Kap 1

Numreringen avser upplaga 3 om inget annat anges

1.11 $M_A = F\cos 30° \cdot a \sin 60° - F \sin 30° \cdot (a + a \cos 60°) = 0$

$M_B = F \sin 30° \cdot a \cos 60° + F \cos 30° \cdot (a - a \sin 60°) \approx 0{,}366 Fa$ moturs

$M_C = F \cos 30° \cdot a \sin 60° + F \sin 30° (a - a \cos 60°) = Fa$ medurs

1.13 $M_C = (80 \cos 15° \cdot 0{,}06 - 80 \sin 15° \cdot 0{,}05)$ Nm $=$

$= 3{,}60$ Nm medurs

1.14 a) $M_O = (8 \cos 25° \cdot 4 + 8 \sin 25° \cdot 3)$ Nm $\approx 39{,}1$ Nm moturs

b) $M_B = (8 \cos 25° \cdot 7 + 8 \sin 25° \cdot 6)$ Nm $\approx 71{,}0$ Nm moturs

c) $M_C = 8 \sin 25° \cdot 3$ Nm $\approx 10{,}1$ Nm moturs

d) $M_D = (8 \sin 25° \cdot 6 - 8 \cos 25° \cdot 2)$ Nm $\approx 5{,}8$ Nm moturs

e) $M_B = (8 \cos 25° \cdot 4 + 8 \sin 25° \cdot 2)$ Nm $\approx 35{,}8$ Nm medurs

1.15 Låt $a = 20$ mm

$b = 100$ mm

$F = 150$ N

Dela upp F i komposanterna $F \sin\alpha$ och $F \cos\alpha$.

Deras momentarmar: $(b + a\cos 70°)$, $a \sin 70°$

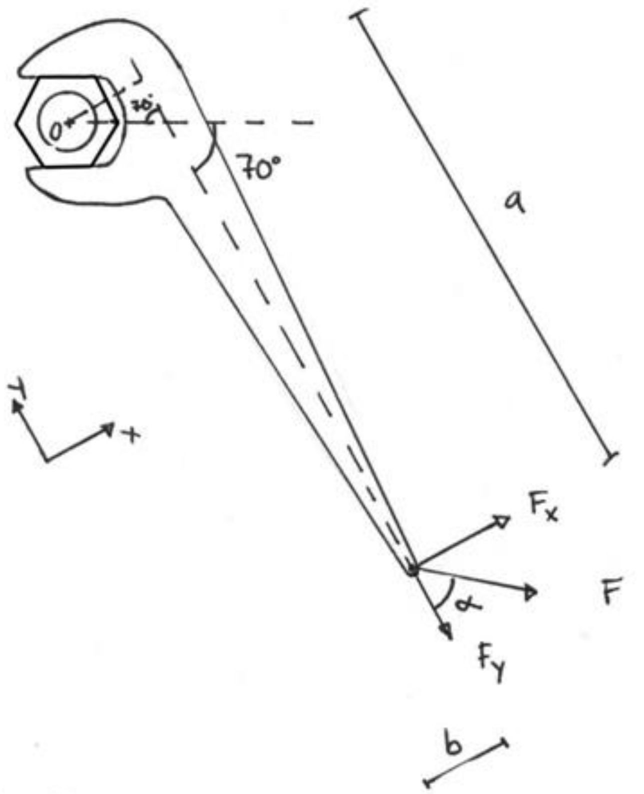
$M_O = F \sin\alpha\,(b + a \cos 70°) - F \cos\alpha \cdot a \sin 70°$

a) Låt $\alpha = 75°$

b) Max och min av $|M_O|$ fås genom studium av

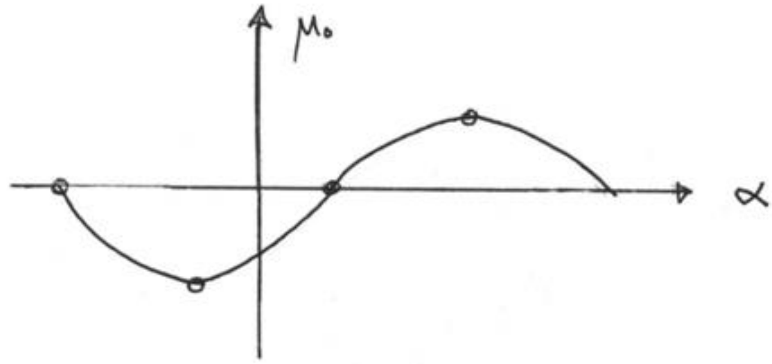
funktionen $M_0(\alpha)$ och derivatan $\frac{dM_0}{d\alpha}$.
Alternativt, geometriskt: $|M_0|$ har minimum då F:s verkningslinje passerar O och maximum då F är vinkelrät mot linjen mellan O och F:s angreppspunkt.

1.15

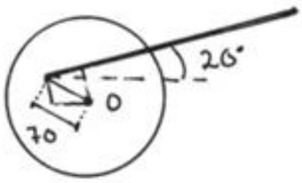


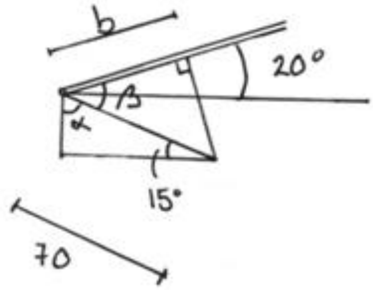
$\curvearrowleft O: F_x \cdot a - F_y \cdot b = 0$

b) Plotta kurvan enl. nedan.



1.16 Dela upp kraften i en horisontell och en vertikal komposant, och utnyttja Varignons teorem.



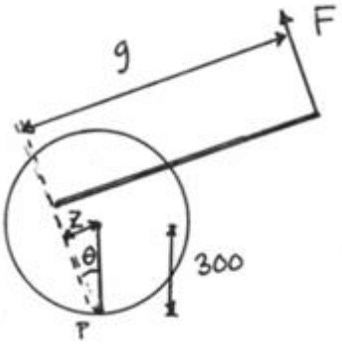


$x = 580 - b$

$b = \cos(\beta) \cdot 70$

$M_o = F \cdot x$

b)



likformighet $\Rightarrow \theta = 20°$

$M_P = F \cdot g$

1.18 a) $\sum F = (0, F) + (F, 0) + (0, 2F) = F(1, 3)$

b) $\sum M_O = -F \cdot 2a + 2F \cdot 2a = 2Fa$ moturs

c) $\sum M_A = Fa + 2F \cdot 3a = 7Fa$ moturs

d) $\sum M_B = Fa + Fa + 2F \cdot 3a = 8Fa$ moturs

e) $\sum M_C = Fa + F \cdot 2a - 2Fa = Fa$ medurs

1.20 a) $100\,N \cdot 50\,mm = 5\,Nm$

b), c) $100\,N \cdot \sin 30° \cdot 50\,mm = 2{,}5\,Nm$

d) $200\,N \cdot \sin 30° \cdot 50\,mm = 5\,Nm$

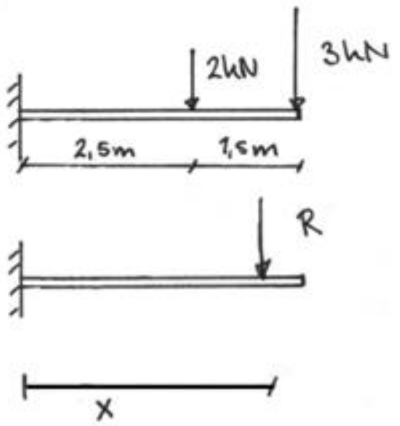
e) $100\,N \cdot 150\,mm = 15\,Nm$

f), g) $100\,N \cdot 50\,mm = 5\,Nm$

Alla moturs

1.22 a) $\sum F = (150 \sin 30°,\ 150 \cos 30°)\,N +$
$+ (200 \cos 40°,\ 200 \sin 40°)\,N +$
$+ (-150 \cos 60°,\ 150 \sin 60°)\,N \approx (153,\ 388)\,N$

b) $\overset{\curvearrowleft}{\sum M_z} = (-150 \sin 30° \cdot 1 - 200 \cos 40° \cdot 3 +$
$+ 200 \sin 40° \cdot 2 + 150 \cos 60° \cdot 2 +$
$+ 150 \sin 60° \cdot 4 + 350 - 300)\,Nm = 342\,Nm$

1.23 a) 

$(\uparrow)$: $2 + 3 = R$

$(\curvearrowleft 0)$: $2 \cdot 2{,}5 + 3 \cdot (2{,}5 + 1{,}5) = R \cdot x$

1.24 a) $(150 - 100)\,\text{N} = 50\ \text{N}$ nedåt

b) $(150 \cdot 0{,}25 + 40 - 100 \cdot 0{,}75)\,\text{Nm} = 2{,}5\ \text{Nm}$ medurs

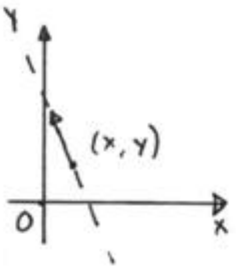
1.27 a) Beräkna de resulterande krafterna i x- och y-riktning.

$$R_x = \Sigma F_x$$
$$R_y = \Sigma F_y$$

Beräkna momentet i origo

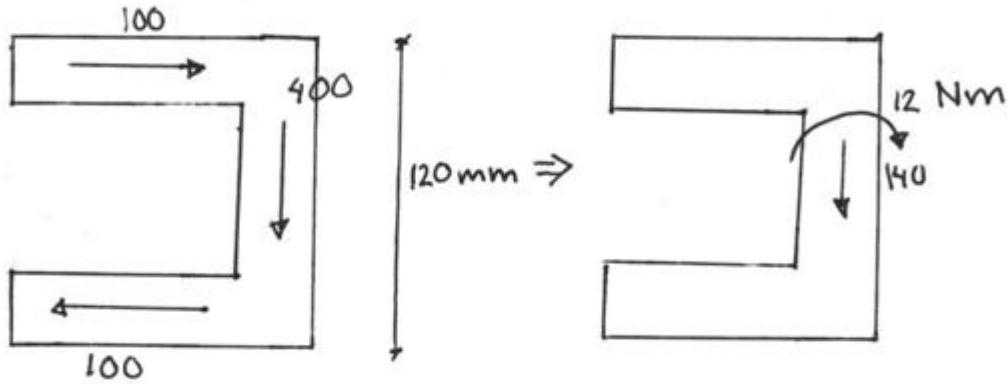
$$\Sigma M_0$$

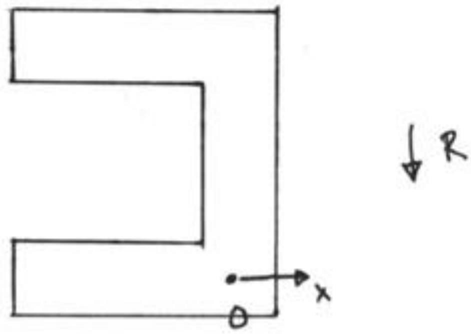
b) Låt x, y vara mätetalen för koordinaterna mätta i meter. Verkningslinjen ges av:



$$\Sigma M_0 = R_y\, x + |R_x|\, y$$

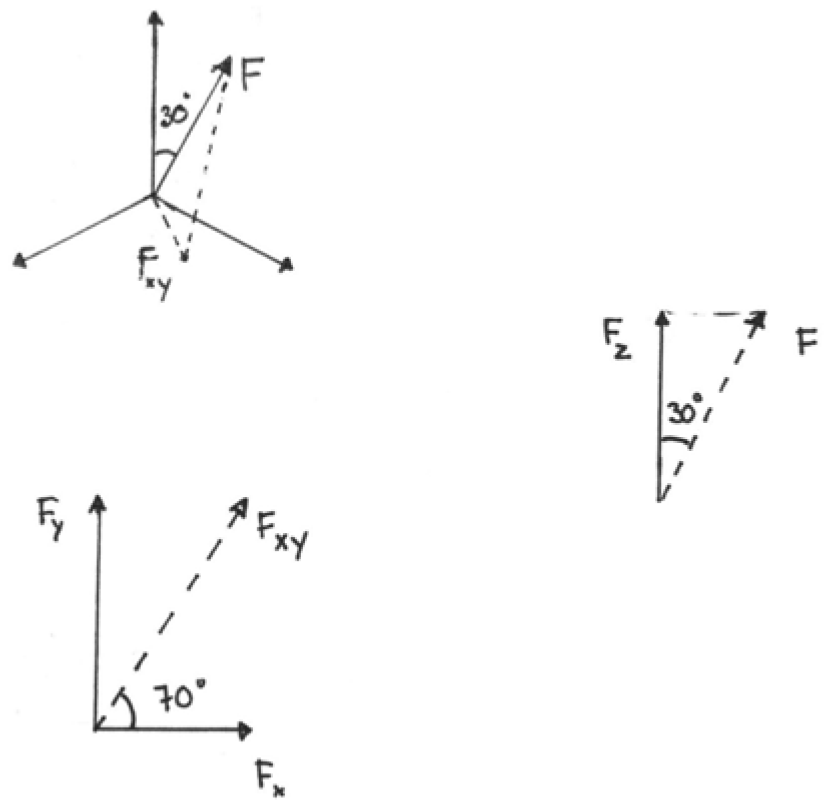
1.32



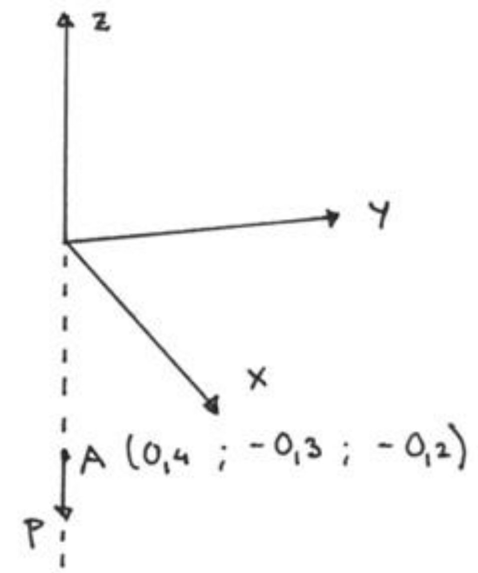


$$\Sigma M_0 = R \cdot x$$

1.33



1.35
endast
upplaga 2



$\underset{\sim}{P} = P \cdot e_P$

1.37
endast
upplaga 2

$|F_{nor}| = \sqrt{641^2 + 320^2}$ N $= 716$ N

använd sambandet $F_\lambda = F e_\lambda$

1.41 endast upplaga 2

$$\mu_o = \underset{\sim}{r} \times \underset{\sim}{P}$$

$$\mu_o = (\mu_x, \mu_y, \mu_z)$$

1.46 Kraften är $S = 17 \frac{\overrightarrow{DA}}{|\overrightarrow{DA}|}$ kN

$$M_o = \overrightarrow{OD} \times S$$

1.50 endast upplaga 2

Byt ut "A" mot "B" i uttrycket för S i ex 1.49

Byt ut "B" mot "C" i S-uttrycket

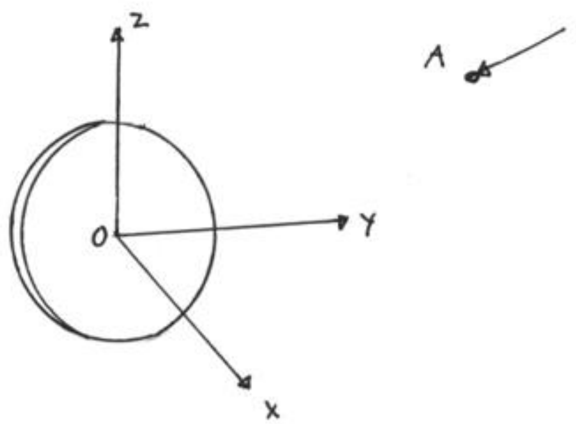
1.47 a) μ_{OA} = momentarm × kraft

från O till pilens angreppspunkt

b) $\mu_o = \underset{\sim}{r} \times \underset{\sim}{F}$

$\mu_o = (\mu_x, \mu_y, \mu_z)$

1.48

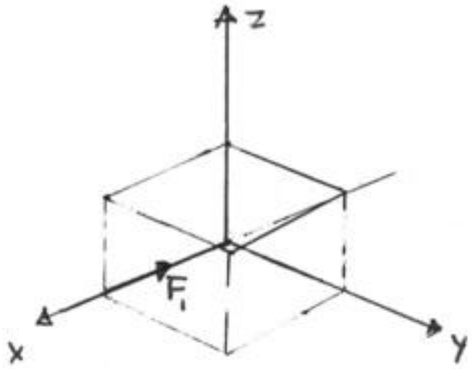


$$\underset{\sim}{\mu_o} = \underset{\sim}{r} \times \underset{\sim}{P}$$

$$\underset{\sim}{r} = \overrightarrow{OA} = \left(550, \frac{200}{\sqrt{2}}, \frac{200}{\sqrt{2}}\right)$$

$|\mu_o|$

1.60 a)



$$\underset{\sim}{F}_1 = F_1 \cdot e_{\lambda_1}$$
$$\underset{\sim}{F}_2 = F_2 \cdot e_{\lambda_2}$$
$$R = F_1 + F_2$$
$$\underset{\sim}{\mu} = \sum M_A = r_A \times F_1$$

b) $\underset{\sim}{\mu} = \sum M_B = r_B \times F_2$

1.64 b) Observera det allmänna sambandet, ekv (1.3.9) mellan ett kraftsystems momentsummor:

$$\sum M_B = \sum M_A + \overrightarrow{BA} \times \sum F$$