BIOMECHANICA – Het Locomotorisch Stelsel

Oefeningen p 9

1. • $m_{hand} = \frac{1,70}{2} \cdot 0,75 = 0,64$ kg

$m_{voorarm} = \frac{4,2}{2} \cdot 0,75 = 1,58$ kg

$m_{bovenarm} = \frac{6,6}{2} \cdot 0,75 = 2,48$ kg

• afstanden tt persoons. 1,80 m : a) X – coördinaat

schouder – MC bovenarm = $(81,16 - 71,74) \cdot 1,80 = 16,956$ cm

schouder – elleboog = $(81,16 - 62,20) \cdot 1,80 = 34,128$ cm

b) Y – coordinaat

elleboog – MC onderarm = $(62,20 - 55,33) \cdot 1,80 = 12,366$ cm

elleboog – MC hand = $(62,20 - 43,13) \cdot 1,80 = 34,326$ cm

$$x_{MC} = \frac{0,64 \cdot 34,128 + 1,58 \cdot 34,128 + 2,48 \cdot 16,956}{0,64 + 1,58 + 2,48}$$

$$= 25,07$$

$$y_{MC} = \frac{0,64 \cdot 34,326 + 1,58 \cdot 12,366 + 2,48 \cdot 0}{0,64 + 1,58 + 2,48}$$

$$= 8,83$$

2. $$x_z = \frac{10.4 + 40.3 + 80.0,5}{7,5} = 26,67$$

$$y_z = \frac{60.4 + 10,3 + 20.0,5}{7,5} = 37,33$$

3. $$x_z = \frac{z_1 \cdot x_{z_1} + 2(z_2 \cdot x_{z_2} + z_3 \cdot x_{z_3} + z_4 \cdot x_{z_4}) + z_5 \cdot x_{z_5} + 2(z_6 x_{z_6} + z_7 x_{z_7} + z_8 \cdot x_{z_8})}{z_1 + 2(z_2 + z_3 + z_4) + z_5 + 2(z_6 + z_7 + z_8)}$$

$$= 34,59$$

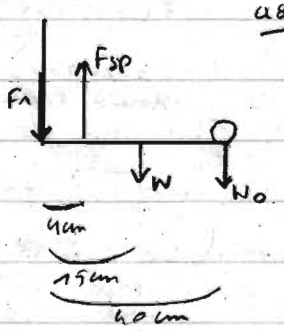
$$y_z = 56,35$$

Oefeningen p 20

1 a&b) $\Sigma \vec{F}_i = 0 \quad +0,04 \cdot F_{sp} - 0,15 \cdot 20 - 0,40 \cdot 49,05 = 0$

$F_{sp} = 565,5$

Ik heb maakt met uit

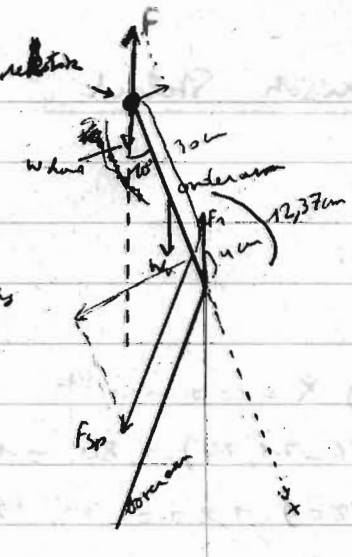


zu Hebel p7

$W_v = 1{,}58\,kg \cdot 9{,}81\,\frac{N}{kg} = 15{,}50\,N$

$W_h = 0{,}64\,kg \cdot 9{,}81\,N/kg = 6{,}29\,N$

2)



$F = 75\,kg \cdot 9{,}81\,\frac{N}{kg} = 735{,}75\,N$

$\sum \bar{\tau}_i = 0 \quad (+ W_h \cdot 0{,}34 \cdot \sin 20° + W_v \cdot \sin 10° \cdot 0{,}1237)$

$-\frac{F}{2} \cdot 0{,}34 \cdot \sin 10° + F_{sp} \cdot 0{,}04 \cdot \sin 20° = 0$

$\Rightarrow F_{sp} = 1536{,}11\,N$

$F_{sp} - F_n - \frac{F}{2} = 0$ $\quad F_{nx}: F_{sp} F \cdot \cos 10° + W_h \cdot \cos 10° + W_v \cdot \cos 10° + F_{sp} \cdot \cos 20° = 0$

$\Rightarrow F_{nx} = -1109{,}66\,N$

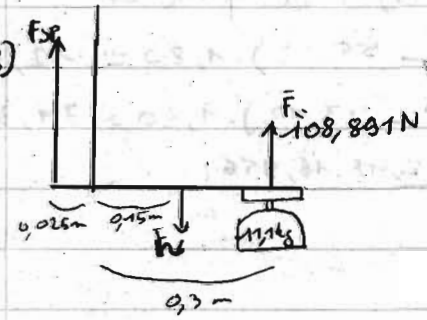
$F_n = 3195{,}18\,N - 735{,}75\,N = 2459{,}43\,N$

$F_{ny}: F_{ny} + \frac{F}{2} \cdot \sin 10° + W_h \cdot \sin 10° + W_v \cdot \sin 10° + F_{sp} \cdot \sin 20° = 0$

$\Rightarrow F_{ny} = +465{,}28$

$\Rightarrow F_n = \sqrt{F_{nx}^2 + F_{ny}^2} = 1196{,}79$

3)



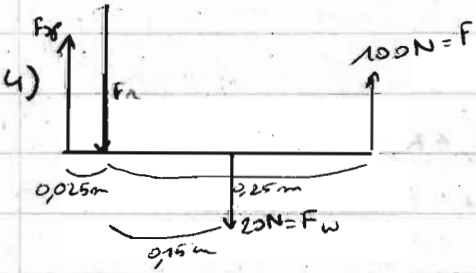
$F = 11{,}1\,kg \cdot 9{,}81\,\frac{N}{kg}$

$F_W = 2{,}2\,kg \cdot 9{,}81\,\frac{N}{kg} = 21{,}582\,N$

$\sum \bar{\tau}_i = 0 \quad -F_{sp} \cdot 0{,}025 - 21{,}582 \cdot 0{,}150 + 108{,}891 \cdot 0{,}3 = 0$

$\Rightarrow F_{sp} = 1177{,}2$

4)



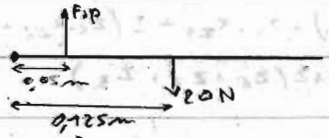
$\sum \bar{\tau}_i = 0 \quad -F_{sp} \cdot 0{,}025 - 20 \cdot 0{,}15 + 100 \cdot 0{,}25 = 0$

$F_{sp} = 880\,N$

$-F_n + F_{sp} - F_W + F = 0$

$F_n = 960\,N$

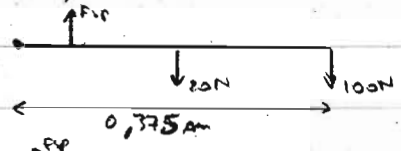
5) a)



$\sum \bar{\tau}_0 = 0 \Rightarrow 0{,}05 \cdot F_{sp} - 0{,}125 \cdot 20 = 0$

$\Rightarrow F_{sp} = 50\,N \rightarrow$ stabilisierend $\rightarrow$ 50N stabilisierend

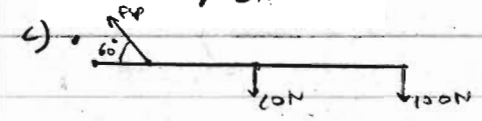
b)



$\sum \bar{\tau}_0 = 0 \Rightarrow 0{,}05 \cdot F_{sp} - 0{,}125 \cdot 20 - 0{,}375 \cdot 100 = 0$

$\Rightarrow F_{sp} = 800\,N \rightarrow$ stabilisierend

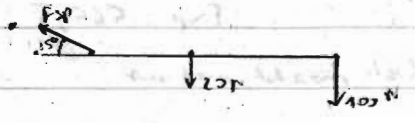
c)



$\sum \bar{\tau}_0 = 0 \Rightarrow 0{,}05 \cdot F_{sp} \cdot \sin 60° - 0{,}125 \cdot 20 - 0{,}375 \cdot 100 = 0$

$\Rightarrow F_{sp} = 924\,N$ $\quad$ stabilisierend: 462N, rotierend: 800N

$F_{ny} = -800 + 20 + 100 = -680\,N$; $F_{nx} = +462\,N$ $\Rightarrow F_n = \sqrt{F_{nx}^2 + F_{ny}^2} = 822\,N$



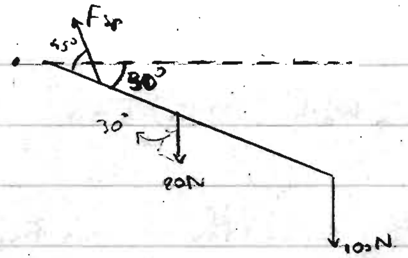
$\sum \bar{\tau}_0 = 0 \Rightarrow F_{sp} \cdot 0{,}05 \cdot \sin 15° - 0{,}125 \cdot 20 - 0{,}375 \cdot 100 = 0$

$\Rightarrow F_{sp} = 3091$ $\quad$ stabilisierend: 2986N, rotierend: 800N

$F_{ny} = -800 + 20 + 100 = -680\,N$; $F_{nx} = 2986\,N$ $\Rightarrow F_n = \sqrt{F_{nx}^2 + F_{ny}^2} = 3062$

$\sum \bar{\tau}_0 = 0 \Rightarrow 0{,}05 \cdot \sin 45° \cdot F_{sp} - 0{,}125 \cdot \cos 30° \cdot 20N - 0{,}375 \cdot \cos 30° \cdot 100N = 0$

$\Rightarrow F_{sp} = 980\,N$ $\quad$ stabilisierend: 693N, rotierend: 693N



$\Sigma \tau_O = 0 \Rightarrow +0{,}05 \cdot \sin 45° \cdot F_{sp} - 0{,}125 \cdot 20N \cdot \cos 30° - 0{,}375 \cdot 100N \cdot \cos 30° = 0$

$\Rightarrow F_{sp} = 980 N$ ↳ rotatie: 693 N; stabiliteit: 693 N

$F_{1y} = -693 + \cos 30° \cdot 20 + \cos 30° \cdot 100 = -589$

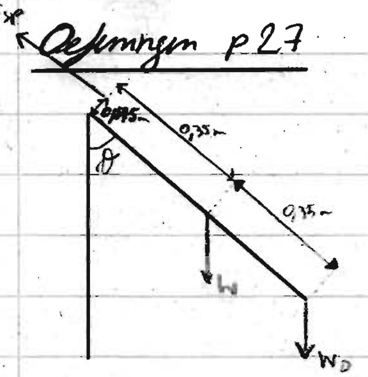
$F_{1x} = -693 + \sin 30° \cdot 20 + \sin 35° \cdot 100 = -633$

$\Rightarrow F_1 = 865 N$

d) hoek spierkracht, grootte spierkracht ???

Oefeningen p27

1)



$W_0 = 9 kg \cdot 9{,}81 N/kg = 88 N$

$W = \frac{6{,}5}{100} \cdot 79 kg \cdot 9{,}81 N/kg = 50 N$

$\Sigma \tau_0 = 0 \Rightarrow 0{,}075 \cdot F_{sp} - W \cdot \sin\vartheta \cdot 0{,}35 - W_0 \cdot \sin\vartheta \cdot 0{,}70 = 0$

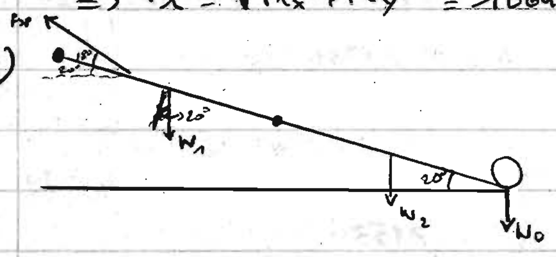
$\Rightarrow F_{sp} = 1055 N \cdot \sin\vartheta$

$\Sigma F_x = 0 \Rightarrow F_{1x} - F_{sp} = 0 \Rightarrow F_{1x} = 1055 N \cdot \sin(90°)$

$\Sigma F_y = 0 \Rightarrow F_{1y} - W - W_0 \Rightarrow F_{1y} = 138 N$

$\Rightarrow F_1 = \sqrt{F_{1x}^2 + F_{1y}^2} = 1064 N$

2)



$W_1 = 3{,}0 kg \cdot 9{,}81 N/kg = 29{,}43 N$

$W_2 = 2{,}5 kg \cdot 9{,}81 N/kg = 24{,}53 N$

$W_0 = 3{,}5 kg \cdot 9{,}81 N/kg = 34{,}36 N$

$\Sigma \tau_0 = +F_{sp} \cdot \sin 18° \cdot 0{,}05 - W_1 \cdot \cos 20° \cdot 0{,}16 - W_2 \cdot \cos 20° \cdot 0{,}56 - W_0 \cdot \cos 20° \cdot 0{,}70 = 0$

$\Rightarrow F_{sp} = 861{,}54 N$

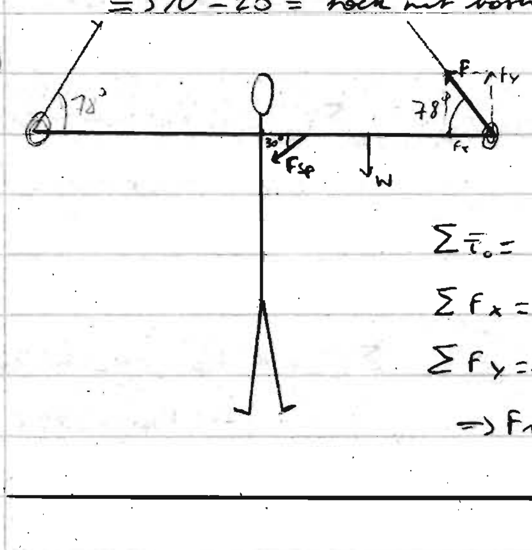
$\Sigma F_x = F_{1x} - F_{sp} \cdot \cos 38° = 0 \Rightarrow F_{1x} = 678{,}90 N$

$\Sigma F_y = F_{1y} + \sin 38° \cdot F_{sp} - W_1 - W_2 - W_0 = 0 \Rightarrow F_{1y} = -442{,}10$

$\Rightarrow F_1 = 810{,}16$; $\tan\vartheta = \frac{F_{1y}}{F_{1x}} \Rightarrow \vartheta = 33{,}07$

$\Rightarrow \vartheta - 20° =$ hoek met horizon $= 13{,}07°$

3)



$W = 3{,}3 kg \cdot 9{,}81 \frac{N}{kg} = 32{,}372 N$

$F_y = 65 kg \cdot 9{,}81 \frac{N}{kg} \div 2 = 318{,}825$ ↳ 2 armen! $\Rightarrow F = F_y \cdot \sin 78° = 311{,}86 N$

$\Sigma \tau_0 = -F_{sp} \cdot \sin 30° \cdot 0{,}07 - W \cdot 0{,}25 + F_y \cdot 0{,}60 = 0 \Rightarrow F_{sp} = 5234 N$

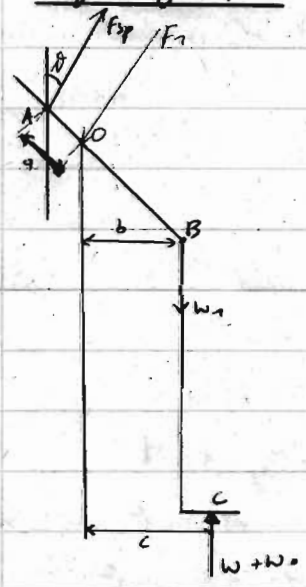
$\Sigma F_x = -F_{sp} \cdot \cos 30° + F_{1x} - F \cdot \cos 78° = 0 \Rightarrow F_{1x} = 4598 N$

$\Sigma F_y = -F_{sp} \cdot \sin 30° + F_{1y} - W + F \cdot \sin 78° = 0 \Rightarrow F_{1y} = 2344{,}33 N$

$\Rightarrow F_1 = 5161 N$, $\vartheta = 27°$

Ćwiczenie p 38

1)



$\Sigma \bar{\tau}_0 = +F_{sp} \cos\theta \cdot a - W_1 \cdot b + (W+W_0) \cdot c = 0$

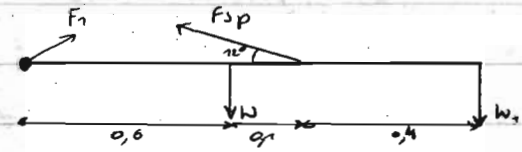
$F_{sp} = 14{,}7\,W$

$\Sigma F_y = F_{sp} \cos\theta - W_1 + W + W_0 + F_{1y} = 0 \Rightarrow F_{1y} = -12\,W$

$\Sigma F_x = F_{sp} \sin\theta + F_{1x} = 0 \Rightarrow F_{1x} = -10\,W$

$\left(\Rightarrow F_1 = \sqrt{F_{1x}^2 + F_{1y}^2} = 15{,}6\,W \right)$

2)



a) $\Sigma \bar{\tau}_1 = 0 \Rightarrow +F_{sp} \cdot \sin 12^\circ \cdot 0{,}7 - W \cdot 0{,}6 - W_1 \cdot 1 = 0 \Rightarrow F_{sp} = 2020\,N$

$\Sigma F_x = -\cos 12^\circ \cdot F_{sp} + F_{1x} = 0 \Rightarrow F_{1x} = 1976\,N$

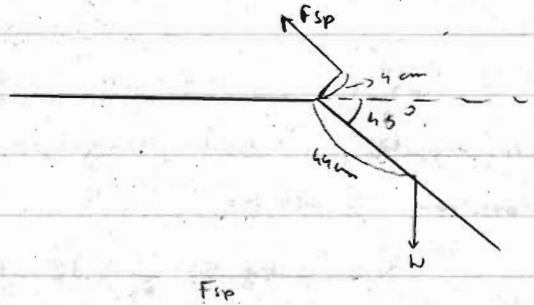
$\Sigma F_y = \sin 12^\circ \cdot F_{sp} - W + F_{1y} = 0 \Rightarrow F_{1y} = 70\,N$

b) $\Sigma \bar{\tau}_1 = 0 \Rightarrow +F_{sp} \cdot \sin 12^\circ \cdot 0{,}7 - W \cdot 0{,}6 - W_1 \cdot 1 = 0 \Rightarrow F_{sp} = 3223\,N$

$\Sigma F_x = -\cos 12^\circ \cdot F_{sp} + F_{1x} = 0 \Rightarrow F_{1x} = 3153\,N$

$\Sigma F_y = +\sin 12^\circ \cdot F_{sp} - W - W_1 + F_{1y} = 0 \Rightarrow F_{1y} = -5\,N$

3) (1)

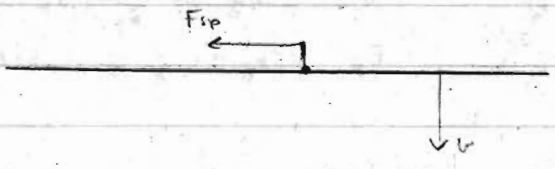


$W = 37\,kg \cdot 9{,}81 \frac{N}{kg} = 363\,N$

$\Sigma \bar{\tau}_0 = 0 \Rightarrow F_{sp} \cdot 0{,}04 - W \cdot 0{,}44 \cdot \sin 45^\circ = 0$

$\Rightarrow F_{sp} = 2823$

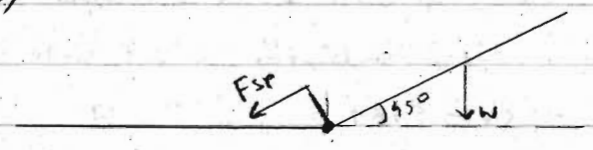
(2)



$\Sigma \bar{\tau}_0 = 0 \Rightarrow F_{sp} \cdot 0{,}04 - W \cdot 0{,}44 = 0$

$\Rightarrow F_{sp} = 3993$

(3)



$\Sigma \bar{\tau}_0 = 0 \Rightarrow F_{sp} \cdot 0{,}04 - W \cdot \cos 45^\circ \cdot 0{,}44 = 0$

$\Rightarrow F_{sp} = 2823$

Oefeningen p 50

1. a) $\Sigma \tau_0 = 0 \qquad -W \cdot x + \frac{W}{6}(0{,}30 + x) = 0$

$\Rightarrow -x + \frac{0{,}30}{6} + \frac{x}{6} = 0$

$\Rightarrow \frac{5x}{6} = \frac{-0{,}30}{6}$

$\Rightarrow x = 0{,}06\ m$ of 6 cm

b) $\Sigma \tau_i = 0 \qquad -N \cdot 0{,}05 - W_{bem} \cdot 0{,}03 + \sin 71° \cdot F_{sp} \cdot 0{,}07 = 0$

$\Rightarrow F_{sp} = 622{,}8\ N$

$\Sigma F_y = 0 \quad \Rightarrow +F_{sp} \cdot \sin 71° - W_{bem} + N + F_{Ay} = 0 \quad \Rightarrow F_{Ay} = -1192{,}5\ N$

$\Sigma F_y = 0 \quad \Rightarrow \cos 71° \cdot F_{sp} + F_{Ax} = 0 \quad \Rightarrow F_{Ay} = -202{,}76\ N$

$\Rightarrow F_A = \sqrt{F_{Ax}^2 + F_{Ay}^2} = 1210\ N$

---

2. $\Sigma_\tau (hengsel) = 0 \qquad -W \cdot 0{,}12 + F_{sp} \cdot \Delta_\perp = 0 \quad \Rightarrow F_{sp} = 1289\ N$

$\Sigma_\tau (bem) = 0 \qquad -F_{sp} \cdot 0{,}07 + F \cdot 0{,}35 = 0 \quad \Rightarrow F = 258\ N$

Oefeningen p 64

1. a). bep F_1:

$\Sigma \tau_i = 0 \Rightarrow +F_1 \cdot \frac{I_A}{\cos 30°} - F_m \cdot 1{,}30 = 0$ ($F_m = m \cdot 9{,}81\ N/kg$, m = 1 kg)

$\Rightarrow F_1 = 57{,}5\ N$

. bep F_{sp}:

$\Sigma \tau_i = 0 \Rightarrow +F_{sp} \cdot 0{,}05 - N_b \cdot 0{,}20 - F_1 (I_A - I_K) = 0$

$\Rightarrow F_{sp} = 707\ N$

b). bep F_2:

$\Sigma \tau_i = 0 \Rightarrow +F_2 \cdot \frac{I_B}{\cos 30°} - F_m \cdot 1{,}30 = 0$

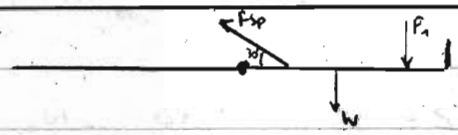
$\Rightarrow F_2 = 78\ N$

. bep. F_{sp}

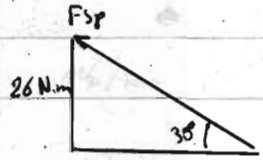
$\Sigma \tau_i = 0 \Rightarrow +F_{sp} \cdot 0{,}05 - N_b \cdot \sin 45° \cdot 0{,}20 - F_2 \left(\frac{I_A}{T} - I_K\right) \cdot \sin 45° = 0$

$\Rightarrow F_{sp} = 647\ N$

2.

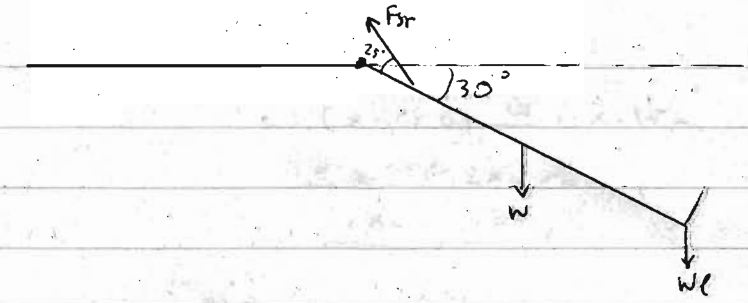


$\Sigma \tau_i = 0 \Rightarrow 26\ N.m - 50N \cdot 0{,}12m + F_1 \cdot 0{,}375 = 0 \quad \Rightarrow F_1 = -53{,}3\ N$



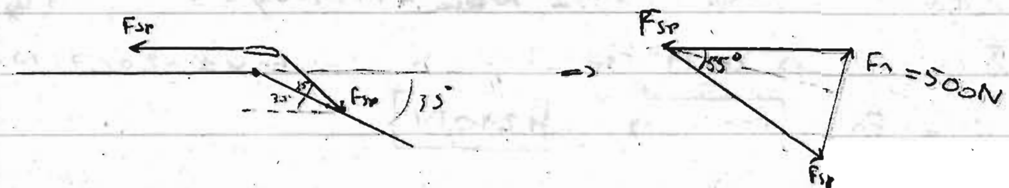
$\Rightarrow \frac{26\ N.m}{0{,}05\ m} = 520N \qquad \frac{520N}{\sin 30°} = F_{sp} = 1040$

3.



$\Sigma T_i = 0 \Rightarrow F_{sp} \cdot \sin 25° \cdot 0{,}05 - W \cdot \sin 60° \cdot 0{,}25 - F_l \cdot \sin 60° \cdot 0{,}37 = 0$

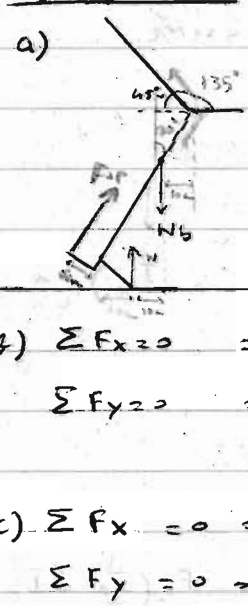
$F_{sp} = \dfrac{W \cdot \sin 60° \cdot 0{,}25 + F_l \cdot \sin 60° \cdot 0{,}37}{\sin 25° \cdot 0{,}05}$ (1)



$F_{sp} = \dfrac{250N}{\sin 27{,}5°} = 541{,}42$ in (1) $\Rightarrow F_l = 8{,}7\,N$

Oefeningen p 68

1. a)



$\Sigma T_i = 0 \Rightarrow -F_{sp} \cdot 0{,}06 + \frac{W}{2} \cdot 0{,}10 = 0 \Rightarrow F_{sp} = 613N$ (1 been)

gn rekening gehouden met zwaartekracht op been zelf

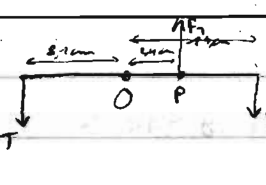
b) $\Sigma F_x = 0 \Rightarrow F_{sp} \cdot \sin 30° + F_{1x} = 0 \Rightarrow F_{1x} = -306{,}5\,N$
$\Sigma F_y = 0 \Rightarrow F_{sp} \cdot \cos 30° + \frac{W}{2} + F_{1y} = 0 \Rightarrow F_{1y} = -891{,}7N$
$\Rightarrow F_1 = 949N$

c) $\Sigma F_x = 0 \Rightarrow F_{1x} - \cos 45° \cdot 991N - \cos 70° \cdot 991N = 0 \Rightarrow F_{1x} = 1040N$
$\Sigma F_y = 0 \Rightarrow F_{1y} + \sin 45° \cdot 991N - \sin 70° \cdot 991N = 0 \Rightarrow F_{1y} = 239{,}5N$
$\Rightarrow F_1 = 1065N$

---

2. $\Sigma T_i = 0 \Rightarrow -2100 \cdot d_3 + 10{,}15 \cdot d_2 + F_{sp} \cdot d_1 = 0 \Rightarrow F_{sp} = 6290N$

3.



$\Rightarrow$ ① In P: $\Sigma T_i = 0$ $T \cdot 0{,}105 - W_b \cdot 0{,}116 = 0$
$\Rightarrow T = 597N$

② In O: $\Sigma T_i = 0$ $T \cdot 0{,}081 + F_1 \cdot 0{,}024 - W_b \cdot 0{,}14 = 0$
$\Rightarrow F_1 = 1135N$