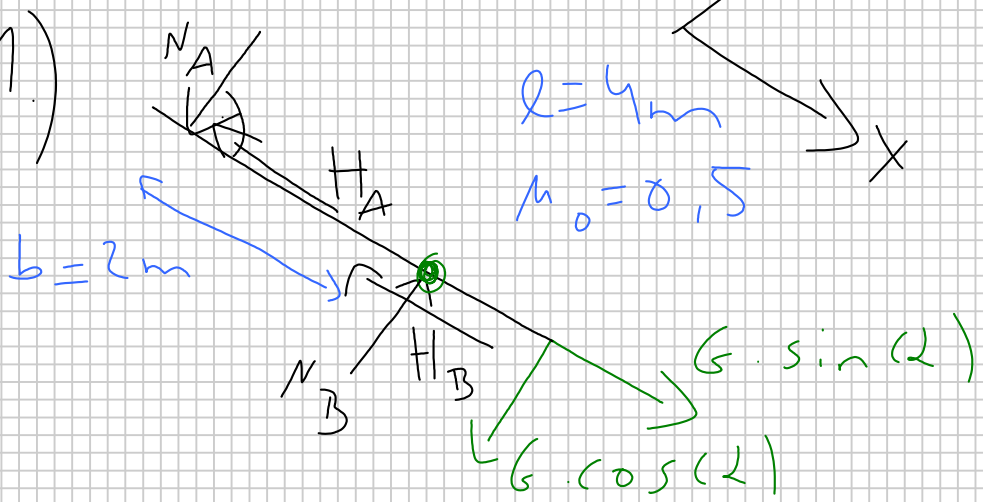
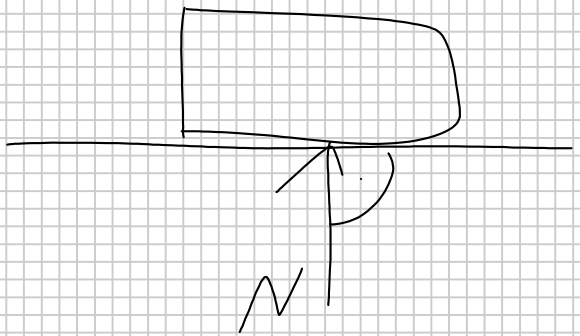
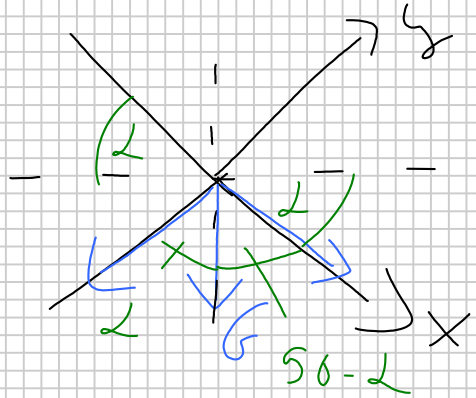
Webinar: Statik
Thema: Reibung und Haftung

Note Title 08.11.2016

1)







$G \cdot \cos(\alpha)$ y-Richtung (negative)

$G \cdot \sin(\alpha)$ x-Richtung

↗ : $-N_A + N_B - G \cdot \cos(\alpha) = 0$

↘ : $-H_A - H_B + G \cdot \sin(\alpha) = 0$

(B) : $N_A \cdot b - G \cdot \cos(\alpha)\,(\ell - b) = 0$

(1) $N_A = \dfrac{G \cdot \cos(\alpha)\,(\ell - b)}{b}$ ⟩ Einsetzen

↗ : $N_B = N_A + G \cdot \cos(\alpha)$

$$N_B = \frac{G \cdot \cos(\alpha) \cdot (l-b)}{b} + G \cdot \cos(\alpha)$$

$$(2) \quad N_B = G \cdot \cos(\alpha) \cdot \left[\frac{l-b}{b} + 1\right]$$

$$\sum y: \; (-N_A - N_B)\,\mu_0 + G \cdot \sin(\alpha) = 0 \qquad \leftarrow H = \mu_0 \cdot N$$

(1) + (2) einsetzen:

$$\left(-\frac{G \cdot \cos(\alpha)\,(l-b)}{b} - G \cdot \cos(\alpha)\left[\frac{l-b}{b} + 1\right]\right)\mu_0 + G \cdot \sin(\alpha) = 0$$

$$-\left(-\frac{G\cdot\cos(\alpha)\,(\ell-b)}{b}-G\cdot\cos(\alpha)\cdot\left[\frac{\ell-b}{b}+1\right]\right)\cdot\mu_0=G\cdot\sin\alpha$$

$$G\cdot\cos(\alpha)\left[\frac{\ell-b}{b}+\frac{\ell-b}{b}+1\right]\mu_0=G\cdot\sin(\alpha)\;/\cdot G$$

$$\cos(\alpha)\left[\frac{\ell-b}{b}+\frac{\ell-b}{b}+1\right]\cdot\mu_0=\sin(\alpha)\;/\cdot\cos(\alpha)$$

$$\left(\frac{\ell-b}{b}+\frac{\ell-b}{b}+1\right)\cdot\mu_0=\tan(\alpha)$$

$$\frac{\sin(\alpha)}{\cos(\alpha)}=\tan(\alpha)$$

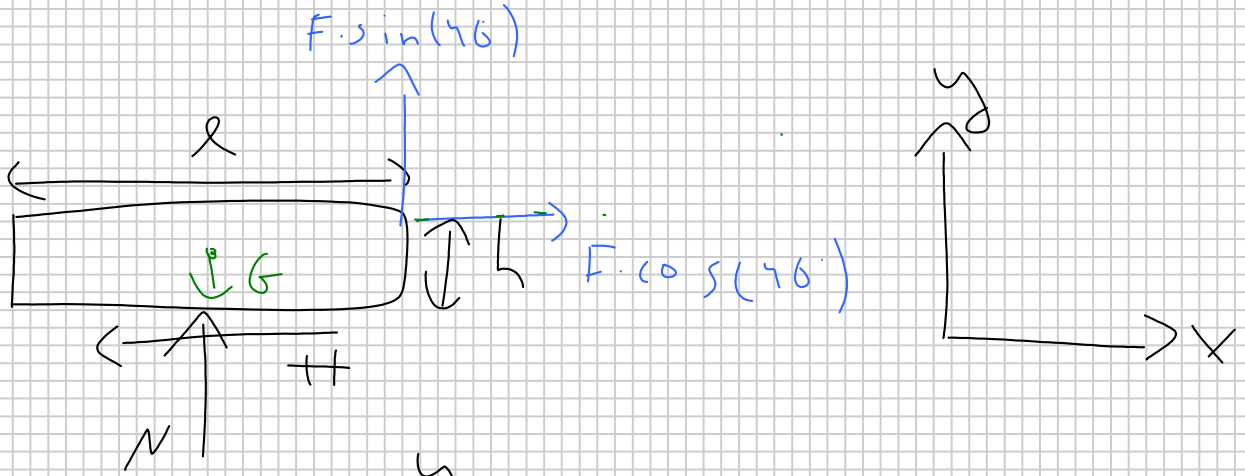
$$\arctan\left[\left(2\,\frac{(\ell-b)}{b}+1\right)\cdot\mu_0\right]=\alpha$$

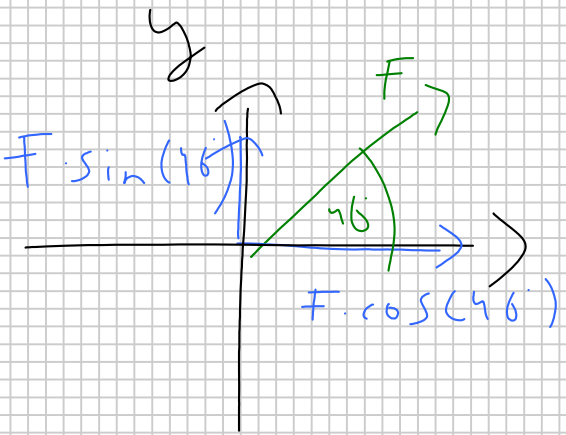
$$\arctan\left[\frac{2\cdot(4m-2m)}{2m}\cdot 0{,}5+0{,}5\right]=\alpha$$

$$\alpha=\arctan(1{,}5)$$

$$\boxed{\alpha=56{,}31^{\circ}}$$

2. Aufgabe)





$\rightarrow$: $-H + F \cdot \cos(40^\circ) = 0$ $\rightarrow H = F \cdot \cos(40^\circ)$

$\uparrow$: $N - G + F \cdot \sin(40^\circ) = 0$ $\rightarrow N = G - F \sin(40^\circ)$

$$H = \mu_0 \cdot N$$

$\rightarrow$: $\mu_0 \cdot N = F \cdot \cos(40^\circ)$ $\rightarrow N = \frac{F \cdot \cos(40^\circ)}{\mu_0}$

$\uparrow$: $N = G - F \cdot \sin(40^\circ)$

Gleichsetzen

$$\bar{F} \cdot \cos(40^\circ) = G \cdot \mu_0 - \bar{F} \cdot \sin(2) \cdot \mu_0$$

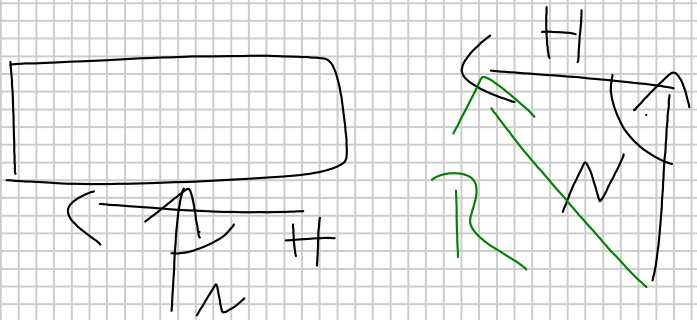
$$F \cdot \cos(40^\circ) + F \cdot \sin(40^\circ) \cdot \mu_0 = G \cdot \mu_0$$

$$F \left(\cos(40^\circ) + \sin(40^\circ) \cdot \mu_0 \right) = G \cdot \mu_0 \quad / \cdot ()$$

$$\boxed{F = \frac{G \cdot \mu_0}{\cos(40^\circ) + \sin(40^\circ) \cdot \mu_0}}$$

$$F = \frac{150\,N \cdot 0{,}5}{\cos(40^\circ) + \sin(10^\circ) \cdot 0{,}5}$$

$$\boxed{F = 68{,}97\,N}$$



$$R = \sqrt{H^2 + N^2}$$

↑: $N = G - F \cdot \sin(\alpha)$

$N = 150\,N - 68{,}97\,N \cdot \sin(40^\circ)$

$N = 105{,}67\,N$

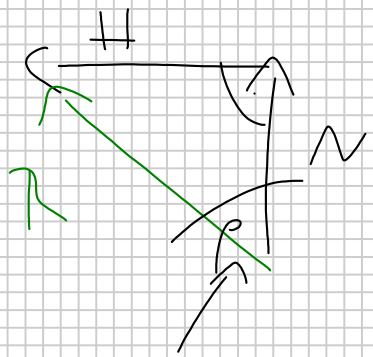
$H = \mu_0 \cdot N$

$H = 0{,}5 \cdot 105{,}67\,N$

$H = 52{,}84\,N$

$R = \sqrt{(105{,}67\,N)^2 + (52{,}84\,N)^2}$

$R = 118{,}14\,N$



$$\tan(\rho) = \frac{H}{N}$$

$$\rho = \arctan\left(\frac{H}{N}\right)$$

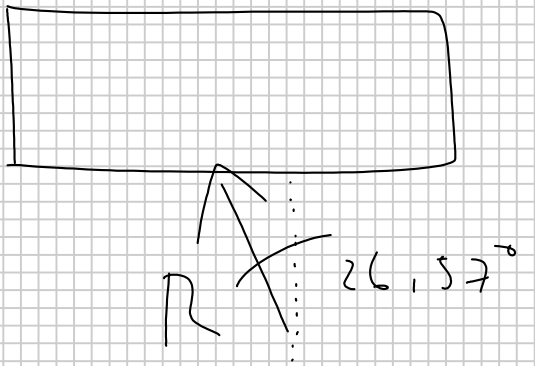
$$H = \mu_0 \cdot N$$

$$\rho = \arctan\left(\frac{\mu_0 \cancel{N}}{\cancel{N}}\right)$$

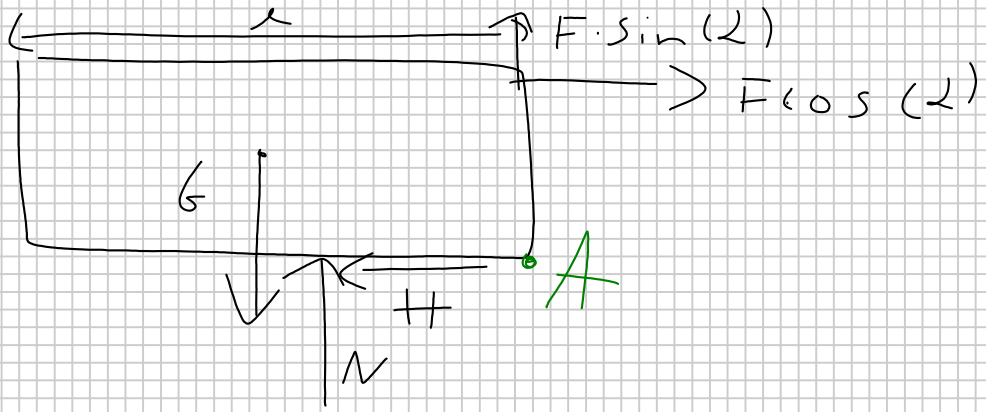
$$\boxed{\rho = \arctan(\mu_0)}$$

$$\rho = \arctan(0,5)$$

$$\boxed{\rho = 26,57^\circ}$$



b)



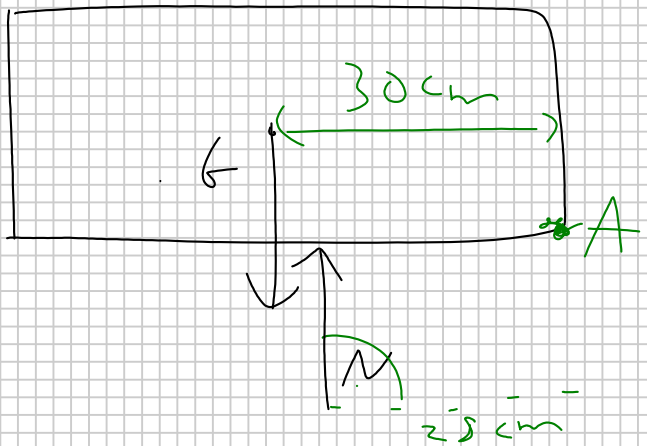
$$(A): \quad \boxed{-N \cdot X} + G \cdot \frac{a}{2} - F \cdot \cos(\alpha) \cdot h = 0$$

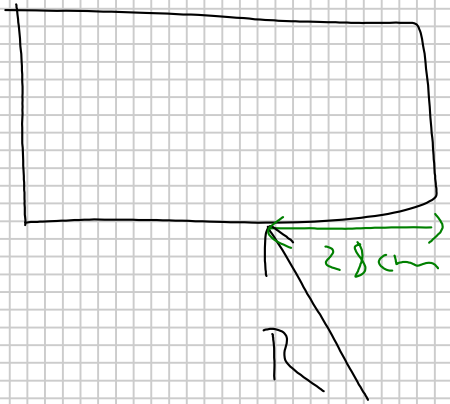
$$X = \frac{G \cdot \frac{a}{2} - F \cdot \cos(\alpha) \cdot h}{N}$$

$$x = \frac{150\,N \cdot \frac{0{,}6\,m}{2} - F \cdot \cos(90) \cdot 0{,}3\,m}{105{,}67\,N}$$

$$x = 0{,}28\,m = 28\,cm$$

→ senkrechter Abstand von N zu A





c)

$$F_0 = \frac{G \mu_0}{\cos(\alpha_0) + \sin(\alpha_0) \mu_0} = N \quad \rightarrow \text{maximieren}$$

$$\frac{\partial N}{\partial \alpha} = -\sin(\alpha_0) + \cos(\alpha_0) \mu_0 = 0$$

$$\sin(\alpha_0) = \cos(\alpha_0) \mu_0 \quad | \cdot \cos(\alpha_0)$$

$$\tan(\alpha_0) = \mu_0$$

$$\alpha_0 = \arctan(\mu_0)$$

$$\alpha_0 = \arctan(0{,}5)$$

$$\boxed{\alpha_0 = 26{,}57°}$$

$$F_0 = \frac{150\,N \cdot 0{,}5}{\cos(26{,}57°) + 1 \sin(26{,}57°) \cdot \mu_0}$$

$$\boxed{F_0 = 67{,}08\,N}$$