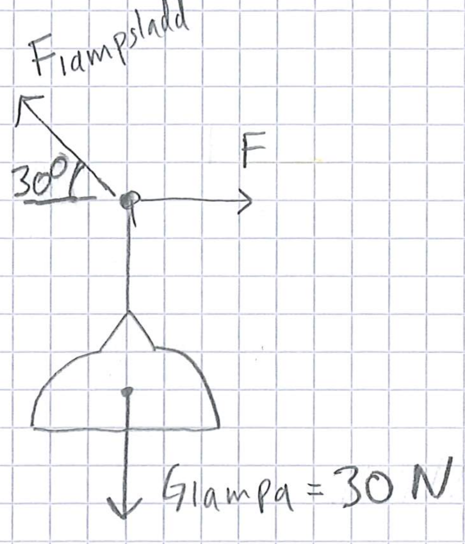
②

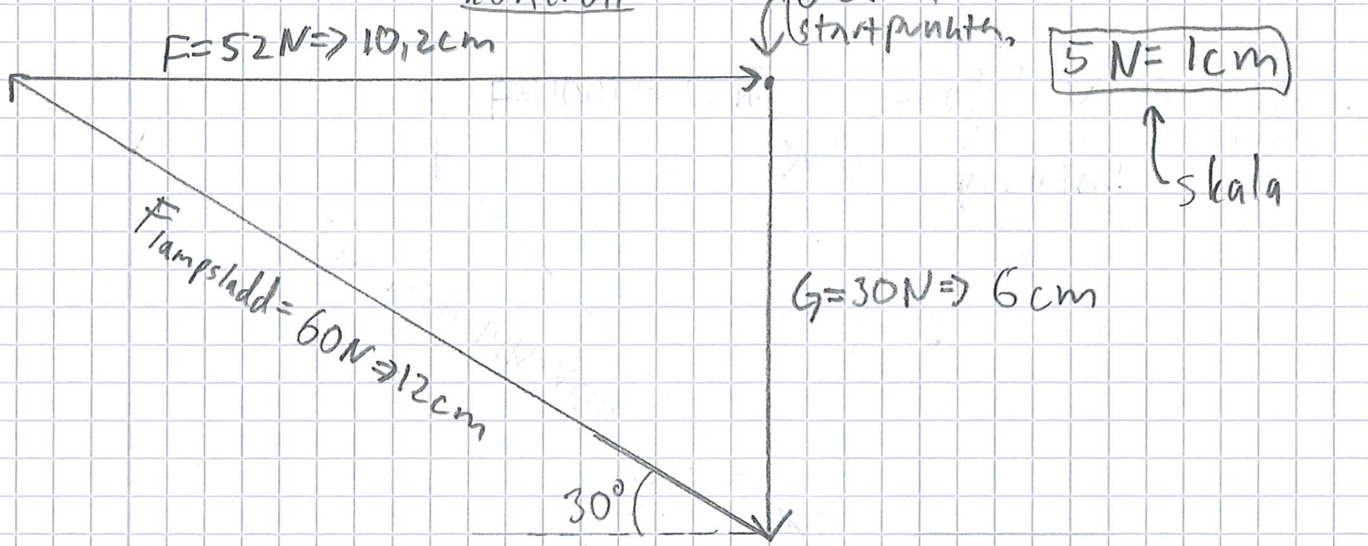


$$\begin{cases} \uparrow: F_{lampsladd} \cdot \sin(30°) - G_{lampa} = 0 \\ \rightarrow: F - F_{lampsladd} \cdot \cos(30°) = 0 \end{cases}$$

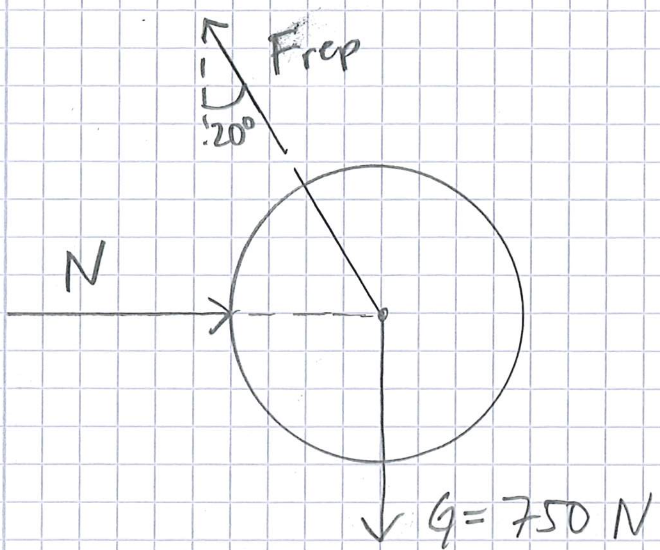
$$F_{lampsladd} = \frac{G_{lampa}}{\sin(30°)} = \frac{30}{\sin(30°)} = \underline{\underline{60\ N}}$$

$$F = F_{lampsladd} \cdot \cos(30°) = 60 \cdot \cos(30°) \approx \underline{\underline{52\ N}}$$

<u>kontroll</u>



3

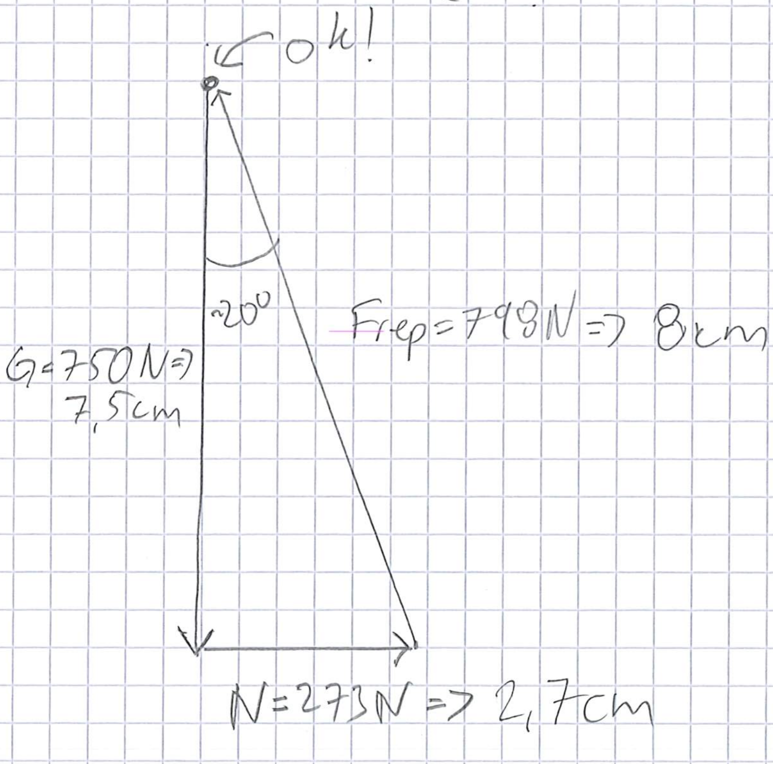


$$\begin{cases} \uparrow: F_{rep} \cdot \cos(20°) - G = 0 \\ \rightarrow: N - F_{rep} \cdot \sin(20°) = 0 \end{cases}$$

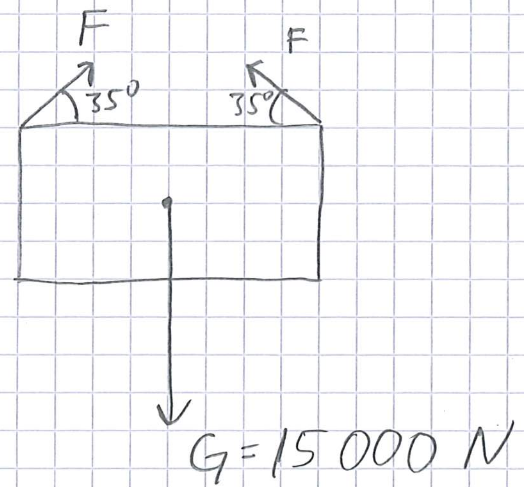
$$F_{rep} = \frac{G}{\cos(20°)} = \frac{750}{\cos(20°)} \approx \underline{\underline{798\,N}}$$

$$N = F_{rep} \cdot \sin(20°) = \left[\frac{750}{\cos(20°)}\right] \cdot \sin(20°) \approx \underline{\underline{273\,N}}$$

<u>Kontroll</u> (100 N = 1 cm)



4

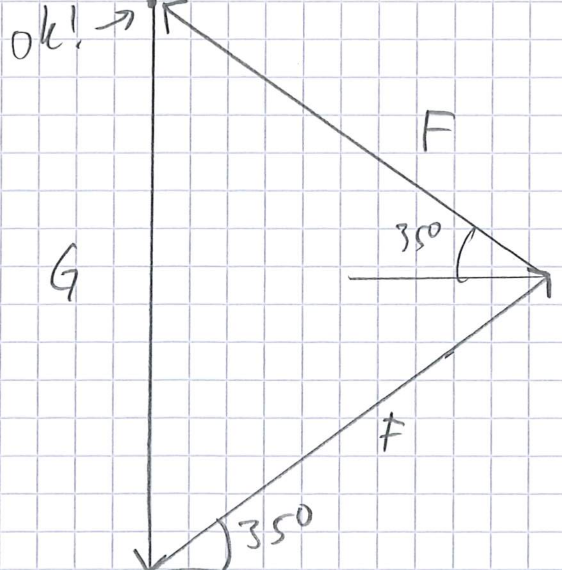


$\uparrow$: $F \cdot \sin(35°) + F \cdot \sin(35°) - G = 0$

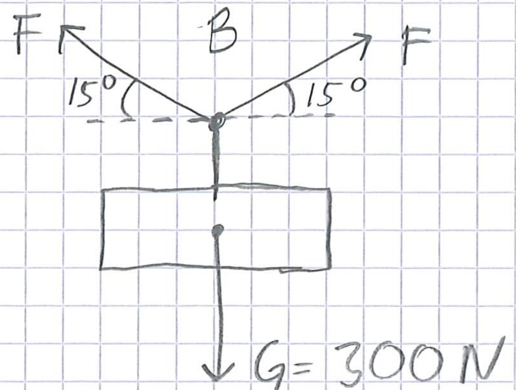
$$F = \frac{G}{2 \cdot \sin(35°)} = \frac{15\,000}{2 \cdot \sin(35°)} \approx \underline{\underline{13\,076\ N}}$$

<u>kontroll</u>

Skala $G = 15\,000\,N = 7{,}5\,cm$



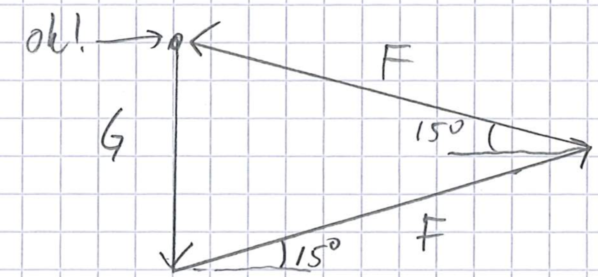
(5)



$\uparrow: F \cdot \sin(15°) + F \sin(15°) - G = 0$

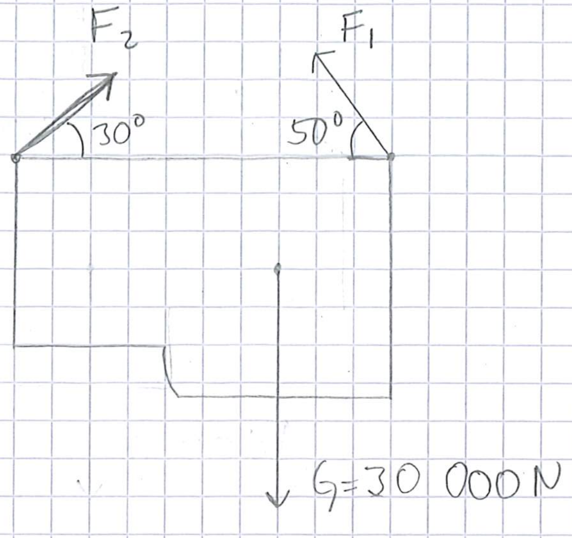
$F = \frac{G}{2 \cdot \sin(15°)} = \frac{300}{2 \cdot \sin(15°)} \approx \underline{\underline{580\,N}}$

<u>kontroll</u>



skala $G = 300\,N = 3\,cm$

⑥



$$\text{I}: \quad \uparrow: F_1 \cdot \sin(50°) + F_2 \sin(30°) - G = 0$$

$$\text{II}: \quad \rightarrow: F_1 \cdot \cos(50°) - F_2 \cdot \cos(30°) = 0$$

$$\text{II}: \quad F_1 = F_2 \cdot \frac{\cos(30°)}{\cos(50°)}$$

stoppa in i ekv. I. ger ⇒

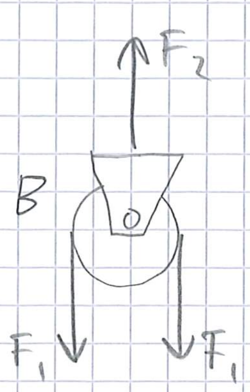
$$F_2 \cdot \frac{\cos(30°)}{\cos(50°)} \cdot \sin(50°) + F_2 \cdot \sin(30°) - G = 0$$

$$F_2 \left[\frac{\cos(30°)}{\cos(50°)} \cdot \sin(50°) + \sin(30°) \right] = G$$

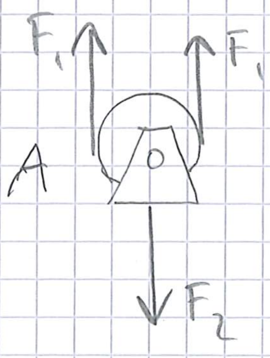
$$F_2 = \frac{G}{\frac{\cos(30°)}{\cos(50°)} \cdot \sin(50°) + \sin(30°)} \approx \underline{\underline{19,6 \text{ kN}}} \quad (\text{när } G = 30\text{kN})$$

$$F_1 = F_2 \cdot \frac{\cos(30°)}{\cos(50°)} \approx \underline{\underline{26,4 \text{ kN}}} \quad (\text{när } F_2 \approx 19,6\text{kN})$$

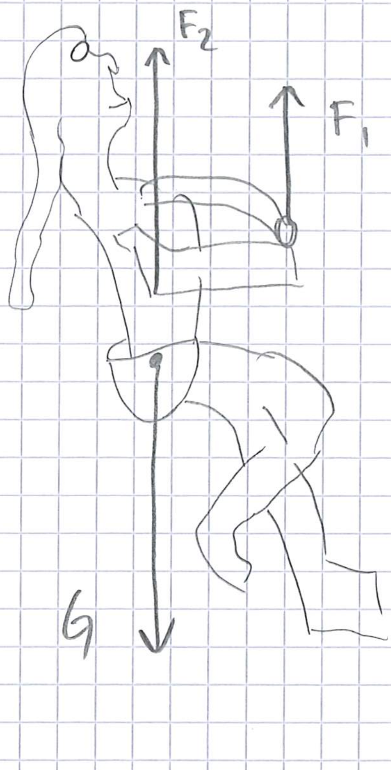
7



$$F_2 = F_1 + F_1 = 2 \cdot F_1$$



$$F_2 = F_1 + F_1 = 2 \cdot F_1$$



$$\uparrow: F_2 + F_1 - G = 0$$

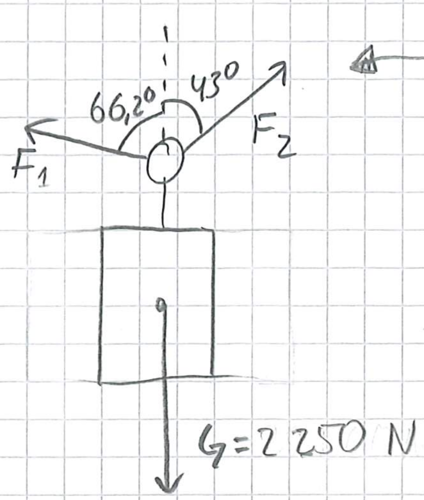
$$\underbrace{F_2}_{= 2F_1} + F_1 = G$$

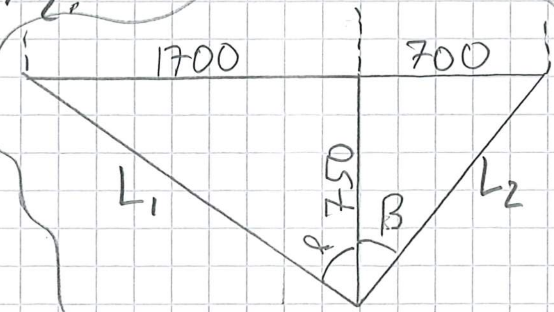
$$2F_1 + F_1 = G$$

$$\boxed{F_1 = \frac{G}{3}}$$

8

Bestäm krafterna F_1 & F_2.





$$\alpha = \arctan\left(\frac{1700}{750}\right) \approx 66{,}2°$$

$$\beta = \arctan\left(\frac{700}{750}\right) \approx 43{,}0°$$

$$\uparrow:\ F_2 \cdot \cos(43°) + F_1 \cdot \cos(66{,}2°) - 2\,250 = 0$$

$$\rightarrow:\ F_2 \cdot \sin(43°) - F_1 \cdot \sin(66{,}2°) = 0$$

$$\rightarrow\ F_2 = F_1 \,\frac{\sin(66{,}2°)}{\sin(43°)}$$

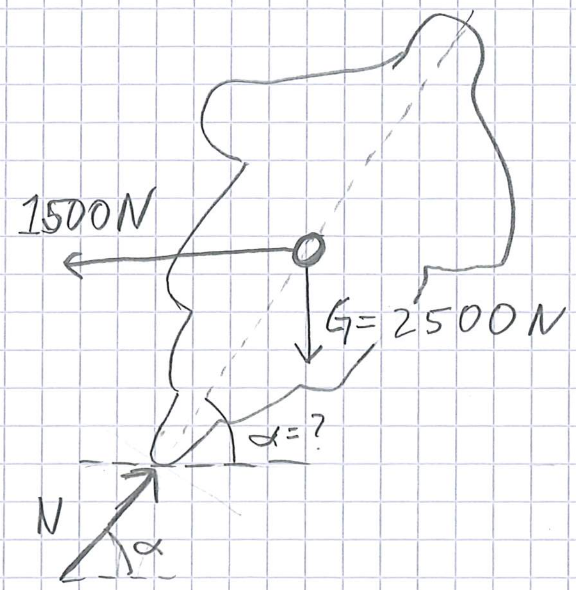
$$\rightarrow\ F_1 \,\frac{\sin(66{,}2°)}{\sin(43°)} \cdot \cos 43° + F_1 \cdot \cos(66{,}2°) = 2\,250$$

$$F_1 = \frac{2\,250}{\frac{\sin(66{,}2°)}{\sin(43°)} \cdot \cos(43°) + \cos(66{,}2°)} \approx \underline{\underline{1\,625\ N}}$$

$$F_2 = F_1 \cdot \frac{\sin(66{,}2°)}{\sin(43°)} \approx \underline{\underline{2\,180\ N}}$$

(9)

Steg ett = rita figur!



I: $\uparrow: N \cdot \sin(\alpha) - G = 0$

II: $\rightarrow: N \cdot \cos(\alpha) - 1500 = 0$

II: $N = \dfrac{1500}{\cos(\alpha)}$

ekvation II i I ger ⇒

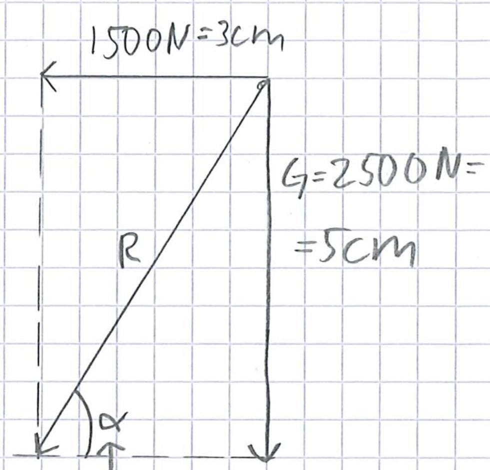
$$\frac{1500}{\cos(\alpha)} \cdot \sin(\alpha) - G = 0$$

$$1500 \tan(\alpha) = G$$

$$\alpha = \arctan\left(\frac{G}{1500}\right) = \arctan\left(\frac{2500}{1500}\right) \approx \underline{\underline{59^\circ}}$$

Alternativ lösning

Kraften rakt ned mot sadeln utgör resultanten till tyngdkraften och centrifugalkraften.

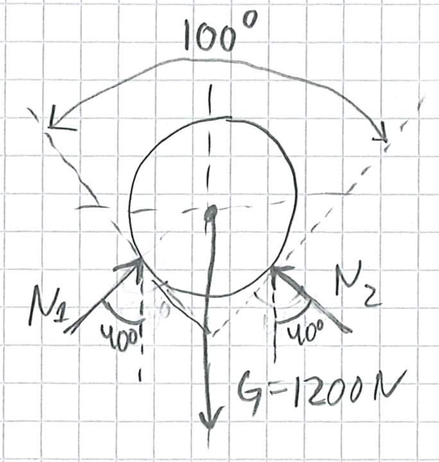


mät vinkeln med gradskiva eller beräkna

$\alpha = \arctan\left(\dfrac{2500}{1500}\right)$

$\Rightarrow \alpha \approx 60^\circ$

(10)



$\uparrow$: $N_1 \cdot \cos(40°) + N_2 \cos(40°) - G = 0$

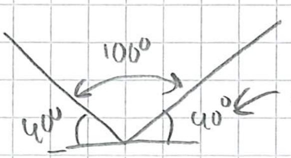
$\rightarrow$: $N_1 \sin(40°) - N_2 \sin(40°) = 0$

$\Rightarrow N_1 = N_2 = N$

$N \cos(40°) + N \cos(40°) = 1200$

$$N = \frac{1200}{\cos(40°) + \cos(40°)} = \underline{\underline{783{,}2\,N}}$$

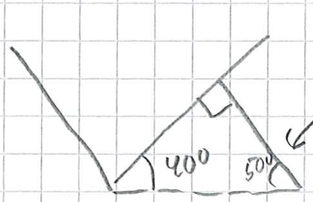
① Varför är vinkeln 40°?



måste vara 40° eftersom vinkelsumman är 180°.

$\Downarrow$

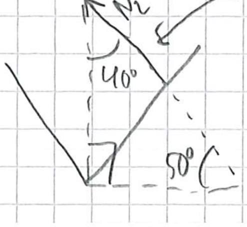
②



denna vinkel blir 50°

$\Downarrow$

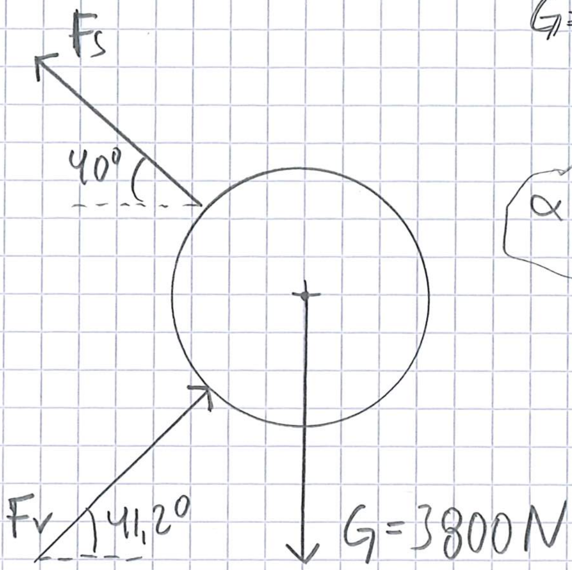
③



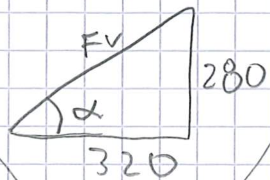
denna vinkel måste då vara 40°

(11)

$G = 380 \cdot 10\ N$



$\alpha = \arctan\left(\frac{280}{320}\right) \approx 41,2°$



$$\begin{cases} \text{I: } \downarrow: G - F_s \cdot \sin(40°) - F_v \cdot \sin(41,2°) = 0 \\ \text{II: } \rightarrow: F_v \cdot \cos(41,2°) - F_s \cdot \cos(40°) = 0 \end{cases}$$

ekv II: $F_v = F_s \cdot \dfrac{\cos(40°)}{\cos(41,2°)}$

ekv I: $G - F_s \cdot \sin(40°) - F_s \cdot \dfrac{\cos(40°)}{\cos(41,2°)} \cdot \sin(41,2°) = 0$

$$G - F_s\left(\sin(40°) + \frac{\cos(40°)}{\cos(41,2°)} \cdot \sin(41,2°)\right) = 0$$

$$F_s = \frac{G}{\sin(40°) + \frac{\cos(40°)}{\cos(41,2°)} \cdot \sin(41,2°)} \approx 2893\ N$$

om $G = 3800\ N$

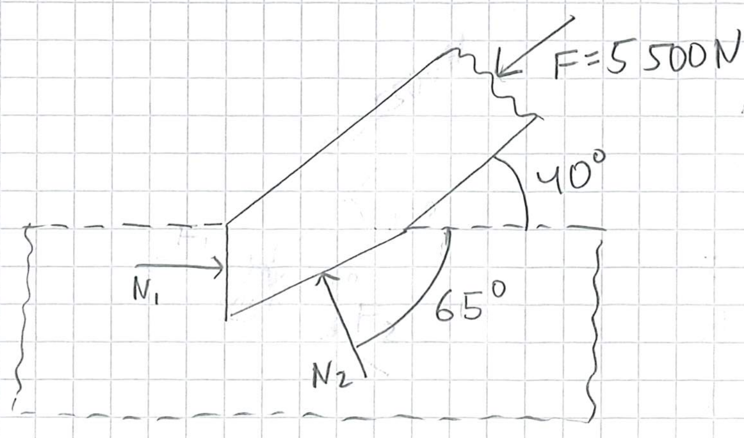
$$F_v = F_s \cdot \frac{\cos(40°)}{\cos(41,2°)} \approx \underline{\underline{2946\ N}}$$

om $F_s = 2893\ N$

Obs! Två stänger:

I vardera stång $= \dfrac{F_s}{2} = \dfrac{2893}{2} \approx \underline{\underline{1447\ N}}$

(12)



↑: $N_2 \cdot \sin(65°) - 5500 \cdot \sin(40°) = 0$

$$\Rightarrow N_2 = \frac{5500 \sin(40°)}{\sin(65°)} = \underline{\underline{3901\,N}}$$

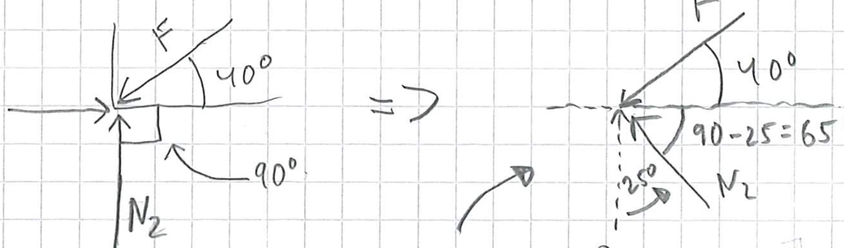
→: $N_1 - 5500 \cdot \cos(40°) - N_2 \cdot \cos(65°) = 0$

$$\Rightarrow N_1 = 5500\cos(40°) + 3901\cos(65°) = \underline{\underline{5862\,N}}$$

<u>Förklaring till vinkeln på 65°</u>

om vinkeln 25° inte hade funnits i figuren skulle det se ut så här:

⇓



förskjut sedan N_2 med 25° moturs ↗. Det gör att vinkeln på 90° grader kommer att bli 65°

↑

$90° - 25° = 65°$