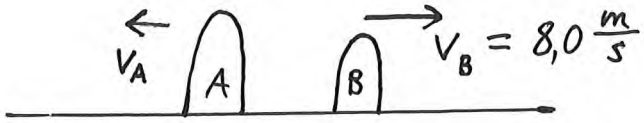
5.01

$m_A = 80\,kg$ $\quad m_B = 50\,kg$ $\quad +\Rightarrow$



a) $m_B V_B = 50\,kg \cdot 8{,}0\ \frac{m}{s} = 400\,kg\ \frac{m}{s} = 4{,}0 \cdot 10^2\,kg\ \frac{m}{s}$

b) $P_{etter} = P_{før}$

$m_A V_A + m_B V_B = 0$

$80\,kg \cdot V_A + 50\,kg \cdot 8{,}0\ \frac{m}{s} = 0$

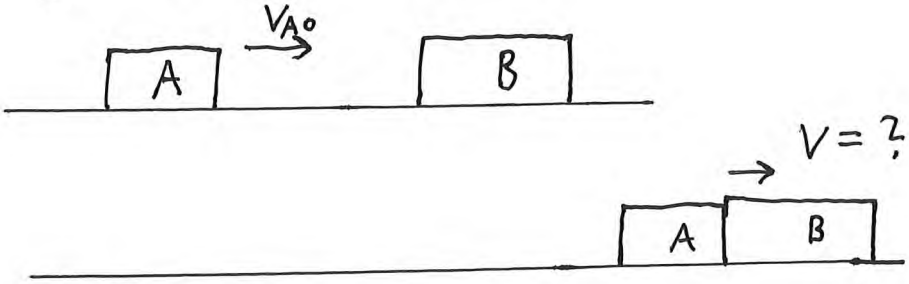
$80\,kg \cdot V_A = -400\,kg\ \frac{m}{s}$

$V_A = -\frac{400}{80}\ \frac{m}{s} = \underline{-5{,}0\ \frac{m}{s}}$

Dvs $5{,}0\ \frac{m}{s}$ i motsatt retning

5.02 $m_A = 2{,}5\,kg$ $\quad m_B = 7{,}5\,kg$

$V_{A0} = 5{,}0\ \frac{m}{s}$ $\quad V_{B0} = 0$



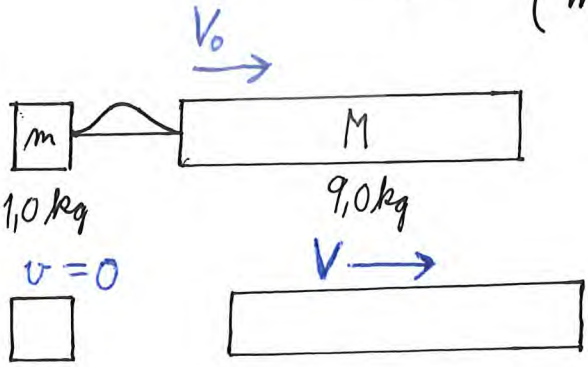
$P_{etter} = P_{før}$

$(m_A + m_B) \cdot V = m_A \cdot V_{A0} + m_B \cdot V_{B0}$

$V = \frac{m_A \cdot V_{A0}}{(m_A + m_B)} = \frac{2{,}5\,kg \cdot 5{,}0\ \frac{m}{s}}{(2{,}5 + 7{,}5)\,kg} = 1{,}25\ \frac{m}{s}$

$\approx \underline{1{,}3\ \frac{m}{s}}$

5.03



$V_0 = 0{,}50\ \frac{m}{s}$

$P_{etter} = P_{før}$

$m \cdot v + M \cdot V = (m + M) \cdot V_0$

$V = \frac{(m+M)}{M} \cdot V_0$

$V = \frac{(1{,}0 + 9{,}0)\,kg}{9{,}0} \cdot 0{,}50\ \frac{m}{s} = \underline{0{,}56\ \frac{m}{s}}$

5.04 

$m_A = 3{,}0\,kg \quad m_B = 5{,}0\,kg \quad v_A = 0{,}80\,\frac{m}{s}$

$p_{etter} = p_{før}$

$m_A \cdot v_A + m_B \cdot v_B = 0$

$m_B \cdot v_B = -m_A v_A$

$v_B = \frac{-m_A v_A}{m_B} = \frac{-3{,}0\,kg \cdot 0{,}80\,\frac{m}{s}}{5{,}0\,kg} = -0{,}48\,\frac{m}{s}$

$E_{p0} = E_k$

$E_{p0} = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 = \frac{1}{2} \cdot 3{,}0\,kg \cdot \left(0{,}80\,\frac{m}{s}\right)^2 + \frac{1}{2} \cdot 5{,}0\,kg \cdot \left(-0{,}48\,\frac{m}{s}\right)^2$

$= \underline{1{,}57}$

5.05 A: m $\quad v_{A0} = 3{,}0\,\frac{m}{s}$ $\quad v_A = -1{,}8\,\frac{m}{s}$

B: $4m$ $\quad v_{B0} = 0$

a) $p_{etter} = p_{før}$

$m \cdot v_A + 4m \cdot v_B = m \cdot v_{A0} + 4m\, v_{B0} \quad | : m$

$v_A + 4v_B = v_{A0}$

$4v_B = v_{A0} - v_A$

$v_B = \frac{1}{4}\left(v_{A0} - v_A\right)$

$v_B = \frac{1}{4}\left(3{,}0\,\frac{m}{s} - \left(-1{,}8\,\frac{m}{s}\right)\right) = \frac{1}{4} \cdot 4{,}8\,\frac{m}{s} = \underline{1{,}2\,\frac{m}{s}}$

b) $\sum E_{k\,før} = \frac{1}{2} m v_{A0}^2 = \frac{1}{2} m \cdot \left(3{,}0\,\frac{m}{s}\right)^2 = \frac{1}{2} m \cdot 9{,}0\,\frac{m^2}{s^2}$

$\sum E_{k\,etter} = \frac{1}{2} m v_A^2 + \frac{1}{2} \cdot 4m \cdot v_B^2 = \frac{1}{2} m \cdot \left[v_A^2 + 4 v_B^2\right]$

$= \frac{1}{2} m \cdot \left[\left(-1{,}8\,\frac{m}{s}\right)^2 + 4 \cdot \left(1{,}2\,\frac{m}{s}\right)^2\right] = \frac{1}{2} m \cdot 9{,}0\,\frac{m^2}{s^2}$

$\sum E_k$ er bevart, kollisjonen var elastisk.

5.06 $m_A = 2{,}0\,kg$ $v_{A0} = 3{,}0\,\frac{m}{s}$ $m_B = 2{,}0\,kg$ $v_{B0} = 0$

a) $p_{etter} = p_{før}$

$$(m_A + m_B)\cdot V = m_A \cdot v_{A0} + m_B \cdot v_{B0}$$

$$V = \frac{m_A \cdot v_{A0}}{(m_A + m_B)} = \frac{2{,}0\,kg \cdot 3{,}0\,\frac{m}{s}}{(2{,}0+2{,}0)\,kg} = \underline{1{,}5\,\frac{m}{s}}$$

b) $m_A v_A + m_B v_B = m_A v_{A0} + m_B v_{B0}$

$$m_A v_A = m_A v_{A0} - m_B v_B$$

$$v_A = \frac{1}{m_A}\cdot(m_A v_{A0} - m_B v_B) = \frac{1}{2{,}0\,kg}\left(2{,}0\,kg \cdot 3{,}0\,\frac{m}{s} - 2{,}0\,kg \cdot 3{,}0\,\frac{m}{s}\right) = \underline{0}$$

c) a) $\Sigma E_{k\,før} = \frac{1}{2} m_A v_{A0}^2 = \frac{1}{2}\cdot 2{,}0\,kg \cdot \left(3{,}0\,\frac{m}{s}\right)^2 = \underline{9{,}0\,J}$

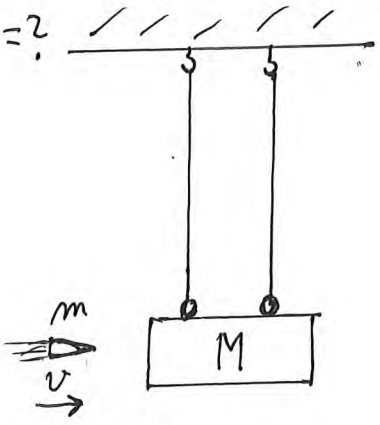
$\Sigma E_{k\,etter} = \frac{1}{2}(m_A + m_B)\cdot V^2 = \frac{1}{2}(2{,}0+2{,}0)\,kg \cdot \left(1{,}5\,\frac{m}{s}\right)^2 = \underline{4{,}5\,J}$

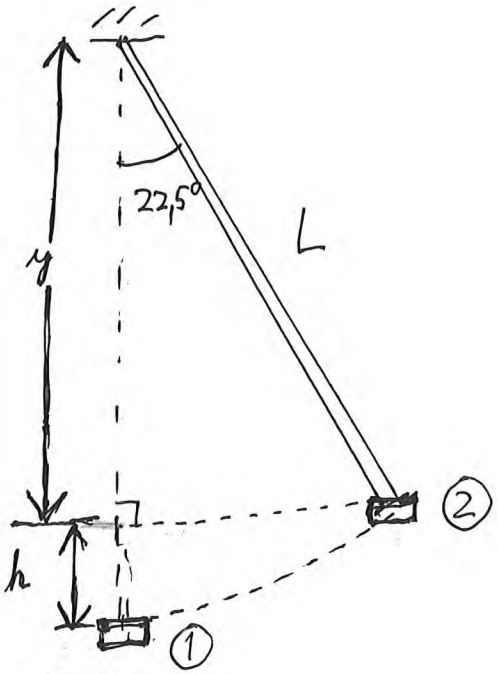
b) $\Sigma E_{k\,før} = \underline{9{,}0\,J}$ $\Sigma E_{k\,etter} = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 = \frac{1}{2}\cdot 2{,}0\,kg \cdot \left(3{,}0\,\frac{m}{s}\right)^2 = \underline{9{,}0\,J}$

d) a) Fullkommen uelastisk støt b) Elastisk støt

5.07 $L = 6{,}00\,m$ $m = 0{,}0120\,kg$ $M = 3{,}00\,kg$

a) $v = ?$





$$h = L - y$$

$$= L - L\cdot\cos 22{,}5^\circ$$

$$= L\cdot(1 - \cos 22{,}5^\circ)$$

$$= 6{,}00\,m\cdot(1-\cos 22{,}5^\circ) = 0{,}45672\,m$$

Bevaring av mekanisk energi etter kollisjon. $E_{k1} = E_{p2}$

$$\frac{1}{2}(m+M)\cdot V^2 = (m+M)\cdot g h \quad | :(m+M)$$

$$\frac{1}{2}V^2 = gh \quad | \cdot 2$$

$$V^2 = 2gh$$

$$V = \sqrt{2gh} = \sqrt{2 \cdot 9{,}81 \frac{m}{s^2} \cdot 0{,}45672 m^1}$$

$$= 2{,}9934 \frac{m}{s}$$

$p_{etter} = p_{før}$ Bevegelsesmengden er bevart i kollisjonen.

$$(m+M)\cdot V = m \cdot v$$

$$v = \frac{(m+M)}{m} \cdot V = \frac{(0{,}0120 + 3{,}00)kg}{0{,}0120 kg} \cdot 2{,}9934 \frac{m}{s}$$

$$= 751{,}34 \frac{m}{s} = \underline{751 \frac{m}{s}}$$

b) $\Delta E_k = E_{k\,før} - E_{k\,etter}$

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

$$= \frac{1}{2} \cdot 0{,}0120 kg \cdot \left(751{,}34 \frac{m}{s}\right)^2 - \frac{1}{2} \cdot 3{,}0120 kg \cdot \left(2{,}9934 \frac{m}{s}\right)^2$$

$$= 3387{,}07 J - 13{,}497 J = 3373{,}587 J$$

$$= \underline{3{,}37 kJ}$$

5,08 $m_A = 0{,}020 kg$ $m_B = 0{,}080 kg$ Sentralt Elastisk

$V_{0A} = 3{,}0 \frac{m}{s}$ $V_{0B} = 0$

$V_A = ?$ $V_B = ?$

Før: 

$$\sum p_o = \sum p_f$$

$$m_A \cdot v_A + m_B \cdot v_B = m_A \cdot v_{oA} + m_B v_{oB}$$

$$\frac{m_A}{m_A} \cdot v_A + \frac{m_B}{m_A} \cdot v_B = \frac{m_A}{m_A} \cdot v_{oA}$$

$$1 \cdot v_A + 4 \cdot v_B = 1 \cdot v_{oA}$$

$$v_A + 4 \cdot v_B = v_{oA}$$

$$v_A = v_{oA} - 4 v_B$$

$$\sum E_{ko} = \sum E_{kf}$$

$$\frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 = \frac{1}{2} m_A v_{oA}^2 + \frac{1}{2} m_B v_{oB}^2$$

$$\frac{m_A \cdot v_A^2}{m_A} + \frac{m_B \cdot v_B^2}{m_B} = \frac{m_A \cdot v_{oA}^2}{m_A}$$

$$1 \cdot v_A^2 + 4 \cdot v_B^2 = 1 \cdot v_{oA}^2$$

$$v_A^2 + 4 v_B^2 = v_{oA}^2$$

$$(v_{oA} - 4 v_B)^2 + 4 v_B^2 = v_{oA}^2$$

$$v_{oA}^2 - 2 \cdot 4 v_B \cdot v_{oA} + 16 v_B^2 + 4 v_B^2 = v_{oA}^2$$

$$-8 v_B \cdot v_{oA} + 20 v_B^2 = 0$$

$$20 v_B^2 = 8 v_B \cdot v_{oA} \quad | : v_B$$

$$20 v_B = 8 \cdot v_{oA}$$

$$v_B = \frac{8}{20} \cdot v_{oA}$$

$$v_B = \frac{2}{5} \cdot 3{,}0 \frac{m}{s} = 1{,}2 \frac{m}{s}$$

$$v_A = 3{,}0 \frac{m}{s} - 4 \cdot 1{,}2 \frac{m}{s}$$

$$= -1{,}8 \frac{m}{s}$$

Alternativ løsning:

$$m_A v_A + m_B v_B = m_A v_{oA} + m_B v_{oB}$$

$$v_A + 4 v_B = v_{oA}$$

$$\left[v_A + v_{oA} = v_B + v_{oB} \right] \leftarrow E_k \text{ bevart}$$

$$v_A + 4 \cdot (v_A + v_{oA}) = v_{oA}$$

$$v_A + 4 v_A + 4 v_{oA} = v_{oA}$$

$$5 v_A = -3 v_{oA}$$

$$v_A = -\frac{6}{5} v_{oA} = -\frac{6}{5} \cdot 3{,}0 \frac{m}{s}$$

$$= -1{,}8 \frac{m}{s}$$

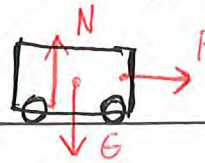
$$v_B = -1{,}8 \frac{m}{s} + 3{,}0 \frac{m}{s}$$

$$= 1{,}2 \frac{m}{s}$$

5.09 a) $F = 200\,N \quad t = 6{,}0\,s$

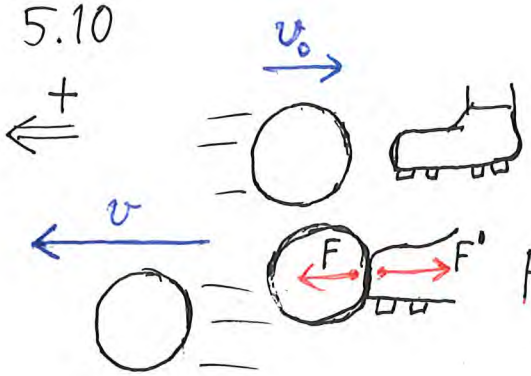
$$I = F \cdot t = 200\,N \cdot 6{,}0\,s = 1200\,Ns = \underline{1{,}2\,kNs}$$

b) $$\Delta p = I_{\Sigma F} = 1200\,Ns = \underline{1{,}2 \cdot 10^3\,kg\,\frac{m}{s}}$$



$(\Sigma F = F)$

5.10



$m = 0{,}44\,kg \qquad 10\,\frac{m}{s}$

$t = 0{,}020\,s \qquad v = 25\,\frac{m}{s}$

$F \cdot t = \Delta p$

$$F = \frac{\Delta p}{t} = \frac{mv - mv_0}{t} = \frac{m(v - v_0)}{t}$$

$$= \frac{0{,}044\,kg \cdot (25 - (-10))\,\frac{m}{s}}{0{,}020\,s} = \underline{77\,N}$$