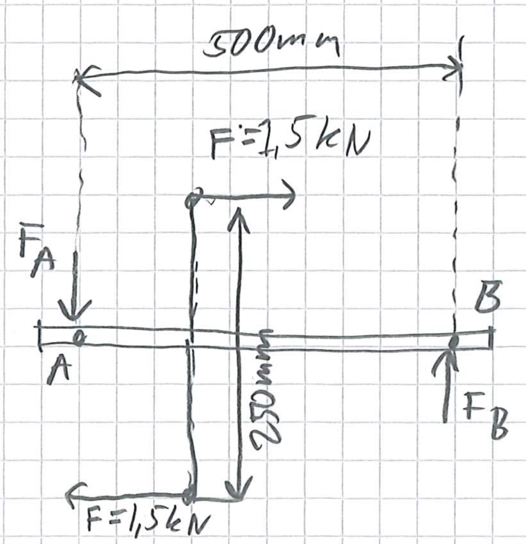

$\curvearrowleft M_0: \quad F \cdot 850 = 45\,000 \quad \Rightarrow \quad F = \frac{45\,000}{850} \approx \underline{\underline{52,94 N}}$

kontroll:

$\curvearrowright M_0: 600 \cdot 650 - 200 \cdot 450 - 300 \cdot 850 - 52,94 \cdot 850 \approx 0$

ok!

(10)



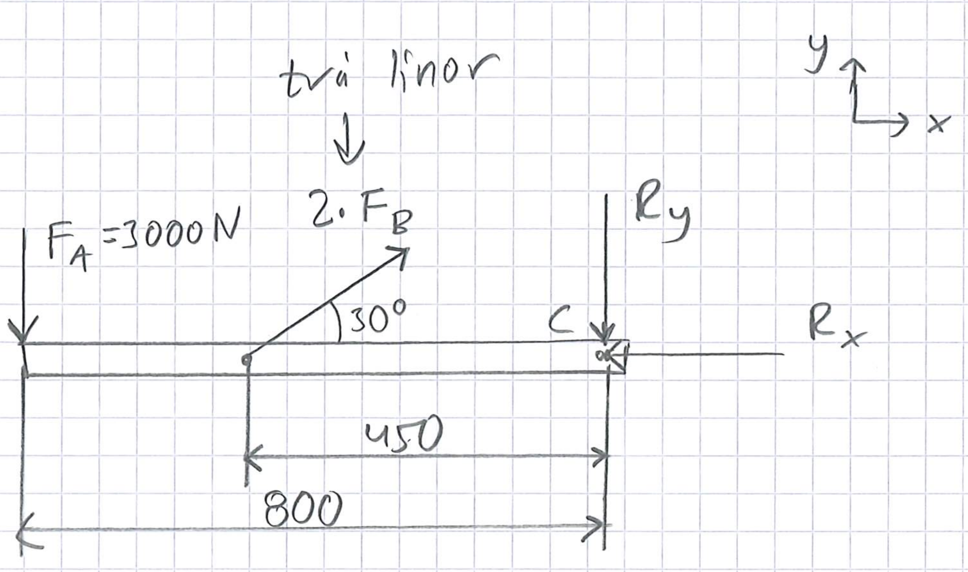

$\uparrow$: $F_B - F_A = 0 \Rightarrow F_A = F_B$

$\overset{\curvearrowright}{M_B}$: $1{,}5 \cdot 0{,}25 - F_A \cdot 0{,}5 = 0$

$$F_A = \frac{1{,}5 \cdot 0{,}25}{0{,}5} = 0{,}75\,kN$$

Kraften $F_A$ & $F_B$ är $\underline{\underline{750\,N}}$

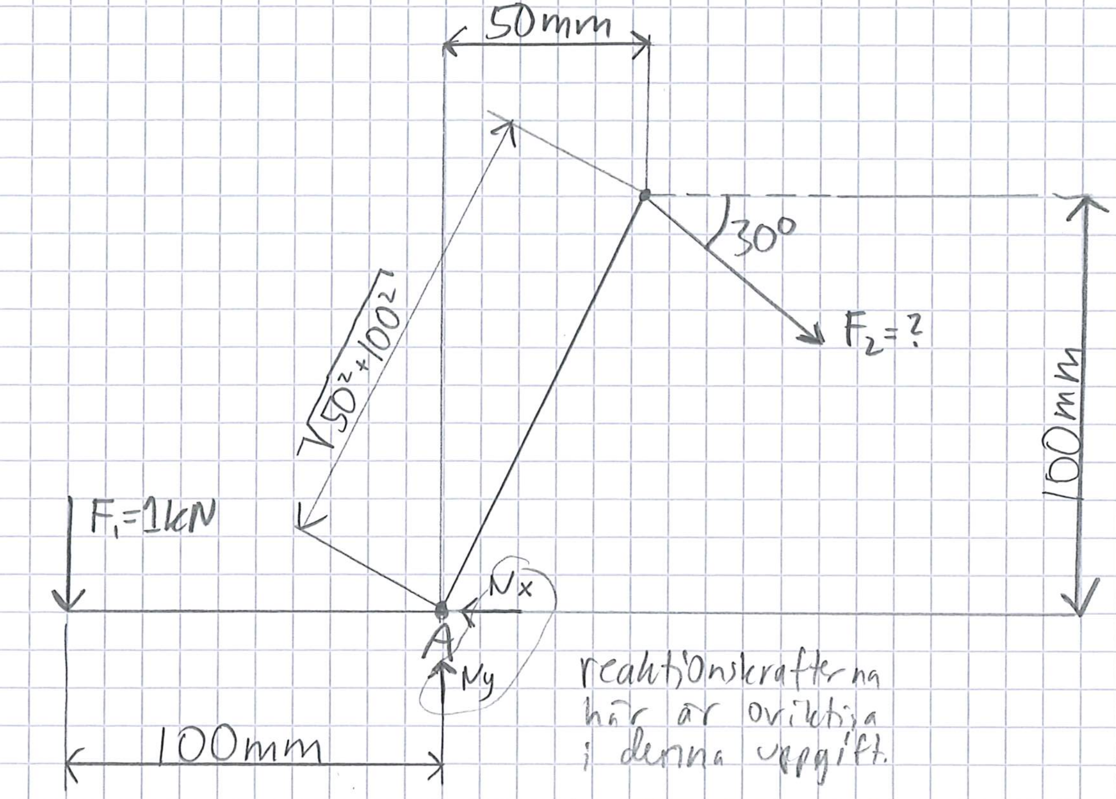
(11)




$$\overset{\curvearrowright}{C}: 2 \cdot F_B \cdot \sin(30°) \cdot 450 - F_A \cdot 800 = 0$$

$$\Rightarrow F_B = \frac{800 \cdot F_A}{2 \cdot 450 \cdot \sin(30°)} = \frac{800 \cdot 3000}{2 \cdot 450 \cdot \sin(30°)} \approx \underline{\underline{5\,333\ N}}$$

12

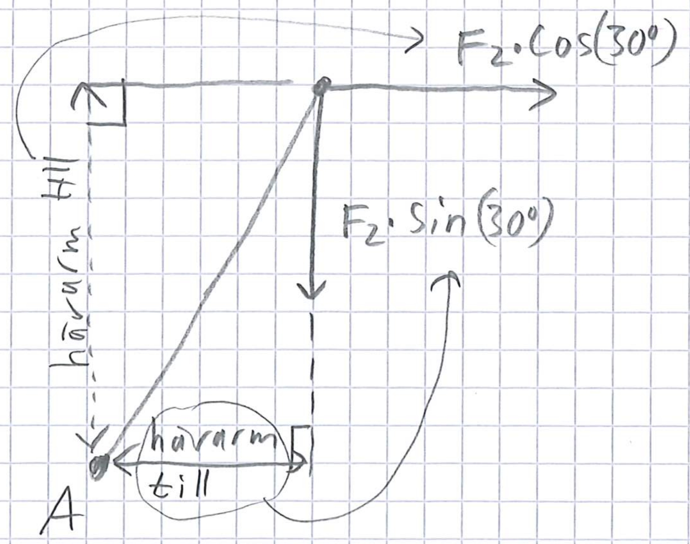



$$\overset{\curvearrowright}{A}:\ F_2\cdot\cos(30^\circ)\cdot 100+F_2\cdot\sin(30^\circ)\cdot 50-F_1\cdot 100=0$$

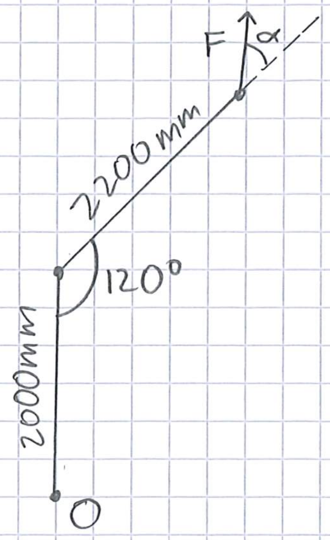
$$F_2\left[\cos(30^\circ)\cdot 100+\sin(30^\circ\cdot 50)\right]=F_1\cdot 100$$

$$F_2=\frac{\overset{F_1}{1000}\cdot 100}{\cos(30^\circ)\cdot 100+\sin(30^\circ)\cdot 50}\approx \underline{\underline{896\ N}}$$

Obs! dela upp $F_2$ i två komposanter.



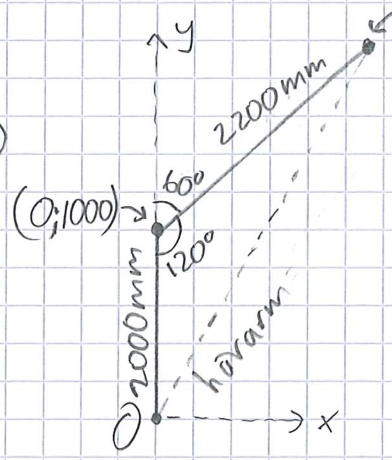
(13)




d) Vinkeln α när momentet runt O är som störst.

⇒ Gäller när F är vinkelrät mot hävarmen

använd ko-ordinater...

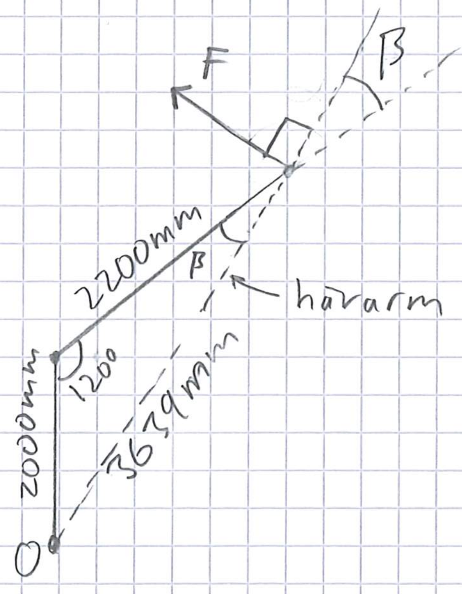



$(2200 \cdot \sin(60°); 2000 + 2200\cos(60°)) \approx$

$\approx (1905{,}26; 3100)$

hävarmens längd $= \sqrt{1905{,}26^2 + 3100^2} \approx$

$\approx 3639$ mm




Hur stor är vinkeln β?

⇒ Använd sinussatsen

$$\frac{\sin(120°)}{3639} = \frac{\sin \beta}{2000}$$

$$\beta \approx \arcsin\left(\frac{2000 \cdot \sin(120°)}{3639}\right) \approx 28{,}4°$$

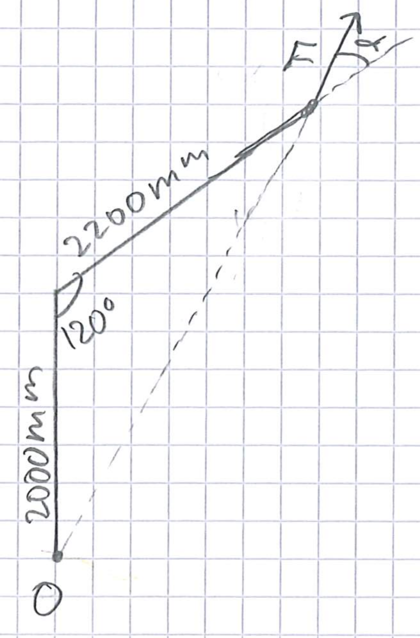
α blir $\beta + 90° = 28{,}4° + 90° = \underline{\underline{118{,}4°}}$

största momentet är: $3{,}639 \cdot 1{,}3 \approx \underline{\underline{4{,}7 \text{ kN}}}$

$\boxed{1/3}$

(13) b) Vinkeln vid minsta momentet?

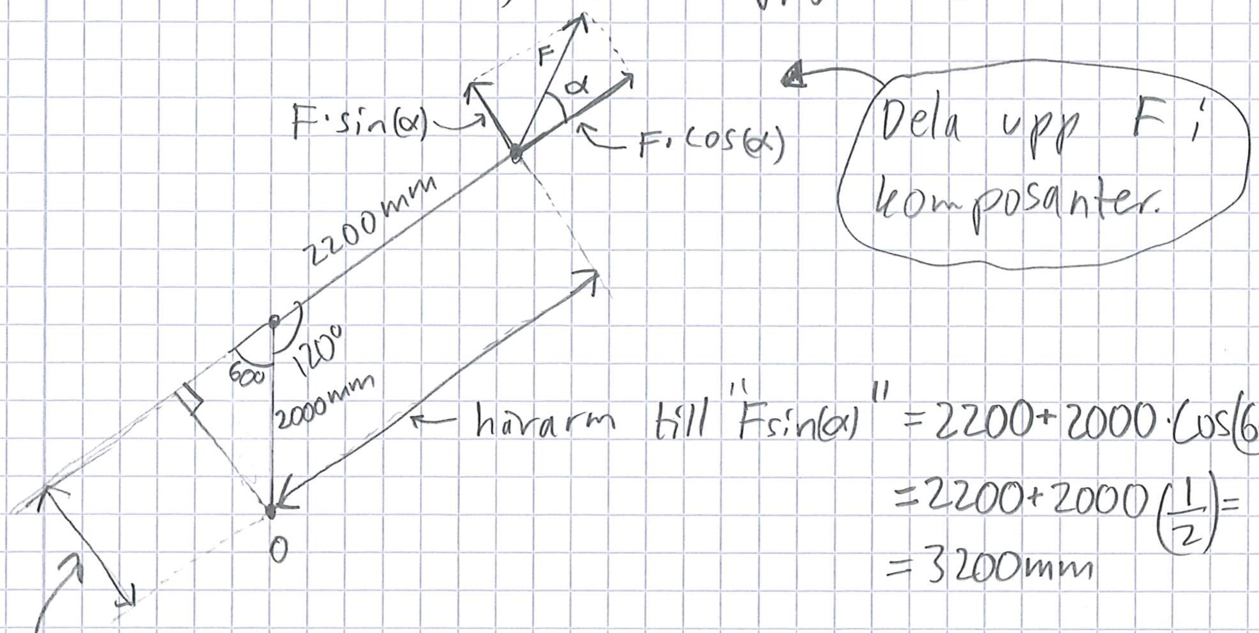
$\Rightarrow$ minsta momentet blir när kraften F är i samma linje som hävarmen, då blir momentet lika med 0 Nm.




D.v.s. $\alpha = \beta$ i detta exempel

$\Rightarrow$ $\alpha = \beta = \underline{\underline{28,4^\circ}}$ och momentet runt punkten O blir då noll.

(13) Alternativ lösning till uppgift (a)




← hävarm till "Fsin(α)" $= 2200 + 2000 \cdot \cos(60°) =$

$= 2200 + 2000\left(\frac{1}{2}\right) =$

$= 3200\,mm$

hävarm till "F·cos(α)" $= 2000 \cdot \sin(60°) = 2000 \cdot \frac{\sqrt{3}}{2}\,mm$

$\circlearrowright O: \; F\cdot\cos(\alpha)\cdot 2000 \cdot \frac{\sqrt{3}}{2} - F\sin(\alpha)\cdot 3200 =$

När når funktionen sitt maxvärde?

$= 1000\cdot\sqrt{3}\cdot F\cos(\alpha) - 3200\,F\sin(\alpha)$

Funktionen når sitt max när derivatan är lika med 0. Dvs:

$\frac{dF}{d\alpha}\; 1000\sqrt{3}\cdot F\cdot\cos(\alpha) - 3200\,F\sin(\alpha) = 0$

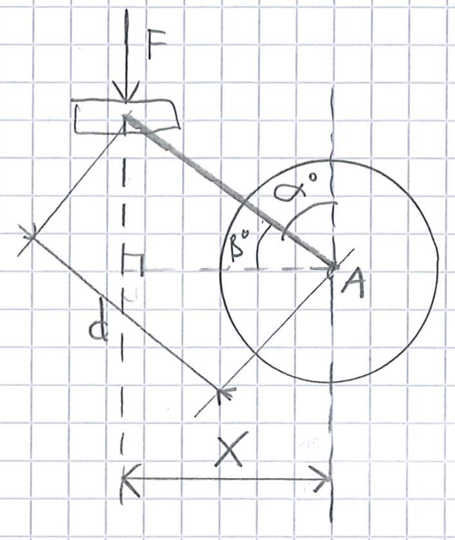
$\Rightarrow -1000\sqrt{3}\,F\sin(\alpha) - 3200\,F\cos(\alpha) = 0$

dividera med F $\Rightarrow$

$-1000\sqrt{3}\cdot\sin(\alpha) - 3200\cdot\cos(\alpha) = 0$

Ekvationen har lösningen $\alpha \approx 118{,}4°$

14




$\beta = 90 - \alpha$

$X = d \cdot \cos(\beta) = d \cdot \cos(90-\alpha)$

$M_A: F \cdot X = F \cdot d \cdot \cos(90-\alpha)$

$\Rightarrow \quad M_A(\alpha) = F \cdot d \cdot \cos(90-\alpha)$

om $\alpha = 0°$:

$M_A(0°) = F \cdot d \cdot \cos(90-0) = 0$

om $\alpha = 90°$

$M_A(90°) = F \cdot d \cdot \cos(0) = F \cdot d$