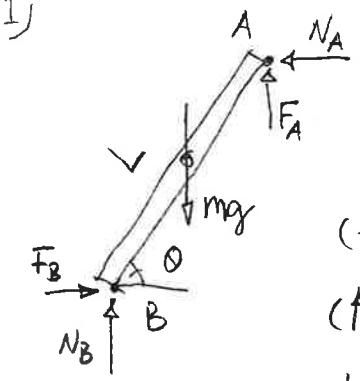
# Seminariepass 10



1)




På gränsen till glidning:

$F_A = \mu_s N_A$ o $F_B = \mu_s N_B$

$(\rightarrow)$ $\mu_s N_B - N_A = 0$ ; $N_A = \mu_s N_B$

$(\uparrow)$ $N_B + \mu_s N_A - mg = 0$ ;

dvs $N_B + \mu_s^2 N_B = mg$ ; $N_B = \dfrac{mg}{1+\mu_s^2}$ ... (*)

$\curvearrowleft_A$ $\mu_s N_B \cdot L\sin\theta - N_B L\cos\theta + mg\frac{L}{2}\cos\theta = 0$

$N_B(\cos\theta - \mu_s\sin\theta) = \dfrac{mg}{2}\cos\theta$

Eliminera $N_B$ mha (*) $\Rightarrow$

$$\frac{mg}{1+\mu_s^2}(\cos\theta - \mu_s\sin\theta) = \frac{mg}{2}\cos\theta$$

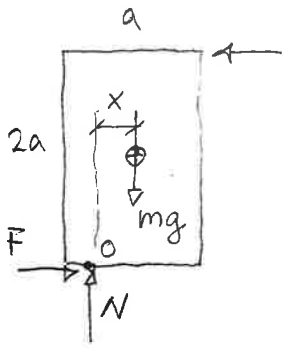
$$\cos\theta - \mu_s\sin\theta = \frac{1+\mu_s^2}{2}\cos\theta \;;$$

$$\cos\theta - 0.3\sin\theta = 0.545\cos\theta \;;$$

$$0.455\cos\theta = 0.3\sin\theta \;;\quad \tan\theta = \frac{0.455}{0.3} \;;$$

$$\tan\theta = 1.52 \;;\quad \theta = 57°$$

2)




$(\rightarrow)$ $F = P$ ... (1)

$(\uparrow)$ $N = mg$ ... (2)

Moment jämvikt:

x beror av storleken på P

På gränsen till att tippa $\Rightarrow x = \frac{a}{2}$

$\curvearrowleft_o$ $P \cdot 2a = mg\frac{a}{2}$ ; $P = \dfrac{mg}{4}$ ... (3)

Friktionsvillkor:

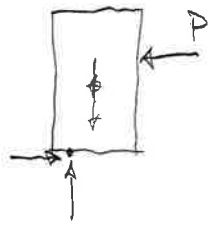
$F \le \mu_s N$ , (1) o (2) $\Rightarrow$ $P \le \mu_s mg$ ;

$P \le 0.3\,mg$

Dvs friktionen tillåter $P = 0.3\,mg$ $\Rightarrow$

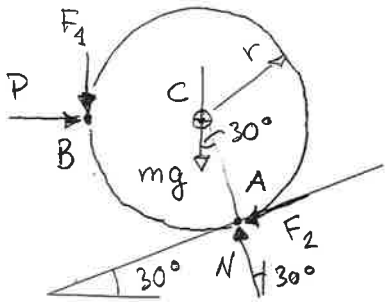
Lådan tippar då $P = 0.25\,mg$

Anm. P längre ner




$\Rightarrow$ lådan glider

3/




Två möjligheter: glider eller rullar upp för planet

Antag att den rullar upp ($F_2 < \mu N$) ⇒

Glidning i B med fullt utbildad friktion $F_1 = \mu P$

↻C ⇒ $F_1 = F_2$, dvs $F_2 = \mu P$

↻A $\mu P(r + r\sin 30^\circ) - P r\cos 30^\circ + mg\, r \sin 30^\circ = 0$;

$P(\cos 30^\circ - \mu(1 + \sin 30^\circ)) = mg \sin 30^\circ$;

$$P = \frac{mg \cdot 0.5}{0.866 - \mu(1+0.5)} = \frac{1200 \cdot 9.81 \cdot 0.5}{0.866 - 0.4 \cdot 1.5} = \underline{22.1\,kN}$$

Kontroll av antagandet genom koll om $F_2 < \mu N$:

(↔) $P - N\sin 30^\circ - \mu P \cos 30^\circ = 0$;

$N \sin 30^\circ = P(1 - \mu\cos 30^\circ)$; $N = \frac{1 - \mu\cos 30^\circ}{\sin 30^\circ} P$;

$N = 28.9\,kN$

$F_2 = \mu P = 0.4 \cdot 22.1\,kN = 8.8\,kN < \mu N = 11.6\,kN$

OK!