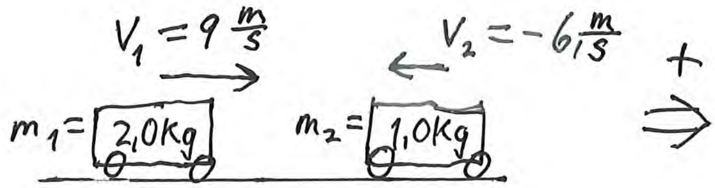
5.305



Etter støt:

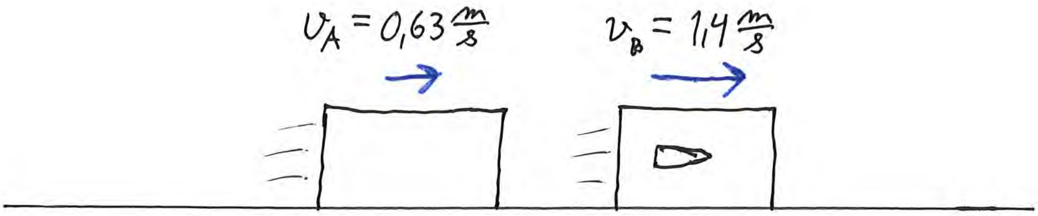
$$m_2 U_2 + m_1 U_1 = m_2 V_2 + m_1 V_1 \qquad \text{og} \quad U_2 = U_1 = U$$

$$(m_2 + m_1) \cdot U = m_2 V_2 + m_1 V_1$$

$$U = \frac{m_2 V_2 + m_1 V_1}{(m_2 + m_1)} = \frac{1{,}0\,\text{kg} \cdot (-6\,\frac{m}{s}) + 2{,}0\,\text{kg} \cdot 9\,\frac{m}{s}}{(1{,}0\,\text{kg} + 2{,}0\,\text{kg})}$$

$$= \underline{4{,}0\,\tfrac{m}{s}} \text{ mot høyre.}$$

5.308+ $\quad m_k = 0{,}0035\,kg$



a) $\quad p_{etter} = p_{før}$

$$(m_k + m_B) v_B = m_k \cdot v_k$$

$$v_k = \frac{(m_k + m_B) \cdot v_B}{m_k} = \frac{(0{,}0035 + 1{,}8)\,kg}{0{,}0035} \cdot 1{,}4\,\frac{m}{s}$$

$$= 721{,}4\,\frac{m}{s} = \underline{0{,}72\,\frac{km}{s}}$$

b) $\quad p_{etter} = p_{før}$

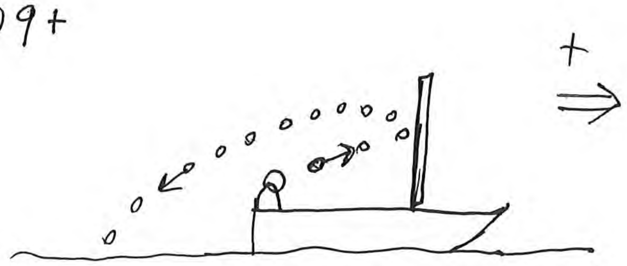
$$m_A \cdot v_A + m_k \cdot v_k = m_k \cdot v_{k0}$$

$$v_{k0} = \frac{m_A \cdot v_A + m_k \cdot v_k}{m_k}$$

$$v_{k0} = \frac{1{,}2\,kg \cdot 0{,}63\,\frac{m}{s} + 0{,}0035\,kg \cdot 721{,}4\,\frac{m}{s}}{0{,}0035\,kg} = 937{,}4\,\frac{m}{s}$$

$$= \underline{0{,}94\,\frac{km}{s}}$$

5.309+



a) Ja. Før et kast er bevegelsesmengden for ball pluss mann med båt den samme som like etter at ballen forlater handa. Båt+ mann vil dermed få en liten negativ bevegelsesmengde under kastet, mens ballen får en tilsvarende positiv bev.mengde. Farten til båten vil altså avta en anelse. Deretter, når ballen treffer plata vil endringen i bevegelsesmengde for ballen bli større enn $m_b \cdot v_b$ ut fra handa, ettersom ballen ikke bare stopper, men spretter tilbake. I beste fall kan ballen få like stor fart tilbake (målt i forhold til båten) slik at bevegelsesmengden $2 \cdot m_b v_b$ overføres til båten via plata.

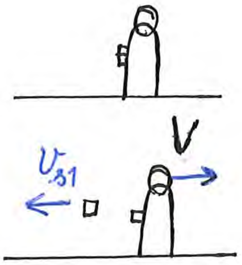
Totalt sett vil altså båten få økt sin bevegelsesmengde i seileretningen, og dermed vil farten til båten ha økt (mens massen avtar litt).

b) Ja. Det ville vare enklere å la vifta sende luftmolekylene bakover med en gang. Det samme gjelder ballene. Plata blir en unødig omvei.

5.310+

a) $M = 90\,kg \quad m_1 = 3{,}0\,kg \quad v_{s1} = 9{,}0\,\frac{m}{s}$

$m_2 = 3{,}0\,kg$



$$p_{etter} = p_{før}$$

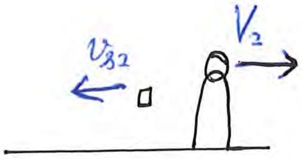
$$+MV + m_1 v_{s1} = 0$$

$$MV = -m_1 v_{s1}$$

$$V = \frac{-m_1 v_{s1}}{(M+m_2)} = \frac{-3{,}0\,kg}{93\,kg} \cdot 9{,}0\,\frac{m}{s} = \underline{-0{,}29\,\frac{m}{s}}$$

$$\left(-0{,}2903\,\frac{m}{s}\right)$$

b)



$p_{etter} = p_{før}$ Måler farten i forhold til mannen.

$$MV_2 + m_2 v_{s2} = 0$$

$$MV_2 = -m_2 v_{s2}$$

$$V_2 = \frac{-m_2 v_{s2}}{M} = \frac{-3{,}0\,kg}{90\,kg} \cdot 9{,}0\,\frac{m}{s} = -0{,}30\,\frac{m}{s}$$

Målt i forhold til bakken blir mannens fart

$$V + V_2 = [-0{,}29 + (-0{,}30)]\,\frac{m}{s} = \underline{-0{,}59\,\frac{m}{s}}$$

Alternativt:

Vi måler fart i forhold til isen.

$$p_{etter} = p_{før}$$

$$MV_2 + m_2 v_{s2} = (M+m_2)V \quad \text{der } v_{s2} = 9{,}0\,\frac{m}{s} - 0{,}29\,\frac{m}{s} = 8{,}71\,\frac{m}{s}$$

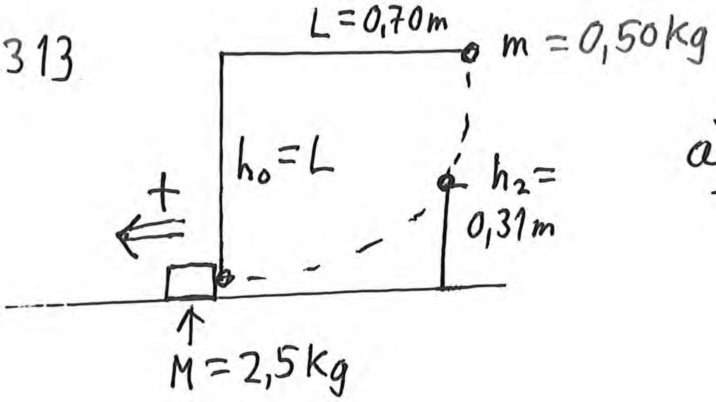
$$MV_2 = (M+m_2)V - m_2 v_{s2}$$

$$V_2 = \frac{(M+m_2)}{M} \cdot V - \frac{m_2}{M} v_{s2}$$

$$V_2 = \frac{(90+3{,}0)}{90} \cdot \left(-0{,}2903\,\frac{m}{s}\right) - \frac{3{,}0}{90} \cdot 8{,}71\,\frac{m}{s}$$

$$= \underline{-0{,}59\,\frac{m}{s}}$$

5.313



a) Før støt: (Kule)

$$E_{p0} = E_K$$

$$\cancel{m} g h_0 = \frac{1}{2} \cancel{m} v^2$$

$$2gh_0 = v^2$$

$$v = \sqrt{2gh_0} = \sqrt{2 \cdot 9{,}81 \cdot 0{,}70}\ \frac{m}{s}$$

$$= 3{,}705\ \frac{m}{s}$$

Etter støt:

(Kule) $E_{K0} = E_{P_2}$

$$\frac{1}{2} \cancel{m} v_0^2 = \cancel{m} g h_2$$

$$v_0 = \sqrt{2gh_2} = \sqrt{2 \cdot 9{,}81 \cdot 0{,}31}\ \frac{m}{s} = 2{,}466\ \frac{m}{s}$$

Støt: $MU + mu = MV + mv$ og $V = 0$

$$MU + mu = mv$$

$$MU = m(v - u)$$

$$U = \frac{m(v-u)}{M}$$

$$U = \frac{0{,}50\,kg \cdot (3{,}705 - (-2{,}466))\frac{m}{s}}{2{,}5\,kg}$$

$U = 1{,}234\ \frac{m}{s} \approx \underline{1{,}2\ \frac{m}{s}}$ mot venstre

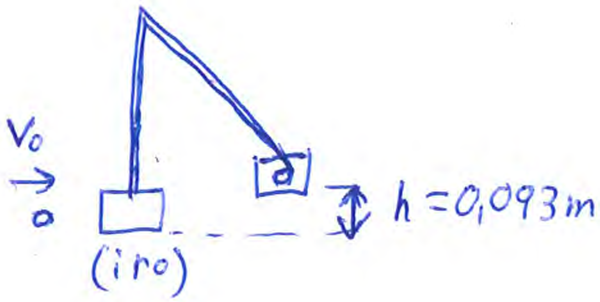
b) $$\sum E_{K0} = \frac{1}{2} m v_0^2 = \frac{1}{2} \cdot 0{,}50\,kg \cdot \left(3{,}705\ \frac{m}{s}\right)^2 = 3{,}4317\ J$$

$$\sum E_K = \frac{1}{2} m v^2 + \frac{1}{2} M V^2 = \frac{1}{2} \cdot 0{,}50\,kg \cdot \left(2{,}466\ \frac{m}{s}\right)^2 + \frac{1}{2} \cdot 2{,}5\,kg \left(1{,}2342\ \frac{m}{s}\right)^2$$

$$= 3{,}424\ J$$

Med to siffers nøyaktighet er svarene like, dvs. <u>elastisk støt</u>

5.316 $M = 1{,}2\,kg$ $m = 0{,}015\,kg$



$$E_p = E_{k0}$$

$$\cancel{(M+m)}gh = \frac{1}{2}\cancel{(M+m)}V_0^2$$

$$2gh = V_0^2$$

$$V_0 = \sqrt{2gh}$$

$$V_0 = \sqrt{2 \cdot 9{,}81 \cdot 0{,}093}\ \frac{m}{s}$$

$$V_0 = 1{,}3507\ \frac{m}{s}$$

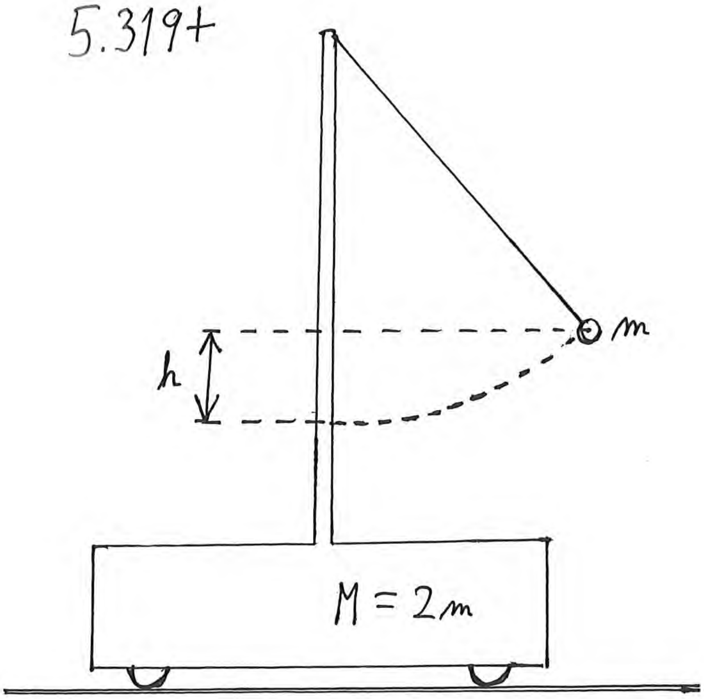
$$\text{før}\ \Sigma p = \Sigma p_{\text{etter}}$$

$$v_0 \cdot m + 0 = (m+M) \cdot V_0$$

$$v_0 = \frac{(m+M)}{m} \cdot V_0 = \frac{1{,}215\,kg}{0{,}015\,kg} \cdot 1{,}3507\ \frac{m}{s}$$

$$= 109{,}4\ \frac{m}{s} = \underline{0{,}11\ \frac{km}{s}}$$

5.319+



$$p_{etter} = p_{før}$$

$$mv + MV = 0$$

$$mv = -MV$$

$$mv = -2mV$$

$$\underline{v = -2V}$$

1) Korrekt.

Farten er målt i forhold til bakken.

$$E_{p0} = E_{k1} + E_{k2}$$

$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}MV^2$$

$$mgh = \frac{1}{2}m(-2V)^2 + \frac{1}{2}2m\cdot V^2$$

$$gh = \frac{1}{2}\cdot 4V^2 + V^2$$

$$gh = 2V^2 + V^2$$

$$gh = 3V^2$$

$$V^2 = \frac{gh}{3}$$

$$\underline{V = \sqrt{\frac{gh}{3}}}$$

3) Korrekt

$$v = -2\cdot V = -2\cdot\sqrt{\frac{gh}{3}} = -\sqrt{\frac{2^2 gh}{3}} = -\sqrt{\frac{4gh}{3}}$$

2) Feil

5.320+

$v_1 = 15\,\frac{m}{s}$ $V_1 = ?$

$v_2 = -10\,\frac{m}{s}$ $V_2 = ?$

$$p_{etter} = p_{før}$$

$$m\,{}_1 + mV_2 = mv_1 + mv_2$$

$$V_1 + V_2 = v_1 + v_2$$

1) $V_2 = v_1 + v_2 - V_1$

$$\sum E_{k\,etter} = \sum E_{k\,før}$$

$$\frac{1}{2}mV_1^2 + \frac{1}{2}mV_2^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$$

$$V_1^2 + V_2^2 = v_1^2 + v_2^2$$

2) $V_2^2 = v_1^2 + v_2^2 - V_1^2$

Vi setter uttrykket for V_2 fra 1) inn i 2)

$$(v_1 + v_2 - V_1)^2 = v_1^2 + v_2^2 - V_1^2$$

$$(15 - 10 - V_1)^2 = 15^2 + 10^2 - V_1^2$$

$$(5 - V_1)^2 = 225 + 100 - V_1^2$$

$$25 - 2\cdot 5\cdot V_1 + V_1^2 = 325 - V_1^2 \quad \Big| -25$$

$$-10V_1 + V_1^2 = 300 - V_1^2 \quad \Big| +V_1^2$$

$$V_1^2 - 10V_1 + V_1^2 = 300 \quad \Big| -300$$

$$2V_1^2 - 10V_1 - 300 = 0$$

$$V_1^2 - 5V_1 - 150 = 0 \qquad A = 1,\ B = -5,\ C = -150$$

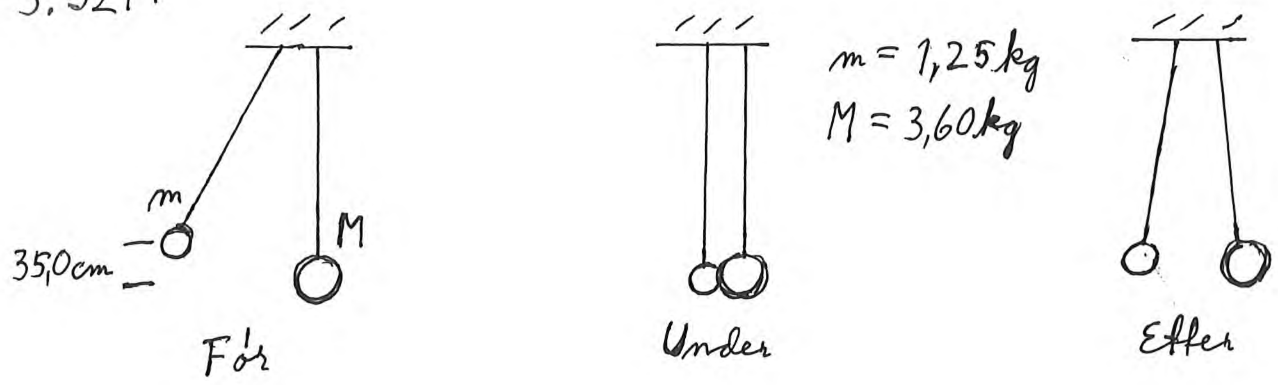
$$V_1 = 15 \text{ eller } V_1 = -10$$

Farten er endret etter støtet, altså er det $V_1 = -10$ som er løsningen.

Vi får $\underline{V_1 = -10\,\frac{m}{s}}$ og $V_2 = v_1 + v_2 - V_1 = (15 - 10 - (-10))\,\frac{m}{s}$

$$\underline{= 15\,\frac{m}{s}}$$

5.321+



$m = 1{,}25\,kg$
$M = 3{,}60\,kg$

a) $E_{p0} = E_{k1}$

$$mgh_0 = \frac{1}{2} m v_1^2 \quad \Big| \cdot \frac{2}{m}$$
$$2gh_0 = v_1^2$$
$$v_1 = \sqrt{2gh} = \sqrt{2 \cdot 9{,}81\,\tfrac{m}{s^2} \cdot 0{,}350\,m} = 2{,}6204\,\tfrac{m}{s} = \underline{2{,}62\,\tfrac{m}{s}}$$

b) $p_{etter} = p_{før}$

$$mv + MV = mv_1$$
$$v + \frac{M}{m} V = v_1$$
$$v = v_1 - \frac{M}{m} V$$

$\sum E_{k\,etter} = \sum E_{k\,før}$

$$\frac{1}{2} m v^2 + \frac{1}{2} M V^2 = \frac{1}{2} m v_1^2 \quad \Big| \cdot \frac{2}{m}$$
$$v^2 + \frac{M}{m} V^2 = v_1^2$$

$$\left(v_1 - \frac{M}{m} V\right)^2 + \frac{M}{m} V^2 = v_1^2$$
$$v_1^2 - 2\frac{M}{m} v_1 V + \frac{M^2}{m^2} V^2 + \frac{M}{m} V^2 = v_1^2 \quad \Big| - v_1^2$$
$$-2\frac{M}{m} v_1 V + \frac{M^2}{m^2} V^2 + \frac{M}{m} V^2 = 0 \quad \Big| \cdot \frac{m}{M}$$
$$-2 v_1 V + \frac{M}{m} V^2 + V^2 = 0$$
$$V \cdot \left(-2v_1 + \frac{M}{m} V + V\right) = 0 \quad \text{og } V \neq 0 \text{ gir}$$
$$-2v_1 + \frac{M}{m} V + V = 0$$
$$\frac{M}{m} V + V = 2v_1$$
$$\left(\frac{M}{m} + 1\right) \cdot V = 2v_1$$
$$V = \frac{2v_1}{\left(\frac{M}{m} + 1\right)} = \frac{2 \cdot 2{,}6204\,\frac{m}{s}}{\left(\frac{3{,}60}{1{,}25} + 1\right)} = 1{,}3507\,\frac{m}{s}$$

$$E_p = E_{k0}$$
$$Mgh = \frac{1}{2} M V^2$$
$$gh = \frac{1}{2} V^2$$
$$h = \frac{V^2}{2g} = \frac{\left(1{,}3507\,\frac{m}{s}\right)^2}{2 \cdot 9{,}81\,\frac{m}{s^2}} = 0{,}09298\,m = \underline{9{,}30\,cm}$$

5,321+

b) $m_1 v_1 + m_2 v_2 = m_1 u_1 + m_2 u_2$

$v_1 + u_1 = v_2 + u_2$ (E_K bevart)

Alternativ Løsning

$mv_1 + \cancel{MV_1}^{=0} = mv + MV$

$v_1 + v = \cancel{V_1}^{=0} + V$

$mv_1 = mv + MV$

$v_1 + v = V$

$\boxed{v = V - v_1}$

$mv_1 = m(V - v_1) + MV$

$mv_1 = mV - mv_1 + MV$

$2mv_1 = (m+M)V$

$\frac{2mv_1}{(m+M)} = V$

$V = \frac{2v_1}{\left(1+\frac{M}{m}\right)} = \frac{2 \cdot 2{,}6204}{\left(1+\frac{3{,}60}{1{,}25}\right)} \frac{m}{s}$

$= 1{,}3507 \frac{m}{s}$

$E_p = E_{K0}$

$Mgh = \frac{1}{2}MV^2$

$gh = \frac{1}{2}V^2$

$h = \frac{V^2}{2g} = \frac{\left(1{,}3507 \frac{m}{s}\right)^2}{2 \cdot 9{,}81 \frac{m}{s^2}}$

$= 0{,}09298\,m$

$= \underline{9{,}30\,cm}$

5.324 $m = 0{,}046\,\text{kg}$ $v_0 = 0$ $v = 50\,\frac{m}{s}$ $t = 2{,}0 \cdot 10^{-3}\,s$

a) $\bar{F} = ?$ $\bar{F} \cdot t = mv - mv_0$

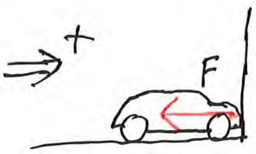
$$\bar{F} = \frac{m(v - v_0)}{t} = \frac{mv}{t} = \frac{0{,}046\,\text{kg} \cdot 50\,\frac{m}{s}}{2{,}0 \cdot 10^{-3}\,s}$$

$$= 1150\,N \approx \underline{1{,}2\,kN}$$

b) Nei, den er ubetydelig i sammenligning.

$$G = mg = 0{,}046\,\text{kg} \cdot 9{,}81\,\frac{N}{kg} = 0{,}45\,N \ll 1150\,N$$

5.325+ $m = 800\,\text{kg}$ $v_0 = 15\,\frac{m}{s}$ $\Delta t = 0{,}10\,s$ $v = 0$

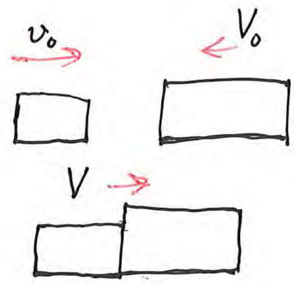


a) $\sum F \Delta t = \Delta p$

$$F \Delta t = \cancel{mv} - mv_0$$

$$F = \frac{-mv_0}{\Delta t} = \frac{800\,\text{kg} \cdot 15\,\frac{m}{s}}{0{,}10\,s} = \underline{1{,}2 \cdot 10^{5}\,N}$$

b) $M = 4200\,\text{kg}$ $V_0 = -10\,\frac{m}{s}$ $\Delta t = 0{,}10\,s$ $\bar{F} = ?$



$$p_{etter} = p_{før}$$

$$(m + M) \cdot V = mv_0 + MV_0$$

$$V = \frac{mv_0 + MV_0}{(m + M)}$$

$$V = \frac{800\,\text{kg} \cdot 15\,\frac{m}{s} + 4200\,\text{kg} \cdot \left(-10\,\frac{m}{s}\right)}{(800 + 4200)\,\text{kg}}$$

$$= -6{,}00\,\frac{m}{s}$$

$$\sum F \Delta t = \Delta p$$

$$F \Delta t = mV - mv_0$$

$$\bar{F} = m \cdot \frac{(V - v_0)}{\Delta t} = 800\,\text{kg} \cdot \frac{(-6{,}00 - 15)\,\frac{m}{s}}{0{,}10\,s}$$

$$= \underline{-1{,}7 \cdot 10^{5}\,N}$$

5.328 a) Σmv bevart og ΣE_k bevart $\Rightarrow$ elastisk

Kun Σmv bevart $\Rightarrow$ uelastisk

b) Popkornet dytter mot kjelen når det popper, men kjelen har voldsomt mye større masse, og vil derfor ikke flytte (merkbart) på seg.

$$mv + MV = 0$$

$$MV = -mv$$

$$V = -\frac{m}{M} \cdot v \quad \text{og} \quad m << M \Rightarrow V \approx 0$$