Physik, TBM 8E, 26.3.2014

(1) Fallzeit für Stein 1 ist gleich Fallzeit Stein 2

$s_1(t) = -5t^2 - 10t + 100$ $\quad s(t) = at^2 + v_0 t + s_0$

$s_2(t) = -5t^2 - 25t + h_2$

Fallzeit Stein 1:

$s_1(t) = -5t^2 - 10t + 100 = 0$

$t = \sqrt{21} - 1 \approx 3.582258\,s$

t einsetzen in $s_2(t)$, in dieser Zeit fällt Stein 2:

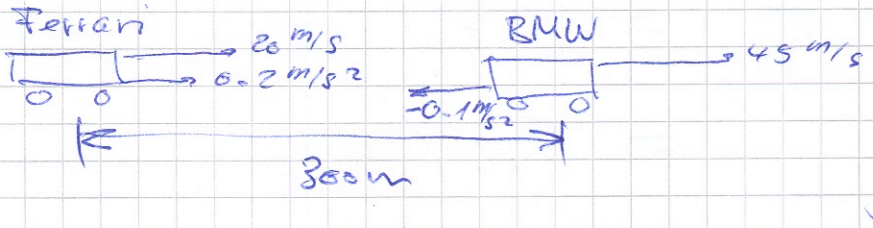
$-5t^2 - 25t + h_2 = 0$ für $t = \sqrt{21} - 1$

$h_2 = 5\left(3\sqrt{21} + 17\right) \approx 153.739\,m$

(2) a) $s_F(t) = \frac{1}{2} \cdot 0.2 \cdot t^2 + 20t$

$= 0.1t^2 + 20t$

$s_{BMW}(t) = -0.05t^2 + 45t + 300$



$v_F(t) = 0.2t + 20$ $\quad v = a \cdot t + v_0$

$v_{BMW}(t) = -0.1t + 45$

b) $\text{Solve}\left(s_F(t) = s_{BMW}(t), t\right)$

$t = 177.908\,s$

$v_F(t) = 55.5817\,m/s$ $\quad s_F(t) = 6'723.31\,m$

$v_{BMW}(t) = 27.2092\,m/s$ $\quad s_{BMW}(t) = 6'723.31\,m$

c) Ferrari 100 m vor BMW:

$$\text{solve}\left(S_F(t) = S_{BMW}(t) + 100\,m,\ t\right)$$

$$t = 181.3696\,s$$

Test:

$$\left\{\begin{array}{l} S_F(t) = 6'916.89\,m \\ S_{BMW}(t) = \underline{6'816.89\,m} \end{array}\right\} \quad \underline{V.}$$

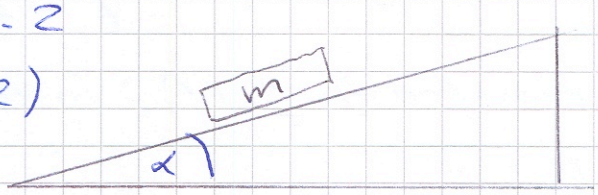
$$\text{Diff.} = 100\,m$$

(3) $m = 5'000\,kg$

$a = 20\,\% = 0.2$

$\alpha = \arctan(0.2)$

$\hat{=} 11.3099°$



a) $\vec{F}_{tot} = \vec{F}_{Reib} + \vec{F}_{//}$; $\vec{F}_{//}$ = Hangabtriebskraft

$\vec{F}_{Reib} = \mu \cdot \vec{F}_{\perp}$ $\vec{F}_{\perp}$ = Normal- oder Impresskraft

$= \mu \cdot F_G \cdot \cos\alpha$

$F_{//} = F_G \cdot \sin\alpha$

$F_{tot} = \mu \cdot F_G \cdot \cos\alpha + F_G \cdot \sin\alpha$ 10'786.4N / 9'805.78N

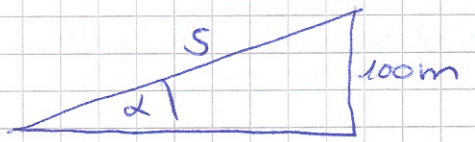
$= F_G\left(\mu \cdot \cos\alpha + \sin\alpha\right)$

$= mg\left(\mu \cdot \cos\alpha + \sin\alpha\right) = \underline{20'592.2\,N}$

b) $P = F \cdot v = 20'592.2\,N \cdot 7.5\,m/s$

$= \underline{154.441\,kW}$

c) Zurückgelegte Strecke, um 100 m Höhe zu überwinden:



$$\sin\alpha = \frac{Gk}{H} = \frac{100}{s}$$

$$s = \frac{100}{\sin\alpha} = 509.902\,m$$

$$s = v \cdot t, \quad v = 7.5\,m/s$$

$$t = \frac{s}{v} = 67.9869\,s$$

$$E = P \cdot t = 10.5\,MJ \hat{=} 78\,\%$$

$$13.4615\,MJ \hat{=} 100\,\%$$

$$= 3.73932\,kWh$$

Preis: 74.79 Rp ≈ 75 Rp.

(4) $h = 5m$, $m = 0.1kg$, $d = 60m$

a) Fallzeit: $-5m = -\frac{1}{2} g t^2$

$5 = 5t^2 \Rightarrow \underline{t = 1s}$

60m in 1s $\Rightarrow \underline{\underline{v_0 = 60\ m/s}}$

b) $E_{kin} = \frac{1}{2} m v^2 = F \cdot s$ (Kraft mal Weg)

$F = \frac{m v^2}{2s} = \underline{\underline{450N}}$

$a = \frac{F}{m} = \underline{\underline{4'500\ m/s^2}}$

c) $E = \frac{1}{2} m v^2 = 180$ Joule

Zeit: $s = \frac{1}{2} a t^2$

$\sqrt{\frac{2s}{a}} = \sqrt{\frac{2 \cdot 0.4}{4500}} \approx 0.0133s$

$P = \frac{E}{t} \approx \underline{\underline{13.5\ kW}}$

(5)

$$F_{Res} = 1000N + 1250N - \underbrace{750N}_{F_{G_1,m_4}} - \underbrace{250N}_{F_{Reib}}$$

$$= 1250N$$

$$m_{tot} = 400kg \; ; \; a = \frac{F_{Res}}{m_{tot}} = \frac{25}{8} m/s^2$$

$$= \underline{3.125 \, m/s^2}$$

$$s = \frac{1}{2} a t^2 = \frac{1}{2} \cdot 3.125 \cdot 1^2 = \underline{1.5625 \, m}$$

$$F_A = F_B + m_2 g + a \cdot m_2 = 125kg \, (10 \, m/s^2 - 3.125 \, m$$

$$859.375$$

$$F_B = a(m_3 + m_4) + \mu m_3 g + F_{G_1,m_4}$$

$$\Rightarrow \underline{1546.88N}$$

$$F_C = a \cdot m_4 + F_{G_1,m_4} =$$

$$= \underline{984.375N}$$

$F_D = F_C$, nur Umlenkrolle dazwischen