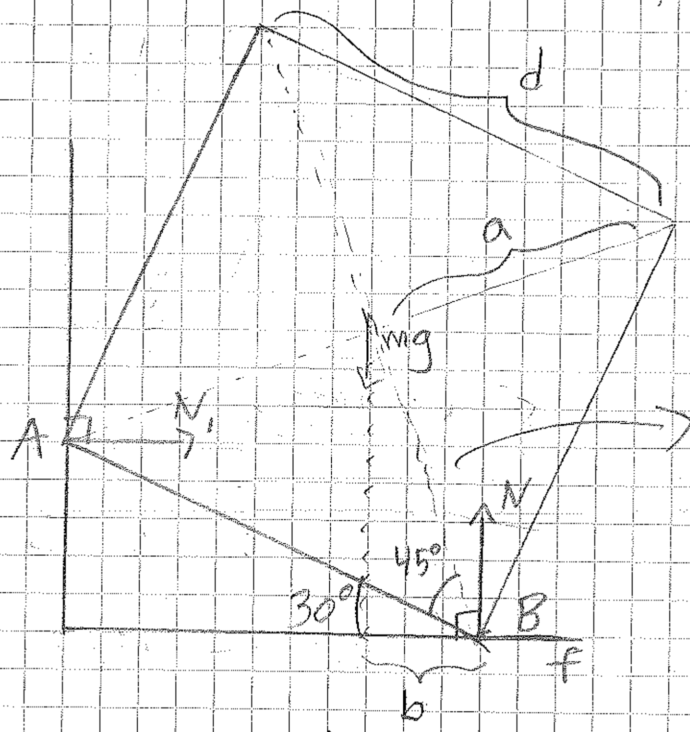
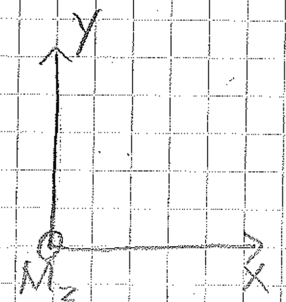
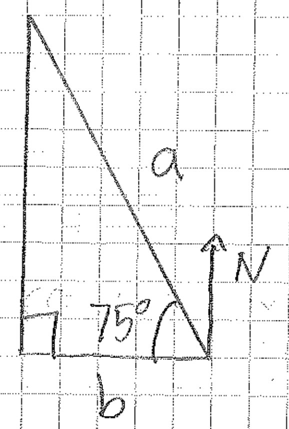
5.5.2 Friläggning av kuben:







$b = \cos(75°) \cdot a$

$(2a)^2 = d^2 + d^2$ (Pythagoras sats)

$\Rightarrow a = \frac{d}{\sqrt{2}}$

$\Rightarrow b = \frac{d}{\sqrt{2}} \cos 75$

$f = \mu N$ villkor för precis innan glidning.

Jämvikt:

$\rightarrow: N_1 - f = 0$ $\qquad N_1 = f$

$\Rightarrow$

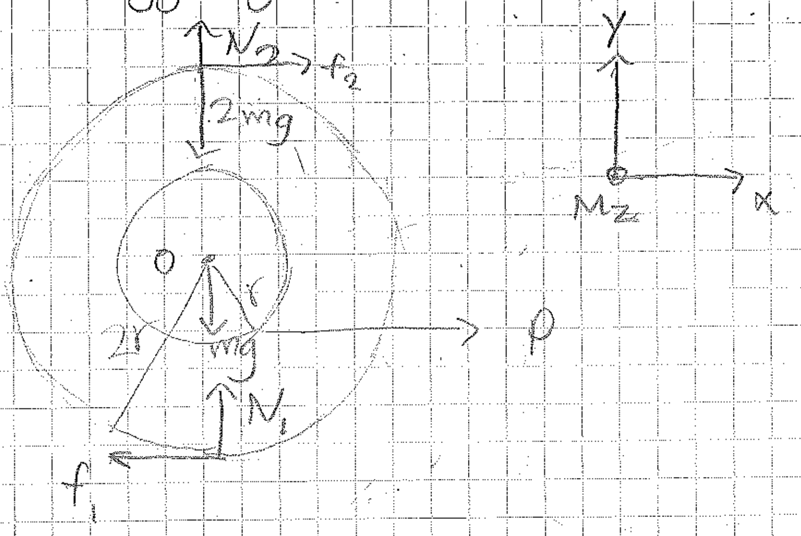
$\uparrow: N - mg = 0$ $\qquad N = mg$

$\overset{\frown}{M_B}: -N_1 \cdot \sin 30° \cdot d + mg \cdot \frac{d}{\sqrt{2}} \cos 75 = 0$

$\Rightarrow f = \frac{\frac{\cancel{d}}{\sqrt{2}} mg \cdot \cos 75}{\sin 30° \cdot \cancel{d}} = mg \cos 75 \cdot \frac{1}{\sqrt{2}} / \frac{1}{2}$

$f = \sqrt{2}\, mg \cos 75 \Rightarrow \mu = \sqrt{2} \cos 75$

S.5.14. Friläggning:



Jämvikt:

$\rightarrow$: $P - f_1 + f_2 = 0 \Rightarrow P - 0{,}5N_1 + 0{,}3N_2 = 0$

$\uparrow$: $N_1 - mg - 2mg + N_2 = 0 \Rightarrow N_1 - 3mg + N_2 = 0$

$\curvearrowleft M_0$: $P \cdot r - f_1 \cdot 2r - f_2 \cdot 2r = 0 \Rightarrow P - N_1 - 0{,}6N_2 = 0$

$\underline{P = N_1 + 0{,}6N_2}$

$N_1 + 0{,}6N_2 - 0{,}5N_1 + 0{,}3N_2 = 0$

$0{,}5N_1 + 0{,}9N_2 = 0$

$N_1 = -1{,}8N_2$

$-1{,}8N_2 - 3mg + N_2 = 0$

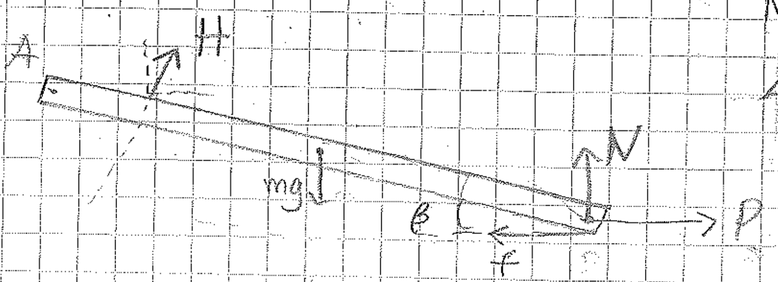
$-0{,}8N_2 = 3mg$

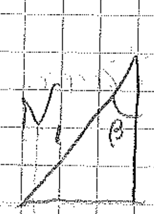
$N_2 = -\frac{15}{4}mg$

$\underline{N_1 = \frac{27}{4}mg}$

$P = \frac{27}{4}mg - 0{,}6 \cdot \frac{15}{4}mg = \frac{9}{2}mg$?

5.5.15 Friläggning:





Jämvikt: $|f| > \mu N \Rightarrow \mu > \frac{f}{N}$

$\rightarrow$: $P - f + H\sin\beta = 0$

$\uparrow$: $N - mg + H\cos\beta = 0$

$\overset{\frown}{M_A}$: $mg \cdot 5a\cos\beta - H \cdot 8a = 0$

$\Rightarrow H = mg\frac{5}{8}\cos\beta$

$N = mg - H\cos\beta = mg - mg\frac{5}{8}\cos^2\beta$

$= mg(1 - \frac{5}{8}\cos^2\beta)$

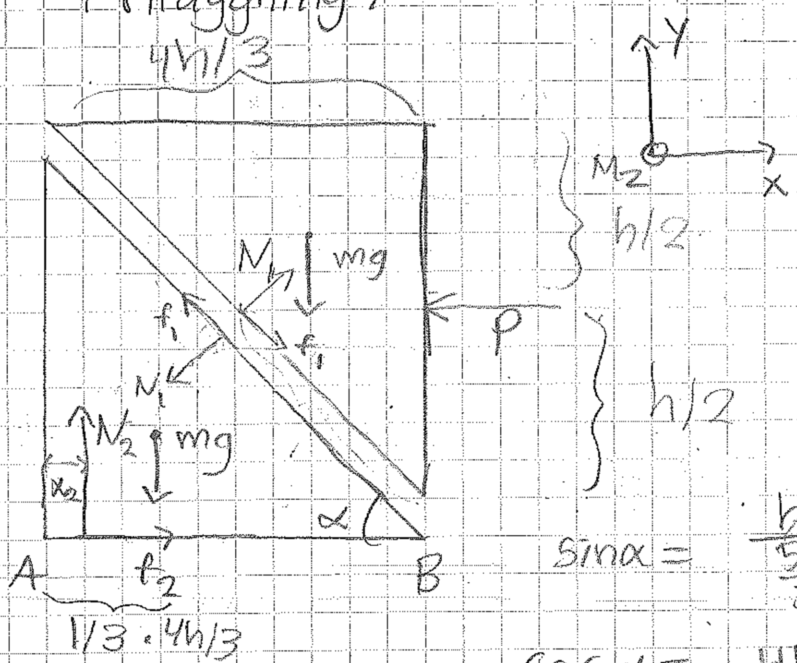
$f = P + H\sin\beta$

Gränsfallet ger $f = \mu N = \mu mg(1 - \frac{5}{8}\cos^2\beta)$

$\mu mg(1 - \frac{5}{8}\cos^2\beta) = P + H\sin\beta$

$\Rightarrow P = \mu mg(1 - \frac{5}{8}\cos^2\beta) - mg\frac{5}{8}\cos\beta\sin\beta$

5.5.21 Friläggning:



$h^2 + \frac{16h^2}{3}$

$19h^2$

$\sin\alpha = \frac{h}{\frac{5h}{3}} = \frac{3}{5}$

$\cos\alpha = \frac{\frac{4h}{3}}{\sqrt{h^2+\left(\frac{4h}{3}\right)^2}} = \frac{\frac{4h}{3}}{\frac{5h}{3}} = \frac{4}{5}$

Jämvikt ger:

Hela:

$\rightarrow$: $f_2 - P = 0$ (1)

$\uparrow$: $N_2 - 2mg = 0$ (2)

$\curvearrowleft M_A$: $N_2 \cdot x_2 - mg \cdot \frac{4h}{9} - mg\frac{8h}{9} + P\frac{h}{2} = 0$ (3)

Undre:

$\rightarrow$: $f_2 - f_1\cos\alpha - N_1\sin\alpha = 0$ (4)

$\uparrow$: $N_2 - mg + f_1\sin\alpha - N_1\cos\alpha = 0$ (5)

$\curvearrowleft M_B$: $-N_1 x_1 + mg\frac{4h}{9} + P\frac{h}{2} = 0$ (6)

1 och 2 $\Rightarrow$ $f_2 = P$, $N_2 = 2mg$

$f_2 < \mu_2 N_2 \Rightarrow$ $P < 2\mu_2 mg \Rightarrow$ $P < mg$ $(\mu_2 = 1/2)$

4 och 5 $\Rightarrow$ $f_1 = P\cos\alpha - mg\sin\alpha$, $N_1 = P\sin\alpha + mg\cos\alpha$

5.5.2) (Fortsättning)

$f_1 < \mu_1 N_1 \Rightarrow P < \frac{\mu_1 \cos\alpha + \sin\alpha}{\cos\alpha - \mu_1 \sin\alpha} mg$

$\Rightarrow P < \frac{28}{29} mg \qquad (\mu_1 = 1/8)$

Om $P > \frac{28}{29} mg$ börjar det övre prismat glida.

Kan stjälpning ske innan, alltså för ett mindre värde på P?

Undre balansvillkor: $0 \leq x_2 \leq 4h/3$

(3) ger $\Rightarrow \quad x_2 = \left(\frac{2}{3} - \frac{P}{4mg}\right)h$

Om $x_2 \leq 0$:

$0 \leq \frac{2}{3} - \frac{P}{4mg} \Rightarrow P \leq \frac{8}{3} mg$

Om $x_2 \leq 4h/3$:

$4\cancel{h}/3 \leq \left(\frac{2}{3} - \frac{P}{4mg}\right)\cancel{h}$

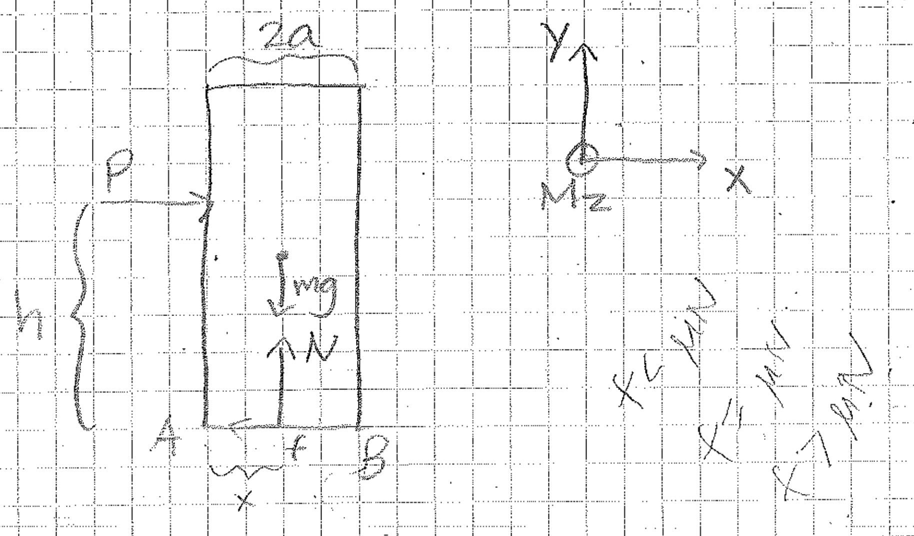
$\frac{4}{3} \leq \frac{2}{3} - \frac{P}{4mg}$

$\frac{P}{4mg} \leq -\frac{2}{3}$

$P \leq -\frac{8}{3} mg$ (motsatt riktning)

$\frac{8}{3} mg > \frac{28}{29} mg \Rightarrow$ glidning sker före stjälpning.

S.5.27. Friläggning:



Jämvikt:

$\rightarrow$: $P - f = 0$

$\uparrow$: $N - mg = 0$

$\curvearrowleft M_B$: $-h \cdot P + mg \cdot a - N(2a - x) = 0$

a) $\Rightarrow$ $f = P$

$N = mg$

$$x = \frac{h \cdot P + mg \cdot a}{N} = \frac{h \cdot P + mg \cdot a}{mg} = a + \frac{hP}{mg}$$

b) $f = \mu N$ för glidning

$P_{max} = \mu N = \mu mg$

c) Om $x > 2a$ (normalkraften är utanför) stjälper lådan:

$x = 2a = a + \frac{Ph}{mg} \Rightarrow P = \frac{amg}{h}$

d) Vid stjälpning är $P > P_{max}$, alltså är:

$\mu mg > \frac{amg}{h} \Rightarrow \mu > \frac{a}{h}$