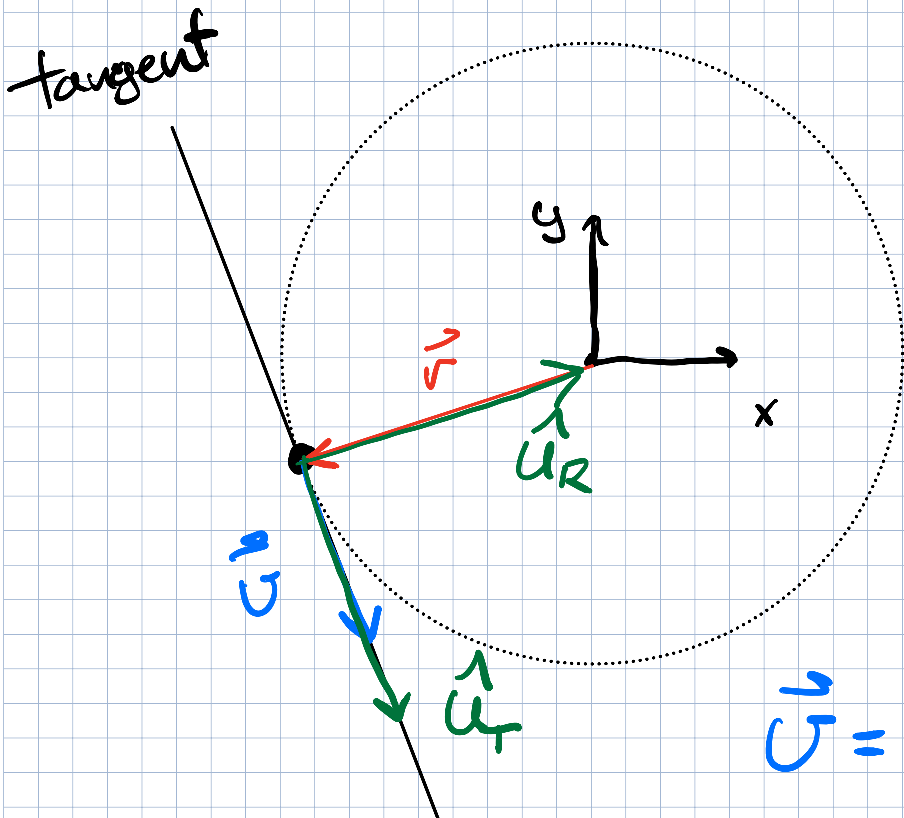
Sirkelbevegelse



$$\vec{v} = v \cdot \hat{u}_T$$

$$\vec{a} = \frac{d}{dt}\vec{v} = \frac{d}{dt}(v \cdot \hat{u}_T)$$

$$\vec{a} = \frac{d}{dt}v \cdot \hat{u}_T + v \cdot \underbrace{\frac{d}{dt}\hat{u}_T}_{= \frac{v}{R} \cdot \hat{u}_R}$$

$$\vec{a} = \underbrace{\frac{dv}{dt}}_{\dot{v},\ v'} \hat{u}_T + \underbrace{\frac{v^2}{R}}_{\text{Sentripitalakselerasjon}} \cdot \hat{u}_R$$

Når $\frac{dv}{dt} = 0$ (Farten er konstant)

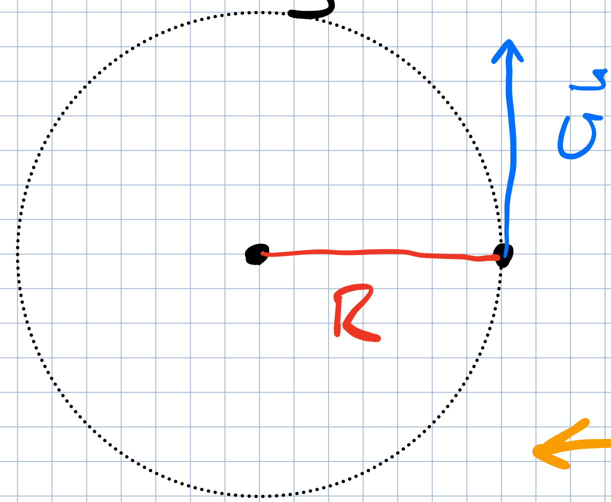
har vi kun sentripitalakselerasjon

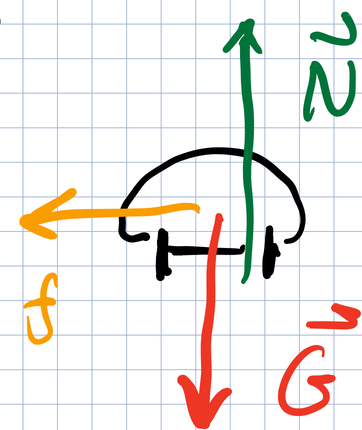
$$\vec{a} = \frac{v^2}{R} \hat{u}_R$$

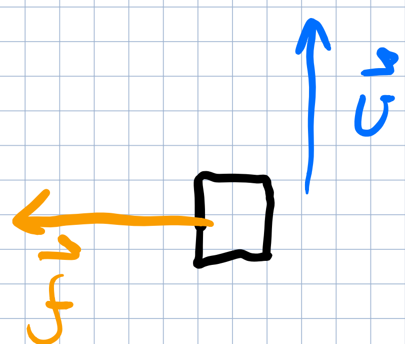
Når $\frac{dv}{dt} \neq 0$ (Farten endrer seg)

$$\vec{a} = \frac{dv}{dt} \hat{u}_T + \frac{v^2}{R} \hat{u}_R$$

Bil i sving



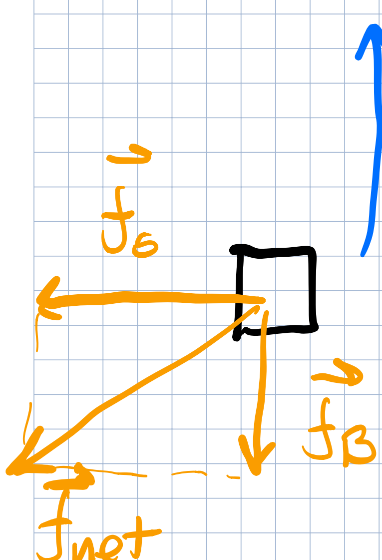




N. 2. lov $\quad \hat{u}_R$

$$\vec{f} = m\vec{a}$$

$$f = m \cdot \frac{v^2}{R}$$

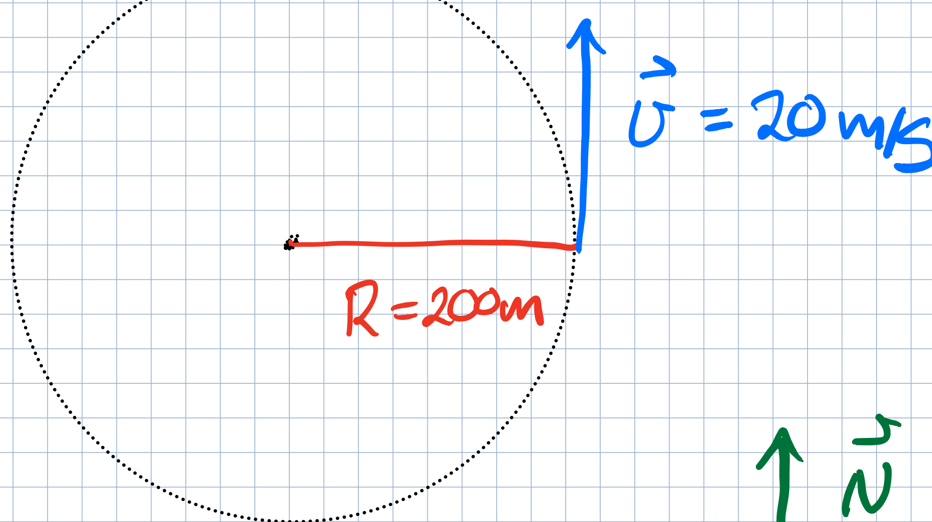


Anta bilen bremser

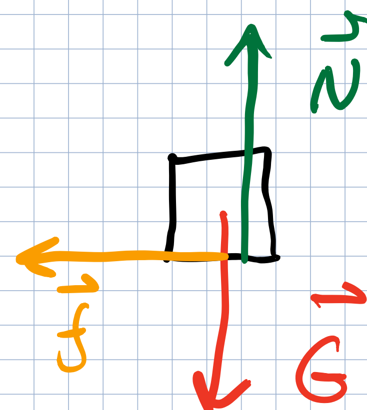
$$\frac{dv}{dt} \neq 0$$

En bil med masse $m = 1500\,kg$ kjører i $20\,m/s$ i en sving med Radius $R = 200\,m$.

Hvor stor er friksjons-koeffisienten μ, for at dette skal gå bra?



Frilegeme diagram:



$\hat{u}_R = x$ y

N. 2. lov

x-retning: $\vec{f} = m\vec{a}_x$ ①

y-retning: $\vec{G} + \vec{N} = m\vec{a}_y$ ②

$\vec{a}_y = 0$

siden $\frac{dv}{dt} = 0$ så e $a_x = \frac{v^2}{R}$

i $\hat{u}_R$-retning.

x-retning.

Friksjon: $f = \mu N$

① $f = m\frac{v^2}{R}$, $\mu N = m\frac{v^2}{R}$

② $-mg + N = 0 \Rightarrow N = mg$

$\mu \cdot \cancel{m}g = \cancel{m}\frac{v^2}{R} \quad | \cdot \frac{1}{g}$

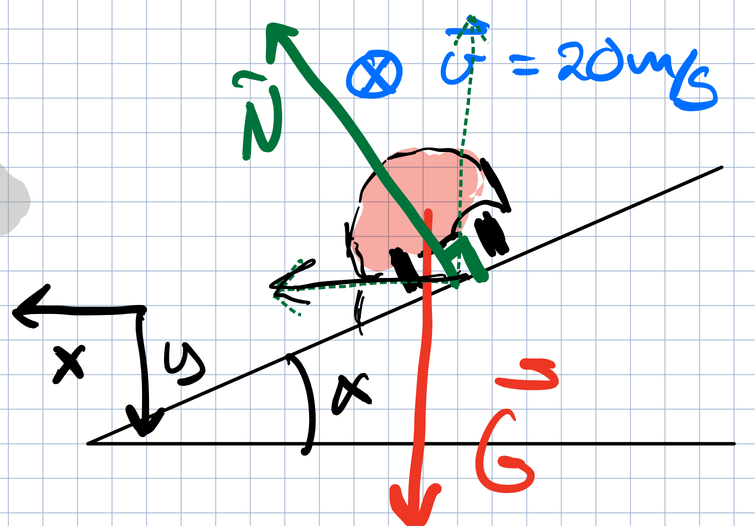
$$\mu = \frac{v^2}{R \cdot g}$$

$$\mu = \frac{(20\ m/s)^2}{200m \cdot 9{,}8\ m/s^2} = 0{,}20$$

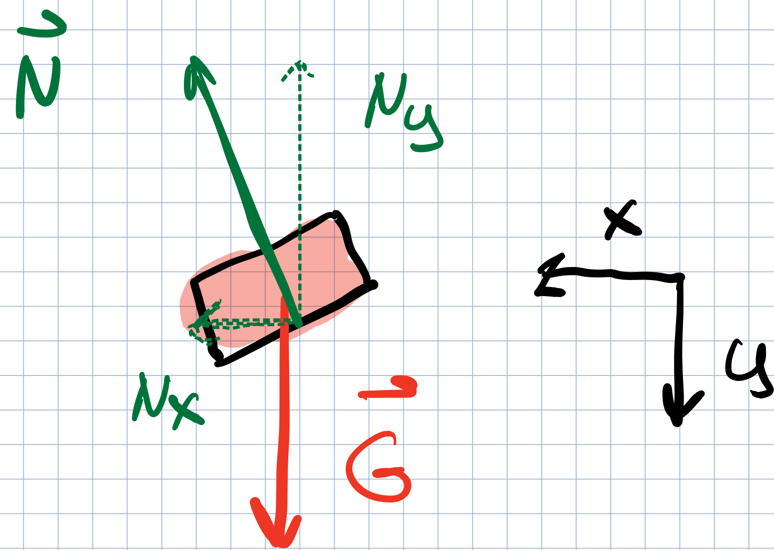
Statens vegvesen:

$$\mu = \begin{cases} 0{,}7 - 0{,}9 & \text{tørr asfalt} \\ 0{,}4 - 0{,}7 & \text{våt asfalt} \\ 0{,}1 - 0{,}4 & \text{snø} \end{cases}$$

Dosering



Frilegemediagram:



N. 2.60 $\quad \vec{G} + \vec{N} = m\vec{a}$

x-retning: $\quad N_x = m \frac{v^2}{R} \quad (1)$

y-retning: $\quad mg - N_y = 0 \quad (2)$

$$N_x = N \cdot \sin\alpha$$

$$N_y = N \cdot \cos\alpha$$

(1) $N \cdot \sin\alpha = m \frac{v^2}{R}$

(2) $N \cdot \cos\alpha = mg$

$$\frac{①}{②} \quad \frac{\cancel{N} \cdot \sin\alpha}{\cancel{N} \cos\alpha} = \frac{\cancel{m} \frac{v^2}{R}}{\cancel{m} g}$$

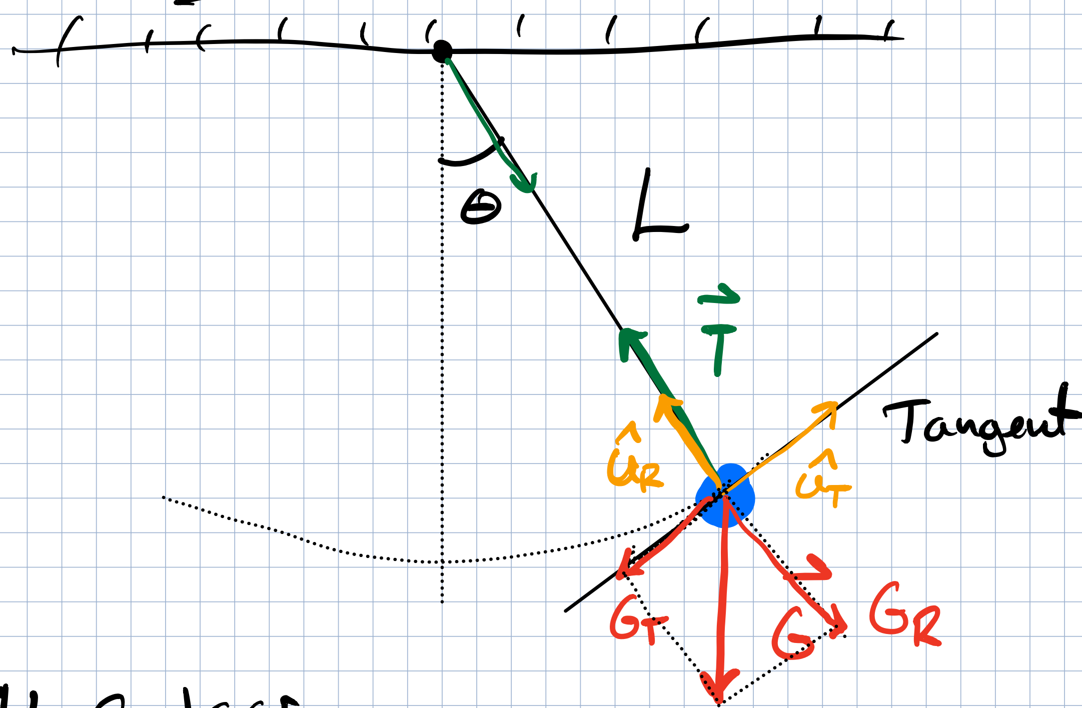
$$\tan\alpha = \frac{v^2}{Rg}$$

$$\alpha = \tan^{-1}\left(\frac{v^2}{Rg}\right)$$

$$\alpha = \tan^{-1}\left(\frac{(20\,m/s)^2}{200\,m \cdot 9{,}8\,m/s^2}\right)$$

$$\alpha = 0{,}20\,\text{radiane} = \underline{12^\circ}$$

Pendel



N. 2. 100

$$\vec{G} + \vec{T} = m\vec{a}$$

$$\vec{T} = T\,\hat{u}_R$$

$$\vec{G} = \underbrace{-G \cdot \cos\theta}_{-G_R}\,\hat{u}_R + \underbrace{-G\sin\theta}_{-G_T}\,\hat{u}_T$$

$$\vec{G} = -mg\cos\theta\,\hat{u}_R - mg\sin\theta\,\hat{u}_T$$

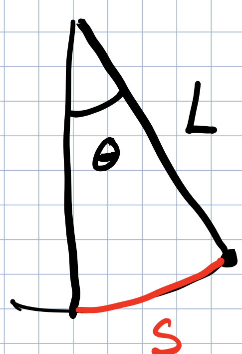
$\hat{u}_T$ -retning:

$$-mg\sin\theta = ma_T$$

$\hat{u}_R$ -retning:

$$-mg\cos\theta + T = 0$$

$$ma_T + mg\sin\theta = 0$$



$$\theta = \frac{s}{L}$$

$$\cancel{m}\frac{d^2s}{dt^2} + \cancel{m}g\sin\left(\frac{s}{L}\right) = 0$$

$$\frac{d^2s}{dt^2} + g\sin\left(\frac{s}{L}\right) = 0$$

småå vinkler Taylor:

$$\sin x \approx x$$

$$\sin\left(\frac{s}{L}\right) \approx \frac{s}{L}$$

$$s'' + \frac{g}{L} s = 0$$

$$s = A\cos\sqrt{\frac{g}{L}}\, t + B\sin\sqrt{\frac{g}{L}} \cdot t$$

$s(0) = 0$ $v(0) = 2{,}0\ \mathrm{m/s}$

$L = 1{,}0\ \mathrm{m}$

$$\omega = \sqrt{\frac{g}{L}}$$

$$s = \frac{v_0}{\omega} \cdot \sin(\omega t)$$