Übungsblatt 2

2)

a) $v = \frac{6 \cdot 4\,m}{(4,5 - 2)s} = 1,6\,m/s$

b) nach ca. 4s

c) bei 0s und ca. 6s

d) vor 0s und nach 6s

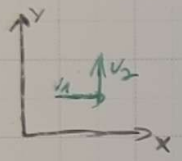
3) $\vec{r} = [1,5m + (12\,m/s)t] \cdot \vec{e_x} + [(16\,m/s)t - (4,9\,m/s^2)t^2] \cdot \vec{e_y}$

$\vec{v} = \frac{d\vec{r}}{dt} = \frac{d\vec{x}}{dt} \cdot \vec{e_x} + \frac{d\vec{y}}{dt} \vec{e_y} = 12\,m/s \cdot \vec{e_x} + (16\,m/s - 9,8\,m/s^2)t \cdot \vec{e_y}$

$\vec{a}\ \frac{d\vec{v}}{dt} = \frac{d\vec{v_x}}{dt} \cdot \vec{e_x} + \frac{d\vec{v_y}}{dt} \cdot \vec{e_y} = 0 \cdot \vec{e_x} + (-9,8\,m/s^2) \cdot \vec{e_y}$

3) kann man Winkel einfach im Taschenrechner lösen?

4)



$v_1 = 60\,km/h \quad v_2 = -60\,km/h$

$v_1 = 60\,km/h = 16,67\,m/s = v_2$

$\vec{a} = \frac{\vec{v_2} - \vec{v_1}}{t_2 - t_1} = \frac{16,67\,m/s \cdot \vec{e_y} - 16,67\,m/s \cdot \vec{e_x}}{5s - 0s} = -3,33\,m/s^2 \vec{e_x} + 3,33\,m/s^2 \vec{e_y}$

5) $\vec{v_1} = 100\,km/h \quad \vec{v_2} = 0\,km/h \quad s = 0,75m \quad t_1 = 0s$

$= 27,78\,m/s$

$t_2 = \frac{s}{\vec{v_1}} = \frac{0,75\,m}{27,78\,m/s} = 26,99\,ms$

$a = \frac{0\,km/h - 27,79\,m/s}{26,99\,ms - 0s} = -1029,27\,m/s^2 \quad \frac{m}{s^2} \Rightarrow \frac{m}{s} \cdot \frac{1}{s} = \frac{m}{s^2}$

warum das doppelte? Anderer Weg?

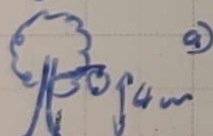
Taschenlampenansatz:

$x = x_0 + v_0 \cdot t + \frac{1}{2} a t^2 \qquad v = v_0 + at \Leftrightarrow a = \frac{v - v_0}{t} = \frac{-v_0}{t}$

$x - x_0 = v_0 \cdot t + \frac{1}{2} \frac{-v_0}{t} t^2 = v_0 \cdot t + \frac{1}{2}(-v_0)t = \frac{1}{2} v_0 t \Leftrightarrow t = \frac{2x}{v_0}$

$a = \frac{-v_0}{t} = \frac{-v_0}{\frac{2x}{v_0}} = \frac{-v_0^2}{2x} = \frac{(27,79\,m/s)^2}{2 \cdot 0,75m} = -516,86\,m/s^2$

b) $h_B = 4\,m$ $h_v = 2{,}5\,m$ $m = 200\,g = 0{,}2\,kg$ $g = 9{,}81\,m/s^2$



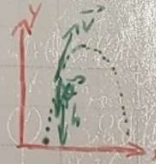
a) $y = y_0 + v_0 t + \frac{1}{2} a_y t^2 \Rightarrow y = \frac{1}{2} g t^2 \Leftrightarrow t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{8\,m}{9{,}81\,m/s^2}} = 0{,}9\,s$

b) $y - h_v = y_0 + v_0 t + a_y t \Rightarrow y - h_v = \frac{1}{2} g t^2 \Leftrightarrow \sqrt{\frac{y - h_v}{\frac{1}{2} g}} = t = \sqrt{\frac{4 - 2{,}5}{9{,}81}} = 0{,}553\,s$

$v^2 = v_0 + 2 g \Delta y \Leftrightarrow v = \sqrt{2 g \Delta y} = \sqrt{2 \cdot 9{,}81 \cdot (4 - 2{,}5)} = 5{,}42\,m/s$

c) $v^2 = v_0 + 2 g \Delta y \Leftrightarrow v = \sqrt{2 g \Delta y} = \sqrt{2 \cdot 9{,}81 \cdot 4} = 8{,}86\,m/s$

7) $h = 9{,}1\,m \quad \vec{v} = 7{,}6\,\vec{e}_x + 6{,}1\,\vec{e}_y$



a) $h = \frac{1}{2}\frac{(v_0 \cdot \sin\varphi)^2}{g} = \frac{1}{2}\frac{v_{0y}^2}{g} = \frac{1}{2}\frac{14{,}7^2}{9{,}81} = 11\,m$

$v_{1y}^2 = v_{0y}^2 - 2g\Delta y \Leftrightarrow v_{0y} = \sqrt{v_{1y}^2 + 2g\Delta y} = \sqrt{6{,}1^2 + 2 \cdot 9{,}81 \cdot 9{,}1} = 14{,}7\,m/s$

b) $x = v_{0x} \cdot t \Rightarrow v_{0x} \cdot \frac{2v_{0y}}{g} = 7{,}6 \cdot \frac{2 \cdot 6{,}1}{9{,}81} = 22{,}28\,m/$

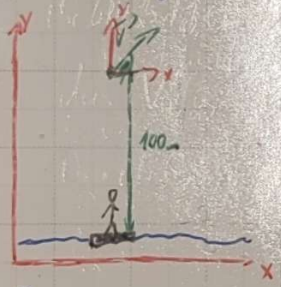
$y = v_{0y} \cdot t - \frac{1}{2}gt^2 \Leftrightarrow t = \frac{2v_{0y}}{g}$ $\quad v_{1x} = v_{0x} \rightarrow$ kein Verlust durch Reibung

c) $\vec{v_3} = 7{,}6\,\vec{e}_x - 14{,}7\,\vec{e}_y$

$|\vec{v_3}| = \sqrt{7{,}6^2 + 14{,}7^2} = 16{,}5\,m/s$

d) $\theta = \arctan\frac{14{,}7}{7{,}6} = 63°$

8) $h = 100\,m \quad v_0 = 25\,m/s \quad \theta = 36{,}91° \quad y = -100\,m \quad y_0 = 0\,m \quad a_y = -9{,}81\,m/s^2$



a) $v_{0y} = v_0 \cdot \sin\theta = 25\,m/s \cdot \sin 36{,}91° = 15\,m/s$

$y = y_0 + v_0t + \frac{1}{2}at^2 \Rightarrow -100 = 15t - \frac{1}{2}9{,}81t^2 \Leftrightarrow 0 = t^2 - 3t - 20{,}4$

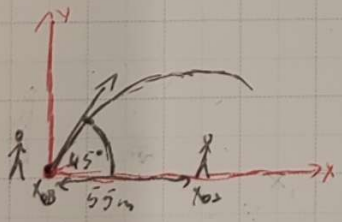
$t_{1/2} = \frac{3}{2} \pm \sqrt{\left(\frac{3}{2}\right)^2 + 20{,}4} = \begin{cases} 6{,}3\,s \\ -3{,}3\,s \end{cases}$

b) $x = x_0 + v_{0x}t + \frac{1}{2}at^2 \Rightarrow x = v_{0x}t = v_0 \cdot \cos\theta \cdot t = 25\,m/s \cdot \cos 36{,}91° \cdot 6{,}3\,s = 126\,m$

c) $x = x_0 + v_{0x}t = 0 + 25\,m/s \cdot \sin 36{,}91° \cdot 6{,}3\,s = 126\,m$

$y = y_0 + v_{0y}t = 0 + 25\,m/s \cdot \cos 36{,}91° \cdot 6{,}3\,s = 94{,}6\,m$

9) $v_0 = 19{,}5\,m/s \quad \theta = 45° \quad L = 55\,m$



$x = \frac{v_0^2 \cdot \sin(2\theta)}{g} = \frac{19{,}5^2 \cdot \sin(2 \cdot 45)}{9{,}81} = 38{,}8\,m$

$t = \frac{2v_0 \cdot \sin\theta}{g} = \frac{2 \cdot 19{,}5 \cdot \sin 45}{9{,}81} = 2{,}81$

$v_3 = \frac{x - L}{t - t_0} = \frac{39\,m - 55\,m}{2{,}81\,s} = -5{,}8 \Rightarrow |v_3| = |-5{,}8\,m/s| = 5{,}8\,m/s$

10)

$n = 5$ $\quad r = 15\,m$

a) $T = \frac{60}{n} = \frac{60}{5} = 12\,s$

b) $a_{zp} = \omega^2 r = \left(\frac{2\pi}{T}\right)^2 r = \left(\frac{2\pi}{12\,s}\right)^2 \cdot 15\,m = 4{,}1\,m/s^2$

c) a_{zp} ist an jedem Punkt gleich.

11) $L = 15m \quad t_S = 30s \quad t_B = 60s$

$v_S = \frac{L}{t_S} = \frac{15m}{30s} = 0,16 m/s$

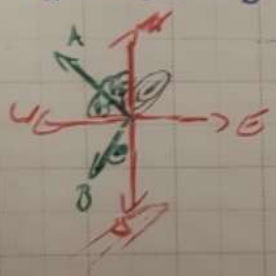
$v_B = \frac{L}{t_B} = \frac{15m}{60s} = 0,25 m/s$

$v_2 = v_S + v_B = 0,16 + 0,25 = 0,41 m/s$

$t = \frac{L}{v} = \frac{15m}{0,41 m/s} = 36,6s$

$t = \frac{L}{\frac{L}{t_B} + \frac{L}{t_S}} = \frac{L}{L(t_S + t_B)} \cdot t_S t_B = \frac{t_B \cdot t_S}{t_S + t_B}$ → hängt nicht von L ab.

12) $v_A = 24,5 m/s \quad v_B = 28,3 m/s$

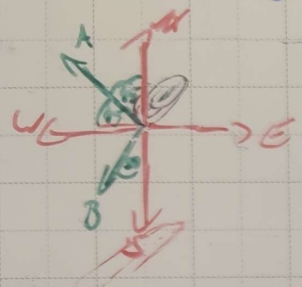


a) $\theta_{AB} = 45° + 90° - 40° = 95°$

$\vec{v}_A = (v_A \cdot \cos 45°)\vec{e_x} + (v_A \cdot \sin 40°)\vec{e_y}$

$\vec{v}_B = (v_B \cdot \sin 40°)\vec{e_x} + (v_B \cdot \cos 45°)\vec{e_y}$

12) $v_A = 24\,\frac{sm}{}$ $v_B = 28\,sm$



a) $\vartheta_{AB} = 45° + 90° - 40° = 95°$

$\vec{v_A} = (v_A \cdot \cos 45°)\vec{e_x} + (v_A \cdot \sin 45°)\vec{e_y}$

$\vec{v_B} = (v_B \cdot \sin 40°)\vec{e_x} - (v_B \cdot \cos 40°)\vec{e_y}$

warum $v_{Ax} \ominus v_{Bx} + v_{Ay} \oplus v_{By}$

$v_{AB} = (v_A \cdot \cos 45° - v_B \cdot \sin 40°)\vec{e_x} + (v_A \sin 45° + v_B \cdot \cos 40°)\vec{e_y}$

$v_{AB} = (24\,sm \cdot \cos 45° - 28\,sm \cdot \sin 40°)\vec{e_x} + (24\,sm \cdot \sin 45° + 28 \cdot \cos 40°)\vec{e_y}$

$= -1\,\vec{e_x} + 38{,}4\,\vec{e_y}$

$|v_{AB}| = \sqrt{(-1)^2 + (38{,}4)^2} = 38{,}4\,\frac{sm}{}$

$\varphi = \arctan |v_{AB}| = 1{,}55°$

b) $\frac{\Delta C_{AB}}{|v_{AB}|} = 4{,}17\,h$