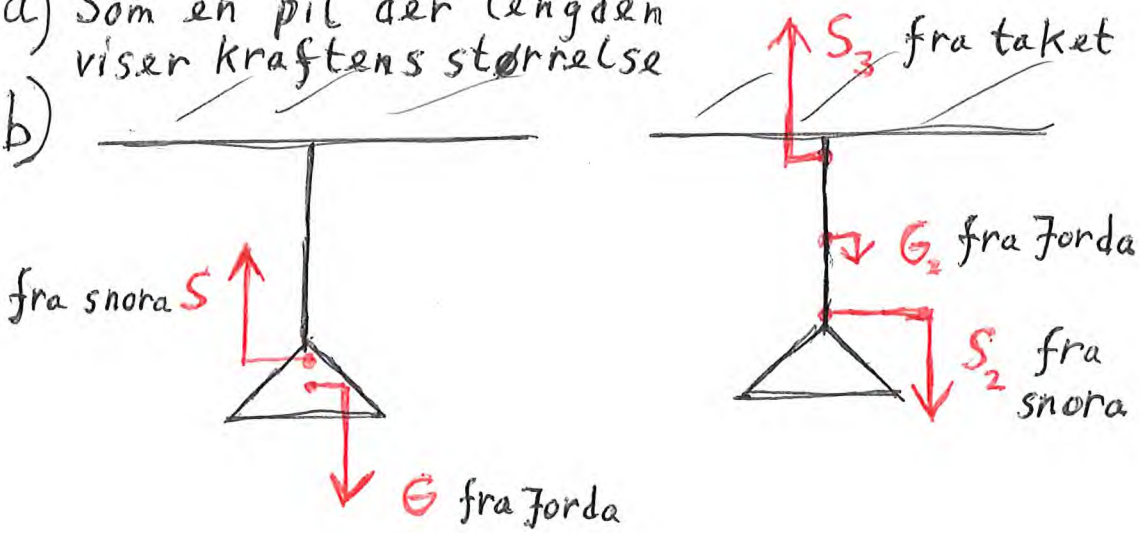
2.02

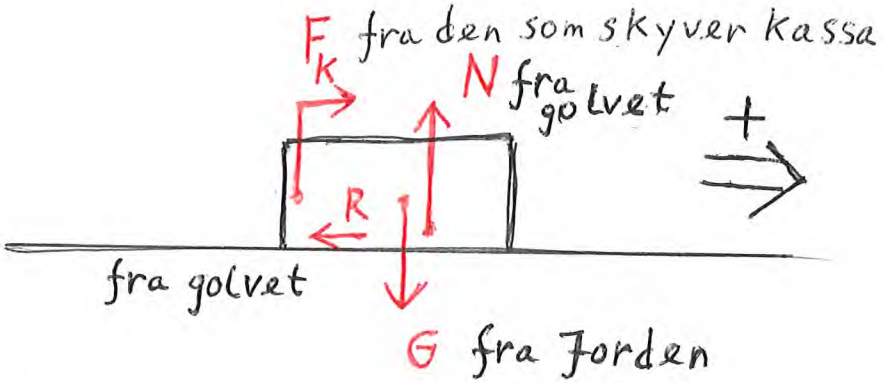
a) Som en pil der lengden viser kraftens størrelse

b)



c)

d)

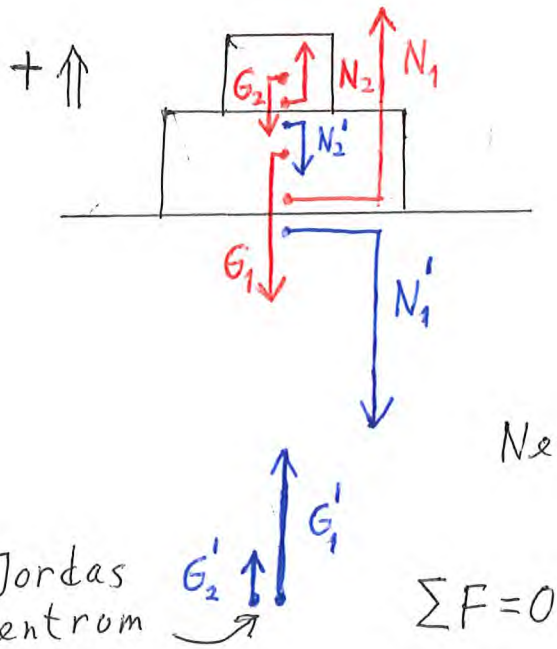


e) G, tyngden, er en fjernkraft.
S, snordrag, F_L, luftmotstand, N, normalkraft
R, friksjonskraft og F_K, skyvekraft er nærkrefter.

2.09

a)

b)



$G_2 = 50N$

$G_1 = 150N$

$\sum F = 0$ stein 2

$N_2 - G_2 = 0$

$N_2 = G_2$

$N_2 = \underline{50N}$

Newton's 3. lov $\Rightarrow$ $N_2' = N_2$

$= \underline{50N}$

$\sum F = 0$ stein 1

$N_1 - G_1 - N_2' = 0$

$N_1 = G_1 + N_2'$

$N_1 = 150N + 50N = \underline{200N}$

Newton's 3. lov

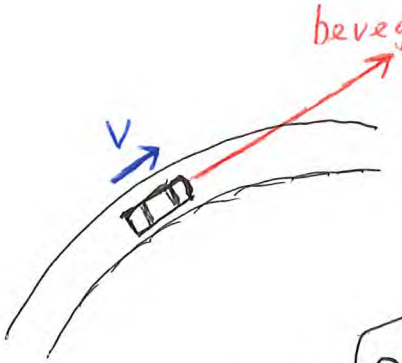
$\Downarrow$

$N_1' = N_1 = \underline{200N}$

og $G_2' = G_2 = \underline{50N}$

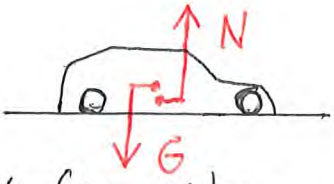
og $G_1' = G_1 = \underline{150N}$

2.12



Bilen havner i grøfta på utsiden av svingen.

← Bil i sving sett fra lufta

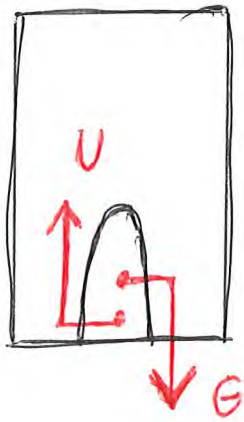


Bil sett fra siden.

Normalkraft og tyngde er de eneste kreftene på bilen når $R = 0$

2.13 $m = 70kg$

a) $g = 9{,}81 \frac{N}{kg}$



$\uparrow +$

$\Sigma F = 0$

$U - G = 0$

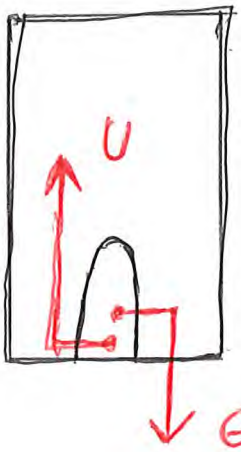
$U = G$

$U = mg$

$U = 70kg \cdot 9{,}81 \frac{N}{kg} = \underline{0{,}69kN}$ opp

$G = \underline{0{,}69kN}$ ned

b)



$+$

$\Sigma F = ma$

$U - G = ma$

$U = ma + mg$

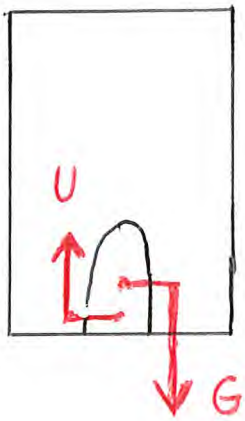
$U = m(a+g)$

$= 70kg \cdot (2{,}5 + 9{,}81) \frac{N}{kg}$

$= \underline{0{,}86kN}$ opp

$G = \underline{0{,}69kN}$ ned

c)



$+$

$\Sigma F = ma$

$U - G = ma$

$U = ma + mg$

$U = m(a+g)$

$= 70kg \cdot (-2{,}5 + 9{,}81) \frac{N}{kg}$

$= \underline{0{,}51kN}$ opp

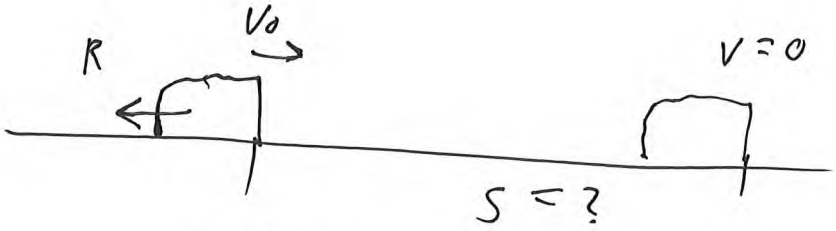
$G = \underline{0{,}69kN}$ ned

2.16 a) Veggen flytter seg ikke, men det gjør ballen. Dessuten er ballen elastisk. Dette fører til at foten stopper over en lengre avstand og lengre tid. I følge Newton's 2. lov $\Sigma F = ma$ vil dermed akselerasjonen og kraften (motkraften) på foten bli mindre enn ved spark i veggen.

2.16 b) Ha hendene fri så stopplengden øker. Da vil også stopptiden øke. Dette gir redusert akselerasjon og følgelig en redusert kraft i følge Newton's 2. lov.

2.17 $V_0 = \frac{32}{3,6}\frac{m}{s} = 8,888\frac{m}{s}$ $m = 78kg$

$s = 5,5m$ $R = ?$



$\Sigma F = ma$

$-R = ma$

$|R| = ma = 78 \cdot 7,181N =$

$\underline{0,56kN}$

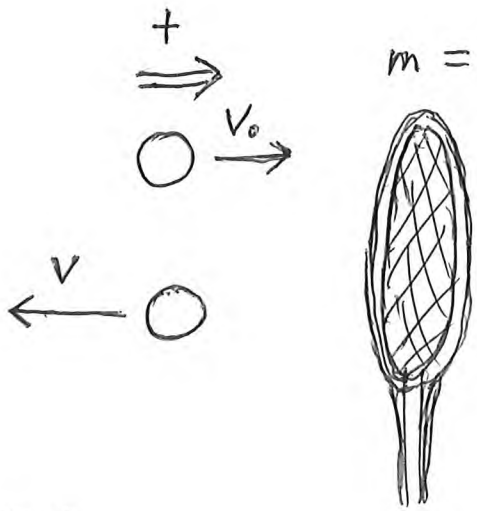
$2as = v^2 - V_0^2$

$2as = -V_0^2$

$a = \frac{-V_0^2}{2s} = \frac{-(8,888\frac{m}{s})^2}{2 \cdot 5,5m}$

$= -7,181\frac{m}{s^2}$

2.18



$m = 57g$

$V_0 = 20\frac{m}{s}$

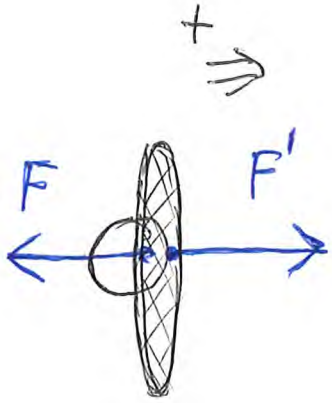
$V = -30\frac{m}{s}$

$\Delta t = 0{,}010\,s$

$\sum F = ma$

$$\bar{a} = \frac{\Delta V}{\Delta t} = \frac{V - V_0}{\Delta t} = \frac{-30\frac{m}{s} - 20\frac{m}{s}}{0{,}010\,s}$$

$$= \frac{-50}{0{,}010}\,\frac{m}{s^2} = -5000\,\frac{m}{s^2}$$



$\sum F = ma$

$\bar{F} = m\bar{a}$

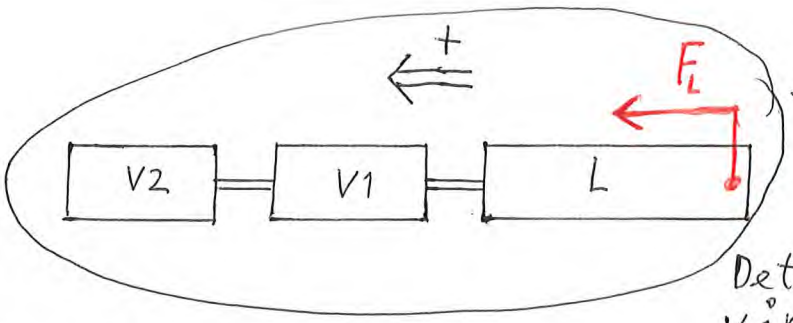
$\bar{F} = 0{,}057\,kg \cdot \left(-5000\frac{m}{s^2}\right)$

$= -285\,N \approx -0{,}29\,kN$

$|\bar{F}'| = |\bar{F}|$ og motsatt rettet.

Dvs. $F' = 0{,}29\,kN$

2.19



$F_L = 86kN$
$m_L = 9000kg$
$m_{V1} = m_{V2} = 8100kg$

Dette er systemet vårt.

a) $\sum F = ma$

$F_L = (m_L + m_{V1} + m_{V2})a$

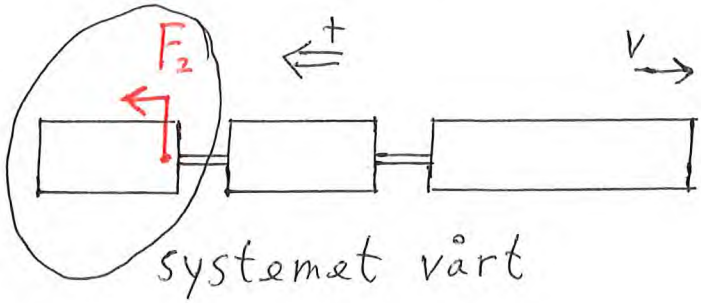
$\frac{F_L}{(m_L + m_{V1} + m_{V2})} = a$

($\Uparrow \sum F = 0$, $G = N$ for toget)

$a = \frac{86 \cdot 10^3 N}{(9{,}000 + 8{,}100 + 8{,}100) \cdot 10^3 kg} = \frac{86N}{25{,}2kg} = 3{,}412 \frac{m}{s^2}$

$= \underline{3{,}4 \frac{m}{s^2}}$

b)



systemet vårt

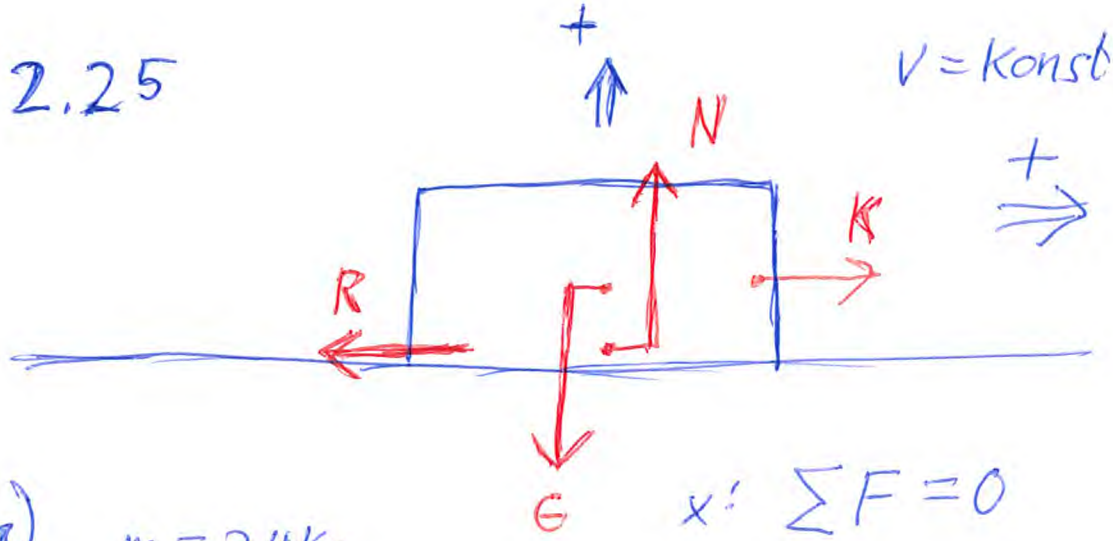
$\sum F = ma$

$F_2 = m_{V2} \cdot a$

$F_2 = 8100\,kg \cdot 3{,}412 \frac{N}{kg} = 27637{,}2N$

$= \underline{28kN}$

2.25



a) $m = 2{,}4\,kg$

$K = 12\,N$

$x: \quad \sum F = 0$

$K - R = 0$

$K = R$

$R = 12\,N$

b) $\mu = ?$

$\mu = \frac{R}{N}$

$R = \mu N$

$y: \quad \sum F = 0$

$N - G = 0$

$N = G$

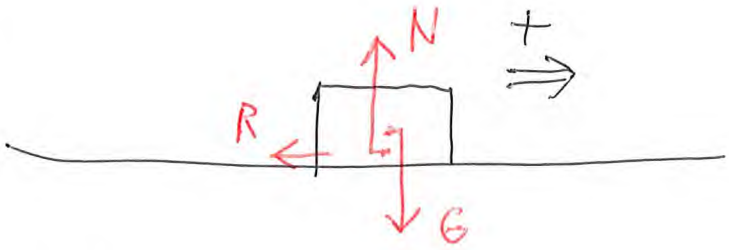
$N = mg$

$$\mu = \frac{R}{mg} = \frac{12\,N}{2{,}4\,kg \cdot 9{,}81\,\frac{N}{kg}}$$

$$= 0{,}51$$

2.26 $G = 750N$ $R = \mu N$

a)



$\mu = 0{,}85$

$R_{gli} = 0{,}85 \cdot N$

$= 0{,}85 \cdot 750N$

$= 637{,}5\,N$

$\uparrow$ Y: $\sum F = 0$

$N - G = 0$

$N = G = 750N$

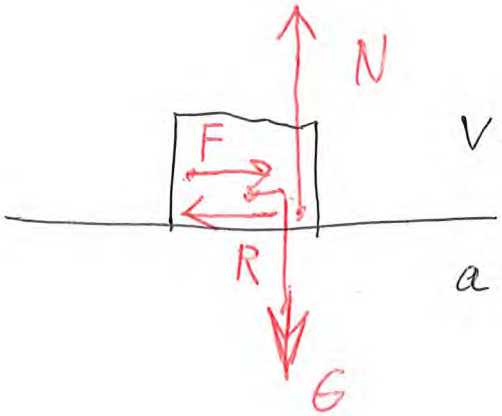
b) $F = 300\,N$

$\sum F = 0$

$F - R = 0$

$F = R$

$R = 300\,N$



$V = 0$

$a = 0$

$300N < R_{gli}$

Glir ikke

c) $F = 800N$ $F > R_{gli}$

$R = R_{gli} = 637{,}5\,N \simeq 0{,}64kN$

$\sum F = ma$

$F - R_{gli} = ma$

$\frac{F - R_{gli}}{m} = a$

$a = \frac{(800 - 637{,}5)\,N}{76{,}45\,kg} = 2{,}1\,\frac{m}{s^2}$

$G = mg$

$\frac{G}{g} = m$

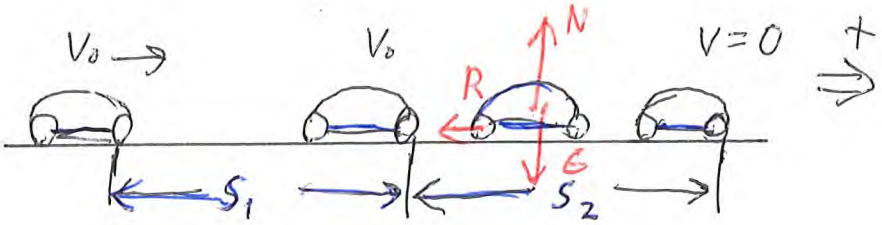
$m = \frac{750\,N}{9{,}81\,\frac{N}{kg}}$

$= 76{,}45\,kg$

2.27 $V_0 = 90\,\frac{km}{h} = 90 \cdot \frac{1000}{3600}\,\frac{m}{s} = 25\,\frac{m}{s}$ $\quad t_1 = 0{,}80\,s$

$V = 0$ $\quad \mu = 0{,}60$

$s_{tot} = ?$



$$s_1 = \bar{v} \cdot t_1 = v_0 \cdot t_1 = 25\,\frac{m}{s} \cdot 0{,}80\,s = 20\,m$$

x: $\sum F = ma$

$-R = ma$

$-\mu N = ma$

$-\mu G = ma$

$-\mu mg = ma$

$a = -\mu g$

y: $\sum F = 0$

$N - G = 0$

$N = G$

og $2as = v^2 - v_0^2$ og $v = 0$

$2(-\mu g) \cdot s_2 = -v_0^2$

$2\mu g s_2 = v_0^2$

$$s_2 = \frac{v_0^2}{2\mu g}$$

$$s_2 = \frac{\left(25\,\frac{m}{s}\right)^2}{2 \cdot 0{,}60 \cdot 9{,}81\,\frac{m}{s^2}} = 53{,}09\,m$$

$s_{tot} = s_1 + s_2 = 20\,m + 53{,}09\,m = \underline{73\,m}$

2.28 $m = 6{,}0\,kg$

$$R_L = kv^2 \qquad k = 0{,}30\ \frac{Ns^2}{m^2}$$

a) Tyngdekraften og luftmotstanden

b) $\Sigma F = 0$ $\quad v = konst.$

$$R_L - G = 0$$

$$R_L = G$$

$$R_L = mg = 6{,}0\,kg \cdot 9{,}81\ \frac{N}{kg} = \underline{59\,N}$$

c) $R_L = G$

$$kv^2 = mg$$

$$v^2 = \frac{mg}{k}$$

$$v = \sqrt{\frac{mg}{k}}$$

$$v = \sqrt{\frac{6{,}0\,\cancel{kg} \cdot 9{,}81\ \frac{\cancel{m}}{\cancel{s^2}}}{0{,}30\ \frac{\cancel{N}s^2}{m^2}}} = \underline{14\ \frac{m}{s}}$$