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Oblig 5

FYS-MEK 1110

a)

Mekanisk energi er bevart:

$$mgh_0 = \frac{1}{2}mv_0^2$$

$$gh_0 = \frac{1}{2}v_0^2$$

$$v_0 = \sqrt{2gh_0}$$

b)

Både mekanisk energi og bevegelsesmengde er bevart, dermed har vi:

$$\text{I} \quad \cancel{m}{v_0^a}^2 = \cancel{m}{v_1^a}^2 + \cancel{m}{v_1^b}^2$$

og:

$$\text{II} \quad \cancel{m}v_0^a = \cancel{m}v_1^a + \cancel{m}v_1^b$$

$$\text{I} \quad {V_0^a}^2 = {V_1^a}^2 + {V_1^b}^2$$

$$\text{II} \quad V_0^a = V_1^a + V_1^b$$

$$\text{II} \quad V_1^a = V_0^a - V_1^b$$

$$\text{I} \quad {V_0^a}^2 = (V_0^a - V_1^b)^2 + {V_1^b}^2$$

$$\text{I} \quad {V_0^a}^2 = {V_0^a}^2 - 2V_0^a V_1^b + {V_1^b}^2 + {V_1^b}^2$$

$$\text{I} \quad 2{V_1^b}^2 = 2V_0^a V_1^b$$

$$\text{I} \quad \underline{V_1^b = V_0^a}$$

$$\text{II} \quad V_0^a = V_1^a + V_0^a$$

$$\text{II} \quad V_1^a = V_0^a - V_0^a$$

$$\underline{V_1^a = 0}$$

Ball b fortsetter med hastighet V_0^a, og ball a forblir i ro etter støtet. Dette stemmer med en Newtons cradle.

c)

$$\frac{1}{2}\cancel{m}{v_1^b}^2 = \cancel{m}g h_1$$

$$\frac{1}{2}{v_1^b}^2 = g h_1 \quad \Big| \quad v_1^b = v_0^a = \sqrt{2gh_0}$$

$$\cancel{\frac{1}{2}\cdot 2}\cancel{g}h_0 = \cancel{g}h_1$$

$$\underline{h_0 = h_1}$$

d)

$$m_a v_0^a + m_b v_0^b = (m_a + m_b) v_1$$

$$\cancel{m} v_0^a + \cancel{m} v_0^b = 2\cancel{m} v_1$$

$$v_0^a + \underbrace{v_0^b}_{0} = 2v_1$$

$$v_1 = \frac{v_0^a}{2}$$

$$\frac{1}{2} v_1^2 = g h_1$$

$$\frac{1}{2} \left(\frac{v_0^a}{2} \right)^2 = g h_1 \qquad \Big| \; v_1 = \frac{v_0^a}{2}$$

$$\frac{1}{2} \cdot \frac{1}{4} \cdot {v_0^a}^2 = g h_1$$

$$\frac{1}{8} \cdot 2 g h_0 = g h_1 \qquad \Big| \; v_0^a = \sqrt{2 g h_0}$$

$$h_1 = \frac{1}{4} h_0$$

e)

$$\mathrm{I} \quad v_1^b - v_1^a = r v_0^a$$

$$\mathrm{II} \quad v_0^a = v_1^a + v_1^b$$

$$\mathrm{II} \quad v_1^b = v_0^a - v_1^a$$

$$\mathrm{I} \quad v_0^a - v_1^a - v_1^a = r v_0^a$$

$$\mathrm{I} \quad -2 v_1^a = r v_0^a - v_0^a$$

$$\mathrm{I} \quad v_1^a = \frac{-r v_0^a + v_0^a}{2} = \underline{\underline{\frac{v_0^a (1 - r)}{2}}}$$

$$\text{II} \quad v_1^b = v_0^a - \frac{v_0^a(1-r)}{2}$$

$$\text{II} \quad 2v_1^b = 2v_0^a - v_0^a + v_0^a r$$

$$\text{II} \quad 2v_1^b = v_0^a + v_0^a r$$

$$\text{II} \quad v_1^b = \frac{v_0^a(1+r)}{2}$$

f)

$$v_0^a = v_0$$

$$v_1^b = v_0^a = v_0 \quad | \text{fra oppg. b)}$$

$$v_2^c = v_1^b = v_0^a = v_0$$

After first collision	After second collision
$v_1^a = 0$	$v_2^a = 0$
$v_1^b = v_0$	$v_2^b = 0$
$v_1^c = 0$	$v_2^c = v_0$

Der $v_0 = \sqrt{2gh_0}$

g)

$$m v_0^a = m v_1^a + m v_1^b + m v_1^c$$

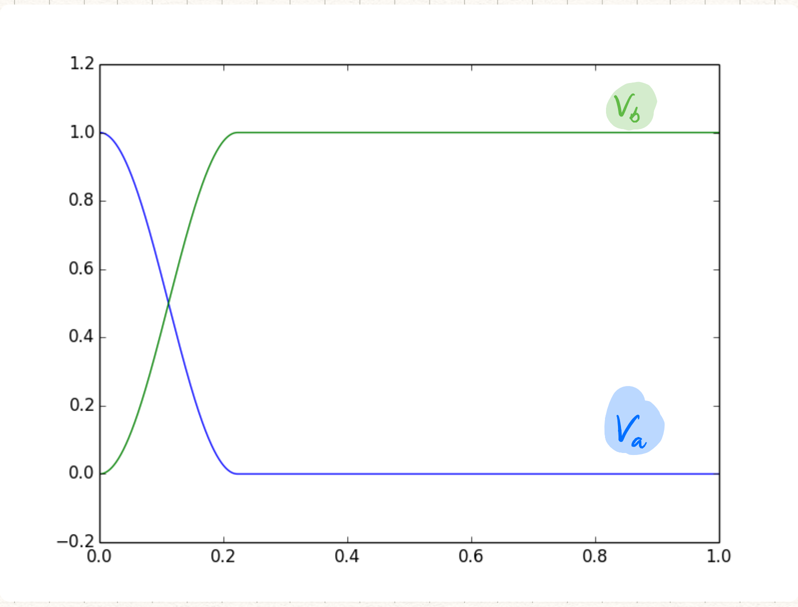
$$\text{I} \quad v_0^a = v_1^a + v_1^b + v_1^c$$

$$\text{II} \quad \frac{1}{2} {v_0^a}^2 = \frac{1}{2} {v_1^a}^2 + \frac{1}{2} {v_1^b}^2 + \frac{1}{2} {v_1^c}^2$$

Her har vi to likninger med 3 ukjente, så de kan ikke løses.

h)

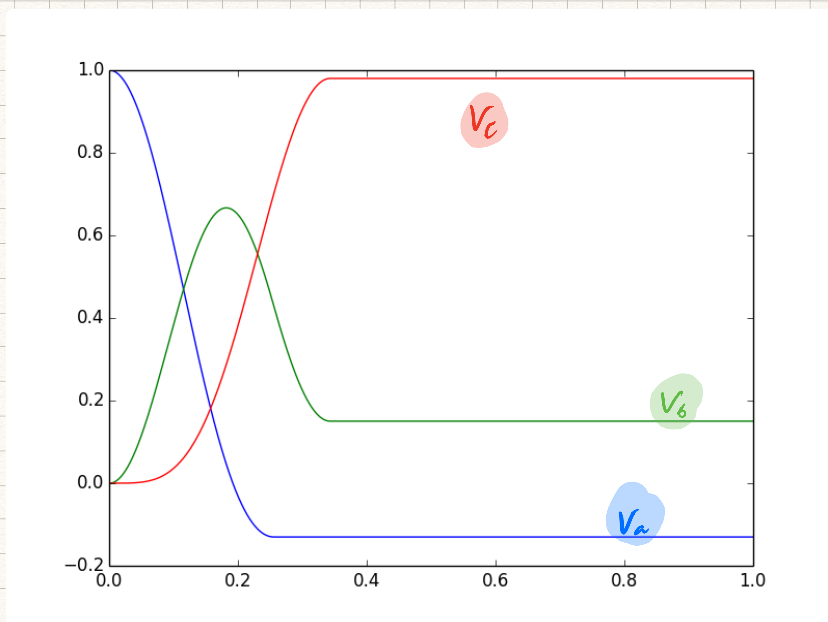
Vi ser at all bevegelsesmengden overføres fra ball a til ball b, og dette stemmer med hva som forventes.



i)

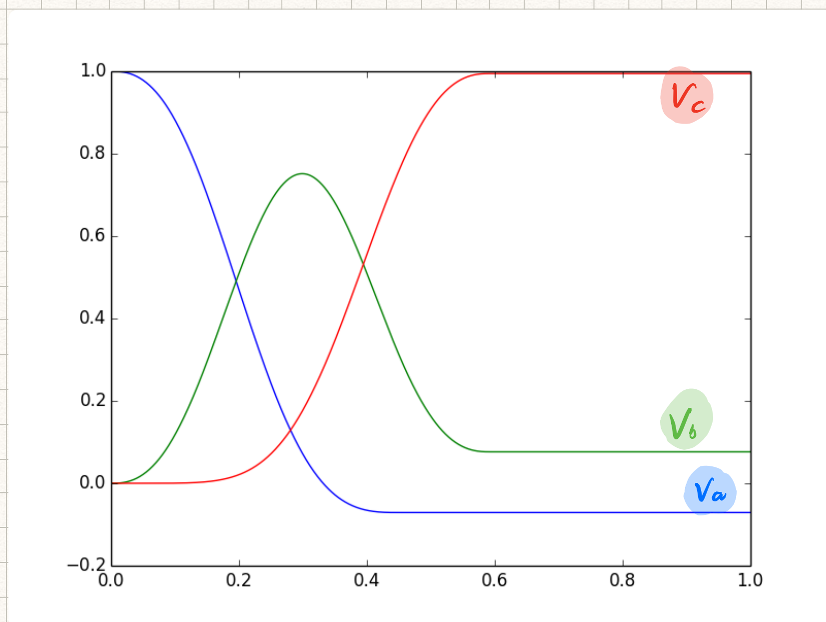
Vi ser at $v_1^c = v_0^a$, og

$v_1^b = -v_1^a$



Dette stemmer med Newtons cradle fordi vi bare simulerer selve støtet, og v_a og v_b vil miste fart senere.

j) Når q er satt til $\frac{3}{2}$ så varer støtet litt lenger, og V_a og V_b er narmere 0.



k)

Når q settes til 4 er
både v_a og v_b (tilnærmet) lik 0
etter støtet.