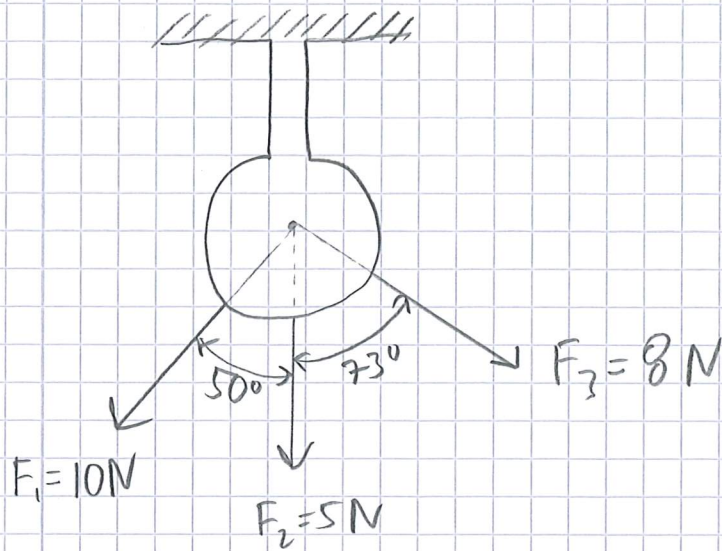


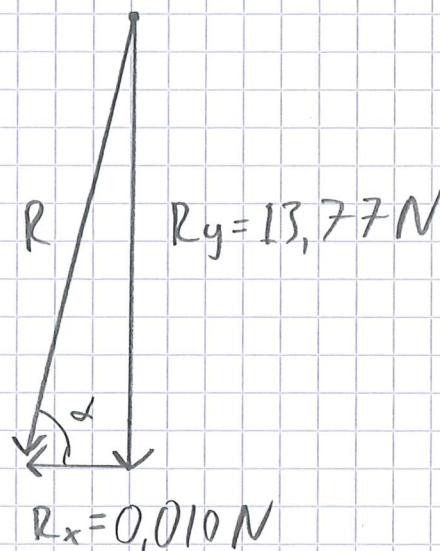
3



Ersätt F_1 , F_2 och F_3 med en kraft.

$$\downarrow: R_y = 5 + 8 \cdot \cos(73^\circ) + 10 \cdot \cos(50^\circ) \approx 13,77 \text{ N}$$

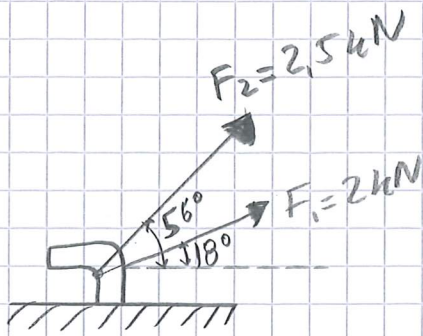
$$\leftarrow: R_x = 10 \cdot \sin(50^\circ) - 8 \cdot \sin(73^\circ) \approx 0,010 \text{ N}$$



$$R = \sqrt{13,77^2 + 0,010^2} \approx \underline{\underline{13,77 \text{ N}}}$$

$$\alpha = \arctan\left(\frac{13,77}{0,01}\right) \approx \underline{\underline{89,96^\circ}}$$

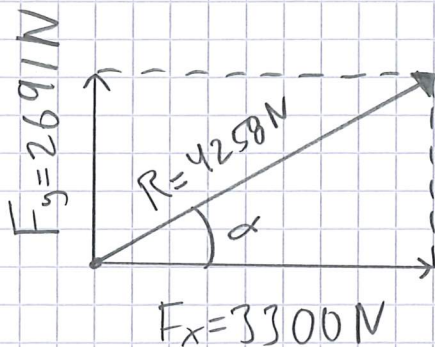
4



Beräkna resultanten.

$$\rightarrow: F_x = 2000 \cdot \cos(18^\circ) + 2500 \cdot \cos(56^\circ) \approx 3300 \text{ N}$$

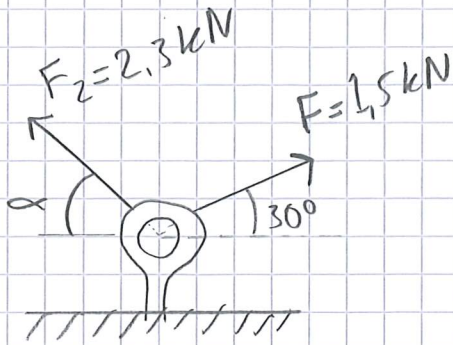
$$\uparrow: F_y = 2000 \cdot \sin(18^\circ) + 2500 \sin(56^\circ) \approx 2691 \text{ N}$$



$$R = \sqrt{3300^2 + 2691^2} \approx \underline{\underline{4258 \text{ N}}} \approx \underline{\underline{4,26 \text{ kN}}}$$

$$\alpha = \arctan\left(\frac{2691}{3300}\right) \approx \underline{\underline{39,2^\circ}}$$

5



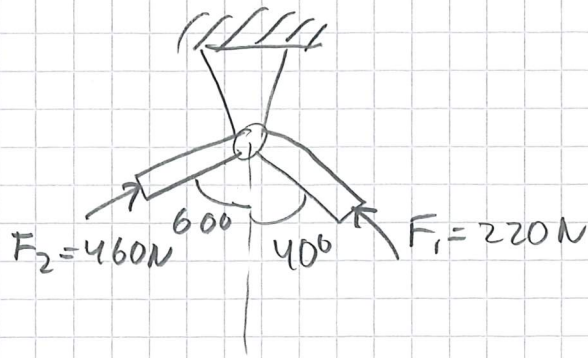
Hur stor ska α vara för enbart axiell dragning?

$$\uparrow \sum R_x = 0$$

$$\rightarrow: R_x = 1500 \cdot \cos(30^\circ) - 2300 \cdot \cos(\alpha) = 0$$

$$\alpha = \arccos\left(\frac{1500 \cdot \cos(30^\circ)}{2300}\right) \approx \underline{\underline{55,6^\circ}}$$

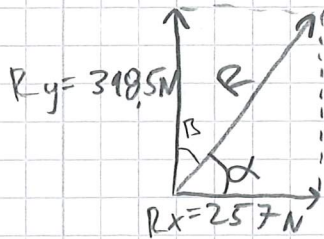
⑥



Resultant?

$$\rightarrow: R_x = 460 \sin(60^\circ) - 220 \sin(40^\circ) \approx 257\text{ N}$$

$$\uparrow: R_y = 460 \cos(60^\circ) + 220 \cos(40^\circ) \approx 398,5\text{ N}$$

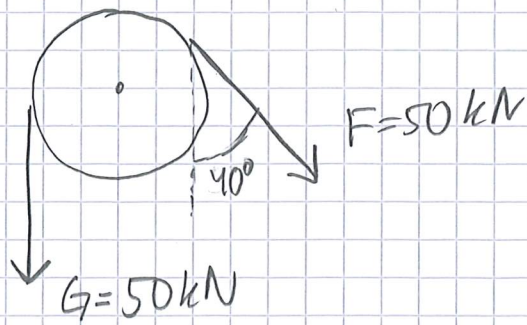


$$R = \sqrt{257^2 + 398,5^2} \approx \underline{\underline{474\text{ N}}}$$

$$\alpha = \arctan\left(\frac{398,5}{257}\right) \approx \underline{\underline{57,2^\circ}}$$

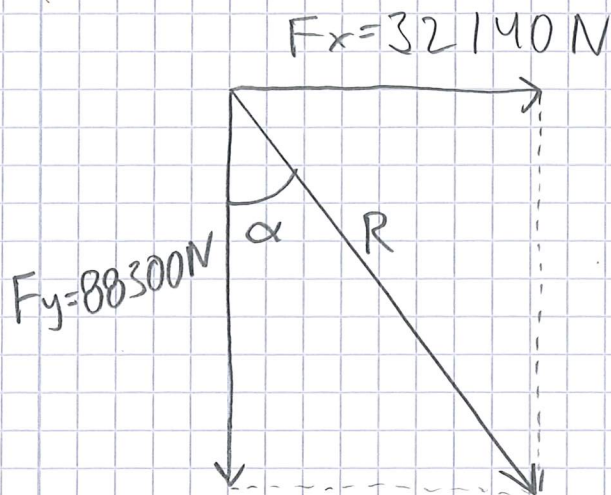
$$\beta = 90 - \alpha = \underline{\underline{32,6^\circ}}$$

7



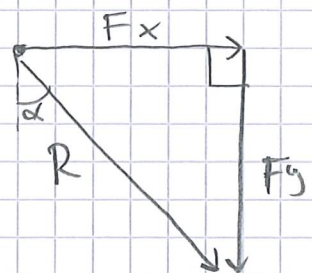
$$\downarrow: F_y = 50\,000 + 50\,000 \cdot \cos(40^\circ) \approx 88\,300 \text{ N}$$

$$\rightarrow: F_x = 50\,000 \cdot \sin(40^\circ) \approx 32\,140 \text{ N}$$



alternativ

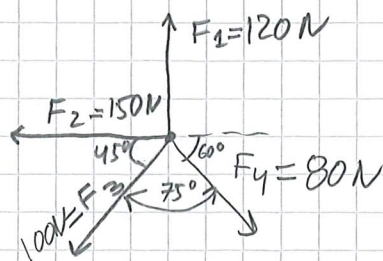
lägg krafterna efter
varandra.



$$R = \sqrt{32\,140^2 + 88\,300^2} \approx 93\,967 \approx \underline{\underline{94 \text{ kN}}}$$

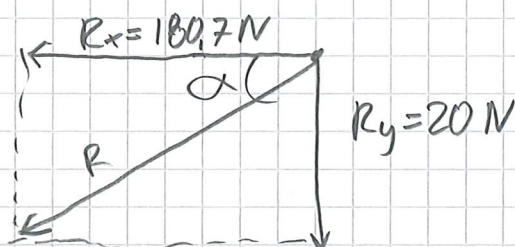
$$\alpha = \arctan\left(\frac{32\,140}{88\,300}\right) \approx \underline{\underline{20^\circ}}$$

8



$$\begin{cases} \rightarrow: R_x = F_4 \cdot \cos(60^\circ) - F_2 - F_3 \cdot \cos(45^\circ) \\ \rightarrow: R_x = 80 \cdot \cos(60^\circ) - 150 - 100 \cdot \cos(45^\circ) \approx -180,7 \text{ N} \end{cases}$$

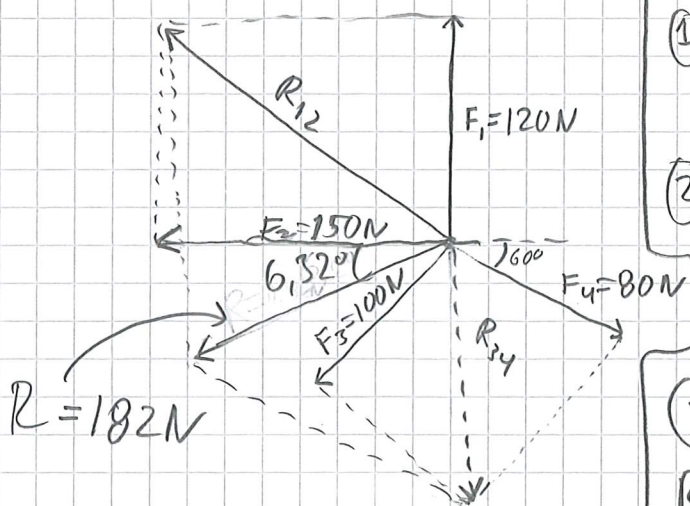
$$\begin{cases} \downarrow: R_y = F_4 \cdot \sin(60^\circ) - F_1 + F_3 \cdot \sin(45^\circ) \\ \downarrow: R_y = 80 \cdot \sin(60^\circ) - 120 + 100 \cdot \sin(45^\circ) \approx 20 \text{ N} \end{cases}$$



a) $R = \sqrt{180,7^2 + 20^2} \approx 181,8 \text{ N}$

b) $\alpha = \arctan\left(\frac{20}{180,7}\right) \approx 6,32^\circ$

Grafsk kontroll



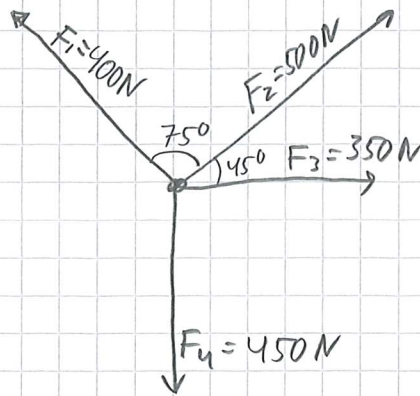
Hur görd?

① lägg ihop F_1 och F_2 till R_{12}

② lägg ihop F_3 och F_4 till R_{34}

③ lägg ihop R_{12} och R_{34} till $R...$

9



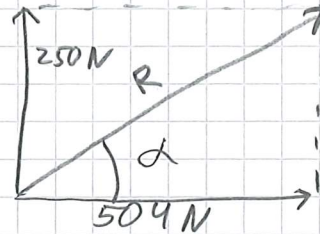
$$- 400 \cos(60^\circ)$$

$$\rightarrow: 350 + 500 \cos(45^\circ) + 400 \cos(45^\circ + 75^\circ) \approx 504\text{ N}$$

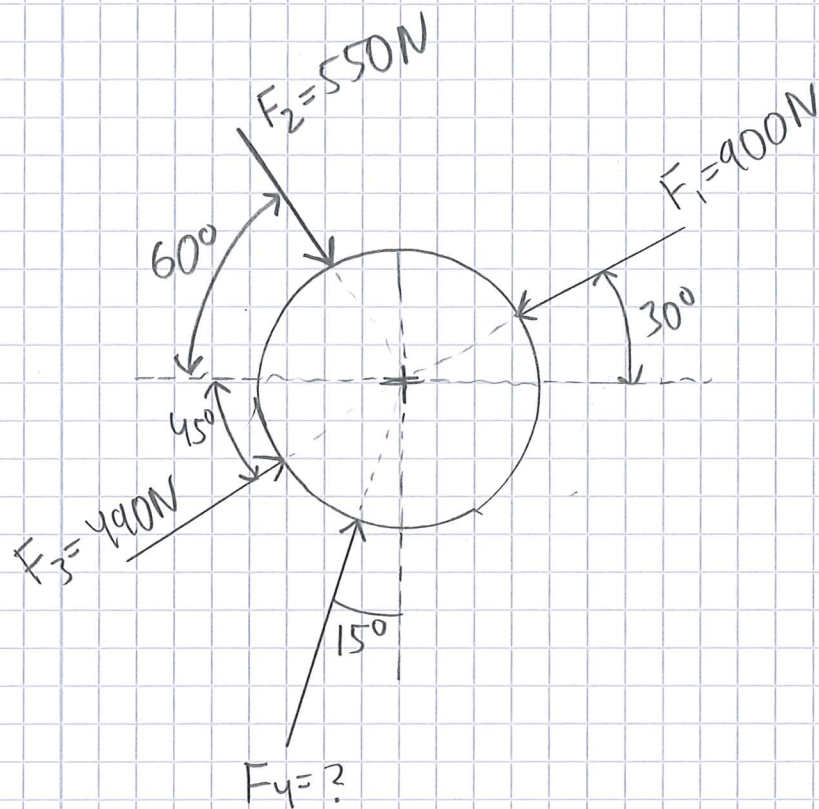
$$\uparrow: 500 \sin(45^\circ) + 400 \sin(45^\circ + 75^\circ) - 450 \approx 250\text{ N}$$

$$R = \sqrt{504^2 + 250^2} \approx \underline{\underline{563\text{ N}}}$$

$$\alpha = \arctan\left(\frac{250}{504}\right) \approx \underline{\underline{26,4^\circ}}$$



10



Beräkna F_4 så att kraftsumman på navskivan blir noll.

$$\uparrow: F_y = 0$$

$$\Rightarrow \uparrow: F_y = F_4 \cdot \cos(15^\circ) + F_3 \cdot \sin(45^\circ) - F_1 \cdot \sin(30^\circ) - F_2 \cdot \sin(60^\circ) = 0$$

lös ut F_4 .

$$\Rightarrow F_4 = \frac{F_1 \cdot \sin(30^\circ) + F_2 \cdot \sin(60^\circ) - F_3 \cdot \sin(45^\circ)}{\cos 15^\circ} =$$

$$= \frac{900 \cdot \sin(30^\circ) + 550 \cdot \sin(60^\circ) - 490 \cdot \sin(45^\circ)}{\cos(15^\circ)} \approx$$

$$\approx \underline{\underline{600 \text{ N}}}$$