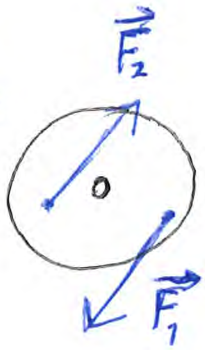
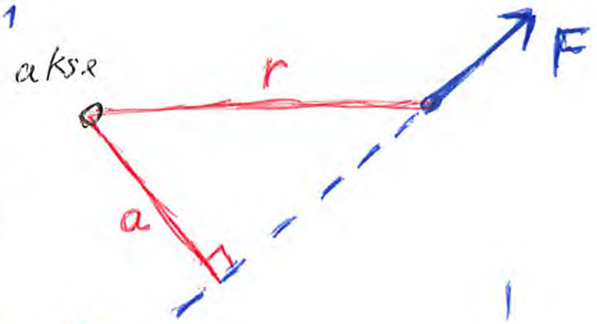
14,01

rotere et hjul med to krefter

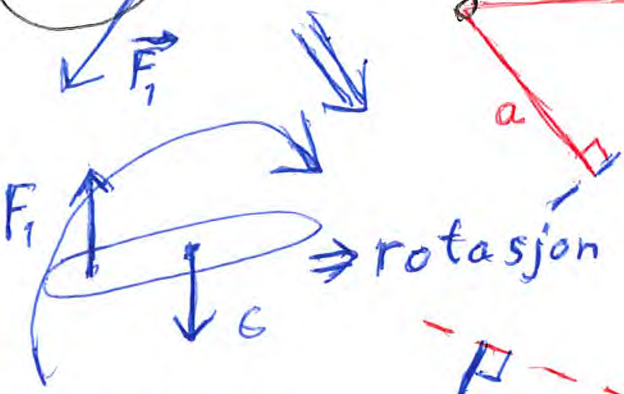


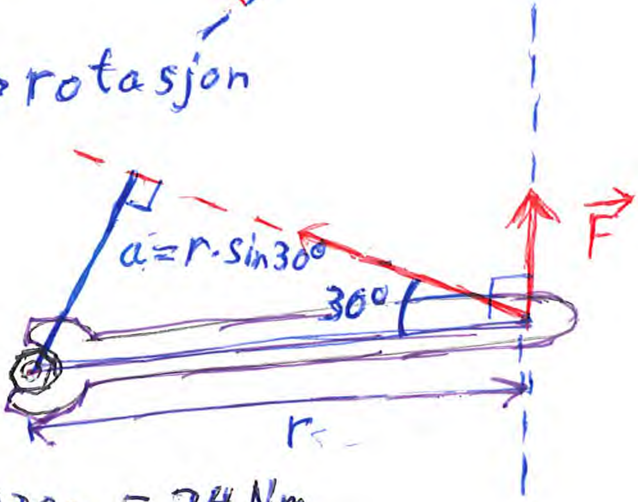
$|\vec{F}_1| = |\vec{F}_2|$

$\vec{F}_2 = -\vec{F}_1$



rotere en pinne i lufta med F_1.





14,02

a) $r = 0{,}30\,m$

$F_1 = 80\,N$

$M = F \cdot a$

$= F_1 \cdot r = 80\,N \cdot 0{,}30\,m = \underline{24\,Nm}$

b) $r = 0{,}15\,m$

$F_2 = ?$

$M = F \cdot a$

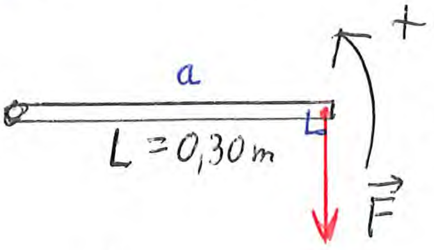
$24\,Nm = F_2 \cdot r$

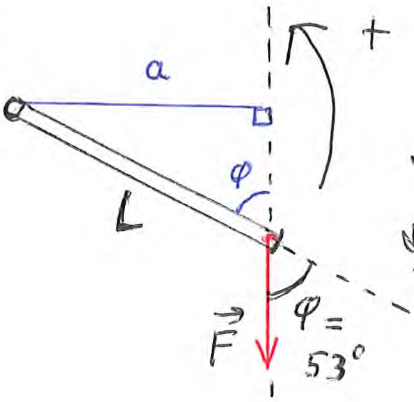
$\frac{24\,Nm}{r} = F_2$

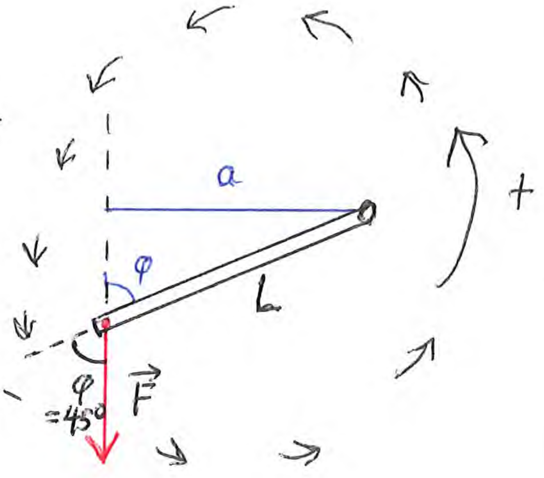
$F_2 = \frac{24\,Nm}{0{,}15\,m} = 160\,N$

$= \underline{0{,}16\,kN}$

14.03 $F = 120\,N$





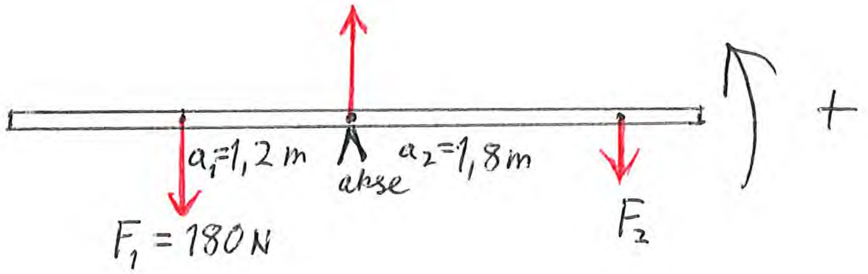


$$M = -aF$$
$$= -L \cdot F$$
$$= -0{,}30\,m \cdot 120\,N$$
$$= \underline{-36\,Nm}$$

$$M = -a \cdot F$$
$$= -L(\sin\varphi)F$$
$$= -0{,}30\,m \cdot (\sin 53^\circ) \cdot 120\,N$$
$$= \underline{-29\,Nm}$$

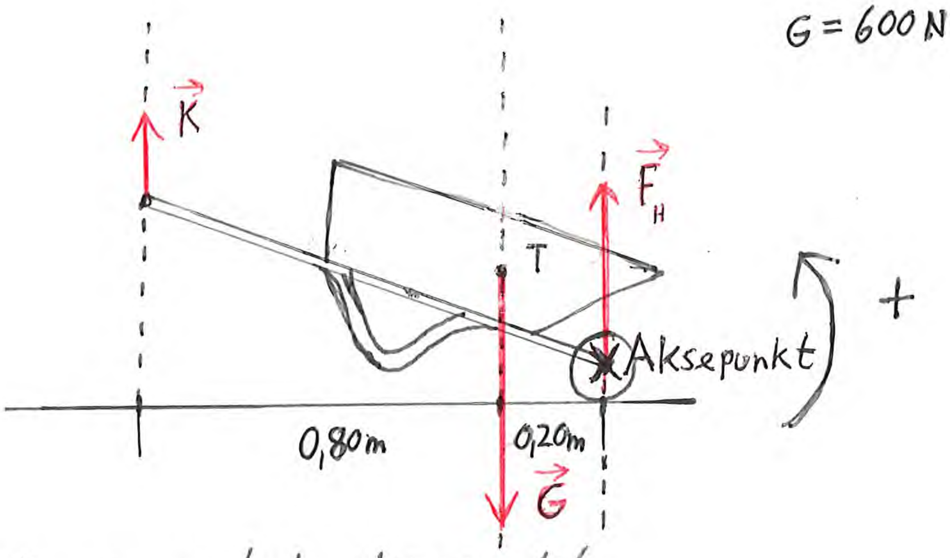
$$M = aF$$
$$= L(\sin\varphi)F$$
$$= 0{,}30\,m \cdot (\sin 45^\circ) \cdot 120\,N$$
$$= \underline{25\,Nm}$$

14.04



$$\Sigma M = 0$$
$$F_1 \cdot a_1 - F_2 \cdot a_2 = 0$$
$$F_1 \cdot a_1 = F_2 \cdot a_2$$
$$\frac{F_1 \cdot a_1}{a_2} = F_2$$
$$F_2 = \frac{180\,N \cdot 1{,}2\,m}{1{,}8\,m} = 120\,N$$
$$= \underline{0{,}12\,kN}$$

14.05



$\Sigma M = 0$ om valgt aksepunkt

$G \cdot a_G - K \cdot a_K = 0$ — $\vec{F}_H$ har arm $= 0$ fordi krafta virker på aksepunktet som vi måler armlengde fra.

$G \cdot a_G = K \cdot a_K$

$600\,N \cdot 0{,}20\,m = K \cdot (0{,}80 + 0{,}20)\,m$

$\frac{600\,N \cdot 0{,}20\,m}{1{,}00\,m} = K$

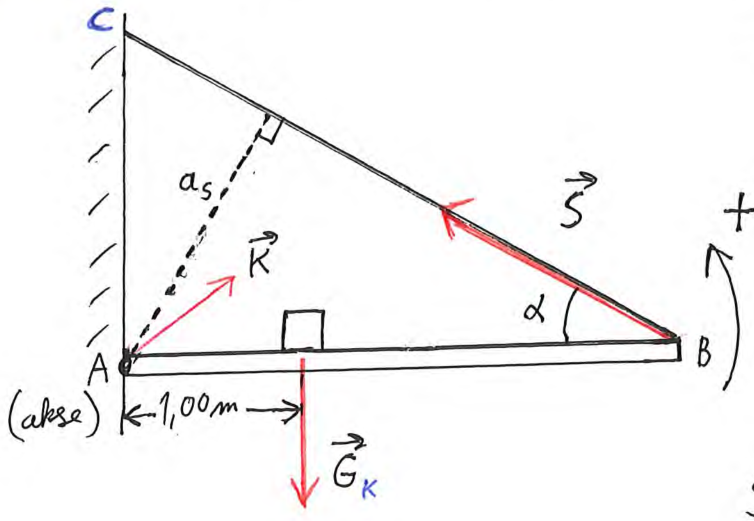
$K = 120\,N$

dvs $\underline{K = 0{,}12\,kN}$

Armlengde er korteste avstand fra linja en kraftvektor ligger på til aksepunktet. Armen må derfor være 90° på den stiplede linja.

Det er to ukjente kreften ved start, K og F_H. Vi velger aksen der en av de ukjente kreftene virker for å fjerne leddet $F \cdot a$ for den krafta fra kraftmomentsummer som da kan gi oss den andre ukjente krafta.

14.06 $AB = 2{,}60\,m$ $\alpha = 30°$ $G_K = 150\,N$



a) $\sum M = 0$

$M_S - M_G = 0$

$S \cdot a_S = G_K \cdot a_G$

$S \cdot AB \cdot \sin\alpha = G_K \cdot a_G$

$S = \dfrac{G_K\, a_G}{AB \cdot \sin\alpha}$

$S = \dfrac{150\,N \cdot 1{,}00\,m}{2{,}60\,m \cdot \sin 30°} = 115{,}3\,N$

$= \underline{0{,}12\,kN}$

b) $\sum \vec{F} = 0$

$\sum F_x = 0$

$K_x - S_x = 0$

$K_x = S_x = S \cdot \cos\alpha$

$K_x = 115{,}2\,N \cdot \cos 30°$

$= 99{,}76\,N$

$= \underline{0{,}10\,kN}$

$\sum F_y = 0$

$K_y + S_y - G_K = 0$

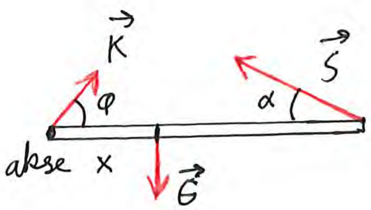
$K_y = G_K - S_y$

$K_y = G_K - S \cdot \sin\alpha$

$K_y = 150\,N - 115{,}2\,N \cdot \sin 30°$

$= 92{,}4\,N = \underline{92\,N}$

c) $S = 200\,N$ før snora ryker.



$\sum M = 0$

$M_G = M_S$

$G \cdot x = S \cdot AB \sin\alpha$

$x = \dfrac{S \cdot AB \cdot \sin\alpha}{G} = \dfrac{200\,N \cdot 2{,}60\,m \cdot \sin 30°}{150\,N}$

$= 1{,}733\,m = \underline{1{,}7\,m}$

d) $K_x = S \cdot \cos\alpha$ som før (med nye tall)

$K_x = 200\,N \cdot \cos 30° = 173{,}2\,N$

$K_y = G - S \cdot \sin\alpha$ som før (nye tall)

$K_y = 150\,N - 200\,N \cdot \sin 30° = 50{,}00\,N$

$K = \sqrt{K_x^2 + K_y^2} = \sqrt{173{,}2^2 + 50{,}00^2}\,N$

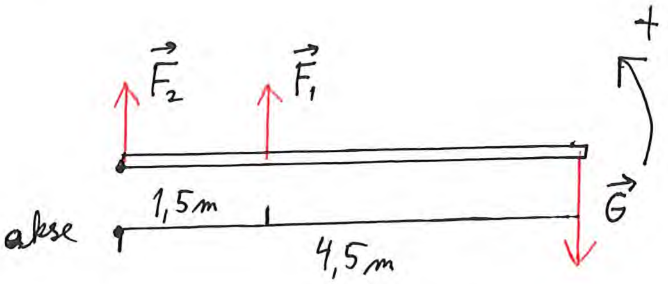
$= 180{,}2\,N = \underline{0{,}18\,kN}$

$\tan\varphi = \dfrac{K_y}{K_x} = \dfrac{50{,}00\,N}{173{,}2\,N}$

$\varphi = \tan^{-1}\left(\dfrac{50{,}00}{173{,}2}\right)$

$\varphi = 16{,}10° = \underline{16°\text{ oppover}}$
<u>fra positiv x-akse.</u>

14.07



$$\sum M = 0$$

$$F_1 \cdot 1{,}5\,m - G \cdot 4{,}5\,m = 0$$

$$F_1 = \frac{mg \cdot 4{,}5\,m}{1{,}5\,m} = 60\,kg \cdot 9{,}81\,\frac{N}{kg} \cdot 3{,}0$$

$$= 1765{,}8\,N$$

$$= \underline{1{,}8\,kN} \quad (\text{opp})$$

$$\sum F_y = 0$$

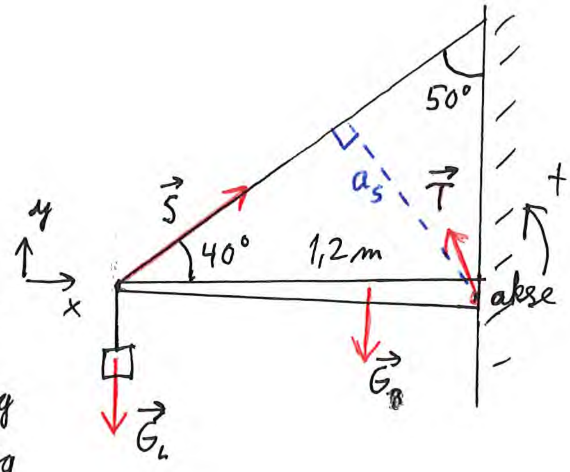
$$F_2 + F_1 = G$$

$$F_2 = G - F_1 = mg - F_1 = 60 \cdot 9{,}81\,N - 1765{,}8\,N$$

$$= -1177{,}2\,N = \underline{-1{,}2\,kN}$$

(ned)

14.08



$S = 85\,N$

$m_L = 5{,}0\,kg$

$m_B = 1{,}5\,kg$

a) $\sum M = 0$

$$G_B \cdot a_B + G_L \cdot a_L - S \cdot a_S = 0$$

$$G_B \cdot a_B = S \cdot a_S - G_L \cdot a_L$$

$$a_B = \frac{S \cdot a_S - m_L \cdot g \cdot a_L}{m_B \cdot g}$$

$$a_B = \frac{85\,N \cdot 1{,}2\,m \cdot \sin 40^\circ - 5{,}0 \cdot 9{,}81\,N \cdot 1{,}2\,m}{1{,}5\,kg \cdot 9{,}81\,\frac{N}{kg}}$$

$$= 0{,}4556\,m = \underline{0{,}46\,m}$$

b) $\sum F_x = 0$

$$S_x + T_x = 0$$

$$T_x = -S_x = -S \cdot \cos 40^\circ$$

$$T_x = -85\,N \cdot \cos 40^\circ$$

$$= -65{,}11\,N$$

$$\sum F_y = 0$$

$$S_y + T_y - G_L - G_B = 0$$

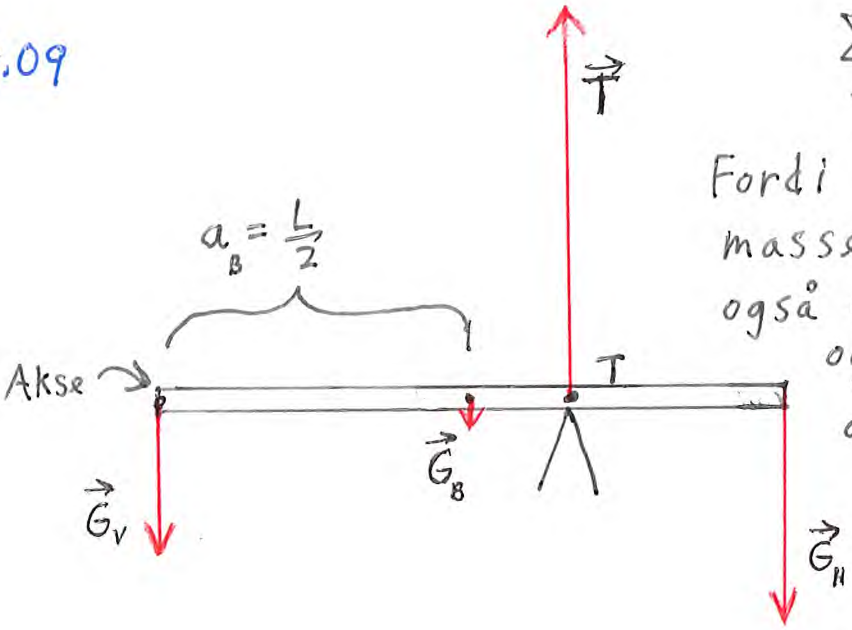
$$T_y = G_L + G_B - S_y$$

$$T_y = (m_L + m_B)g - S \cdot \sin 40^\circ$$

$$T_y = (5{,}0 + 1{,}5) \cdot 9{,}81\,N - 85\,N \cdot \sin 40^\circ$$

$$= 9{,}128\,N$$

14.09



$\sum F = 0$

$T = G_V + G_H + G_B$

Fordi $G = mg$ og alle masser er kjent, er også alle krefter kjent og vi kan velge akseponkt der vi vil, og det passer best i venstre ende fordi vi skal måle lengde derfra.

$a_H = L$

a_T er ukjent. og $L = 4{,}2\,m$

$\sum M = 0$

$T \cdot a_T - G_H \cdot a_H - G_B \cdot a_B = 0$ fordi $a_V = 0$ med akseponkt i venstre ende.

$T \cdot a_T = G_H \cdot L + G_B \cdot \frac{L}{2}$

$(G_V + G_H + G_B) \cdot a_T = \left(G_H + \frac{1}{2} G_B\right) \cdot L$

$(m_V + m_H + m_B) \cdot g \cdot a_T = \left(m_H + \frac{1}{2} m_B\right) \cdot g \cdot L$

$$a_T = \frac{\left(m_H + \frac{1}{2} m_B\right) \cdot L}{(m_V + m_H + m_B)}$$

$$a_T = \frac{\left(1500 + \frac{1}{2} \cdot 120\right) \cdot 4{,}2\,m}{(1000 + 1500 + 120)}$$

$$a_T = \frac{1560}{2620} \cdot 4{,}2\,m = \underline{2{,}5\,m}$$

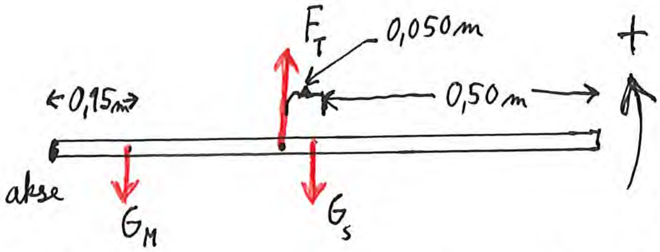
$$T = \sqrt{T_x^2 + T_y^2} = \sqrt{(-65{,}11)^2 + 9{,}128^2}\,N = 65{,}74\,N = \underline{66\,N}$$

$$\tan\varphi = \frac{T_y}{T_x}$$

$$\varphi = \tan^{-1}\left(\frac{|T_y|}{|T_x|}\right)$$

$$\varphi = \tan^{-1}\left(\frac{|9{,}128\,N|}{|-65{,}11\,N|}\right) = \underline{+8{,}0^\circ}$$ dvs opp mot venstre

14.10



$$\sum M = 0$$

$$F_T \cdot 0{,}45\,m - G_M \cdot 0{,}15\,m - G_s \cdot 0{,}50\,m = 0$$

$$F_T \cdot 0{,}45 - G_M \cdot 0{,}15 - G_s \cdot 0{,}50 = 0$$

$m_M = 0{,}0050\,kg$

$G_M = 2 \cdot m_M \cdot g$

$$(m_s + 2m_M) \cdot g \cdot 0{,}45 = 2m_M \cdot g \cdot 0{,}15 + m_s \cdot g \cdot 0{,}50$$

$$(m_s + 2m_M) \cdot 0{,}45 = 2m_M \cdot 0{,}15 + m_s \cdot 0{,}50$$

$$0{,}45\,m_s + 0{,}010\,kg \cdot 0{,}45 = 0{,}010\,kg \cdot 0{,}15 + m_s \cdot 0{,}50$$

$$(0{,}45 - 0{,}15) \cdot 0{,}010\,kg = (0{,}50 - 0{,}45) \cdot m_s$$

$$0{,}30 \cdot 0{,}010\,kg = 0{,}05 \cdot m_s$$

$$m_s = \frac{0{,}30 \cdot 0{,}010\,kg}{0{,}050} = \underline{0{,}060\,kg}$$