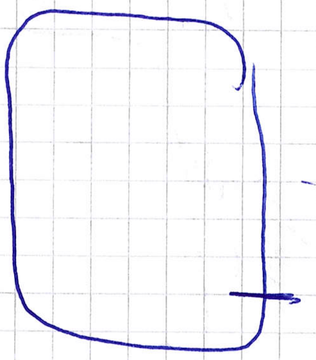
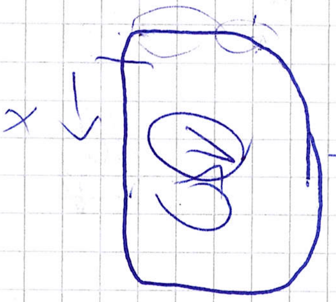
AP1 Gruppentreffen

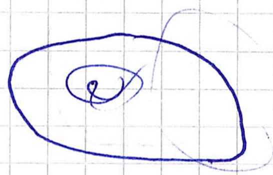
1) 26.04: - Strecke 1 rechnen
(opt: Strecke 2



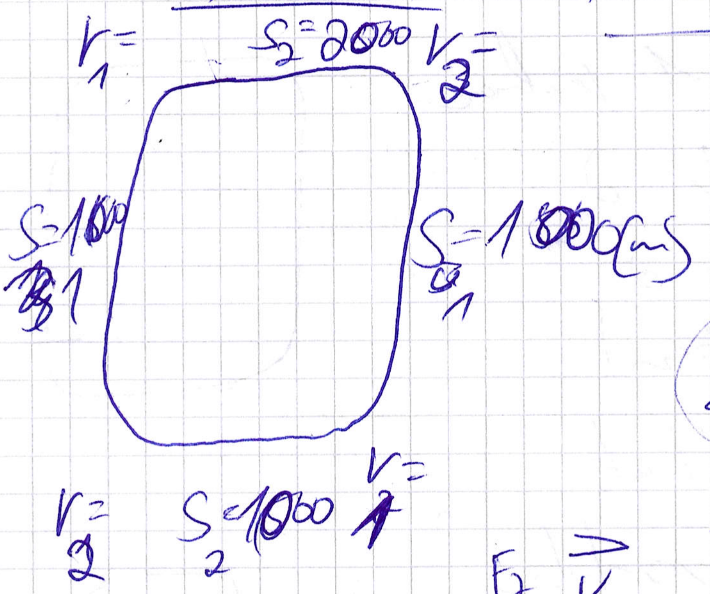
2) No 2: - Strecke 2
(abschließen)
- Git & GitHub
komplett „verstehen"
und initialisieren



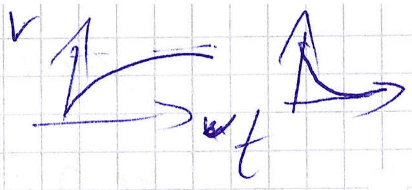
3) No 3: - Diagramme
ausarbeiten
- Zeitplanung
- Lastenheft



Strecke 1



Fahrzeug 1:



$a(v) \rightarrow$ 0-100: 2,5 s

(100-) 0-200:

(200-) 0-300: 13,6 s

$v_{max} = 420 \frac{km}{h}$

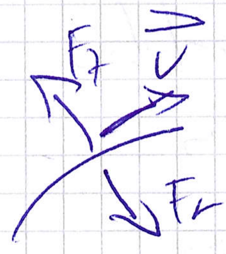
$\mu = 0{,}8 \quad g = 9{,}81 \frac{m}{s^2}$

$m = 2000 kg \quad c_w = 0{,}36$

$\cancel{a_{max}}$

$\cancel{a(v)_{brems}} = \quad \rho = 1{,}2 \frac{kg}{m^3}$

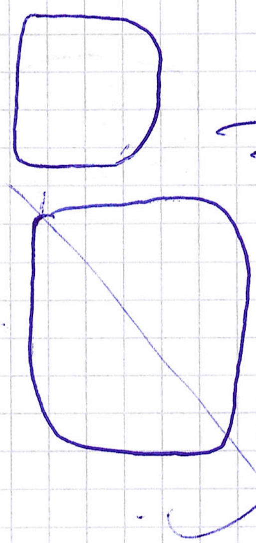
Allg:



$\Rightarrow F_r \geq F_z$

$\mu \cdot F_N = m \frac{v^2}{r} \; ; \; \frac{v^2}{r} = a_z$

$\mu \cdot m \cdot g = m \frac{v^2}{r} \Leftrightarrow \sqrt{\mu g r} = v_{max}$



Fliegender Start

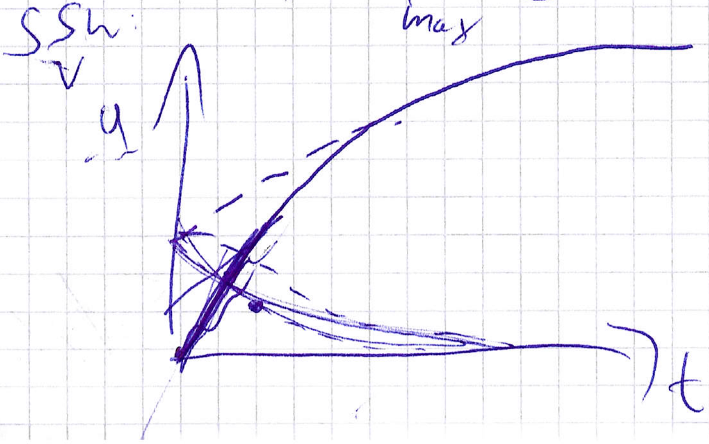
Berechnung $a(v)_{beschl} = \cancel{v_{max} \cdot e^{-\lambda v}}$

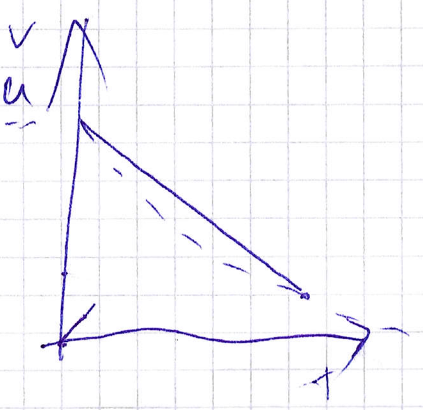
$\cancel{\Leftrightarrow a(v) = v_{max} (1 + e^{-\lambda v})} \quad (v_{max} - v)$

$\cancel{a(v) = v_{max}} \; a_{max} \cancel{(1 - e^{-\lambda v})}$

$a(v) = a_{max} \cdot e^{-\lambda v}$

SSW:





S2/6

Festlegung: 0–100 → das t : a ist danach(!)

~~linear~~ ⇒ a_{max}

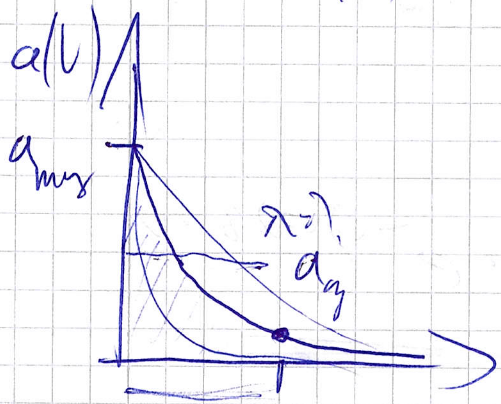
daraus

$$V = a \cdot t \Rightarrow a_{0-100} = \frac{V_{100}}{t}$$

$$\Rightarrow a_{0-100} = \frac{27{,}7778 \frac{m}{s}}{t}$$

$$\Rightarrow a_{0-100} = \frac{27{,}7778 \frac{m}{s}}{2{,}5\,s} \approx \boxed{11{,}1111 \frac{m}{s^2} \overset{!}{=} a_{max}}$$

$$\Rightarrow a(v) = 11{,}1111 \frac{m}{s^2} \cdot e^{-\lambda v}$$



$\boxed{0\text{–}100 \text{ pflicht!}}$

$\boxed{b\text{–}c \text{ frei wählbar}}$

$$a_{b-c} = \frac{c-b}{t_{b-c}} \overset{!}{=} a_{b-c} = \frac{83{,}3333 \frac{m}{s}}{13{,}6\,s} \approx 6{,}1275 \frac{m}{s^2}$$

$$a_{b-c,\varnothing} = \frac{1}{c-b} \int_b^c \left(a_{max} \cdot e^{-\lambda v} \right) dv$$

[Numerisch!]

Erlaubt alle beschl. Kurven

$$\Leftrightarrow a_{b-c,\varnothing} = \frac{1}{c-b} \left[\frac{-a_{max}}{\lambda} e^{-\lambda v} \right]_b^c$$

$$\Rightarrow a_{b-c,\varnothing} = \frac{1}{c-b} \left(\frac{-a_{max}}{\lambda} e^{-\lambda c} + \frac{a_{max}}{\lambda} e^{-\lambda b} \right) \overset{!}{=} a_{b-c}$$

$$\Rightarrow (c-b)\, a_{b-c} = \left(e^{-\lambda b} - e^{-\lambda c} \right) \cdot \frac{a_{max}}{\lambda}$$

$$\Leftrightarrow \quad (c-b)\, a_{b-c} = \left(e^{-\lambda b} - e^{-\lambda c}\right) \cdot \frac{a_{max}}{\lambda}$$

$$\Leftrightarrow \quad \frac{(c-b)\,\lambda\, a_{b-c}}{a_{max}} = e^{-\lambda b} - e^{-\lambda c}$$

$$\Leftrightarrow \quad \frac{(c-b)\, a_{b-c}}{a_{max}} \cdot \lambda + e^{-\lambda c} - e^{-\lambda b} = 0$$

Newton - QNS - Verfahren

Genauigkeit: $\pm 0{,}01$

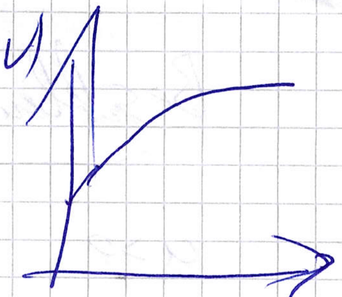
Bsp $\Rightarrow$

$$\frac{83{,}3333 \frac{m}{s} \cdot 6{,}1275 \frac{m}{s^2}}{11{,}1111 \frac{m}{s^2}} \cdot \lambda + e^{-\lambda \cdot 83{,}333} = 0$$

$\Rightarrow$ Nummerisch: $\lambda = 0{,}028$

$$\Rightarrow \quad a_{besch}(v) = 11{,}1111 \cdot e^{-0{,}028 \cdot v}$$

$= a(v)$



$a_{brems}(v) = a_{Lw}(v) + a_{Bremse} + a_{Rollw.}$

Bremse: a_{Bremse}

Luftwiderstand: $\lambda \cdot v_{Lw}^2 = a_{Lw}(v)$ $\quad F_r \propto v^2 \, v$, $F = m \cdot a$, $a_{Lw} \propto v^2$

Rollwiderstand: konst a_{roll}

$\Rightarrow a_{brems}(v) = \lambda v_{Lw}^2 + \underline{a_{Bremse}} + a_{Rollw}$

Gesucht: λ / a_{Bremse} / a_{Rollw}

→ Benutzer legt $a_{Rollw.}$ direkt fest (Richtwert: $-1 \frac{km}{hs}$)

$F_{Lw}(v) = c_w \cdot A \cdot \frac{1}{2} \rho \cdot v^2 \qquad F = m \cdot a \Rightarrow a = \frac{F}{m}$

$\Rightarrow a_{Lw}(v) = \frac{c_w \cdot A \cdot \frac{1}{2} \rho v^2}{m} \Rightarrow \lambda = \frac{c_w \cdot A \rho}{2m}$

a_{Bremse} $\quad s = \frac{1}{2} a t^2 = \frac{(\Delta v)^2}{2 a_{\Delta v}} = s$

$d - c$

$\Rightarrow \sqrt{2as} = \Delta v = (v_1 - v_2)$

$\Leftrightarrow \frac{(v_1 - v_2)^2}{2s} = a_{1-2} \overset{!}{=} a_{Bremse}$ → Benutzer muss Δv für s eingeben

$\Rightarrow a_{brems}(v) = \frac{c_w \cdot A \cdot \rho}{2m} \cdot v^2 + \frac{\Delta v}{2s} + a_{Rollw}$

Beschleunigungsformeln Allgemein:

$a>0$: $a_{Besch}(v) = a_{max} \cdot e^{-\lambda v}$

a_{max}: $a_{max} = \frac{v_{0-100}}{t_{0-100}} = \frac{27{,}7778 \frac{m}{s}}{t_{0-100}}$

λ: $\frac{(c-b)\, a_{b-c}}{a_{max}} \cdot \lambda + e^{-\lambda c} - e^{-\lambda b} = 0$

$a_{b-c} = \frac{c-b}{t_{b-c}}$

$\rightarrow \lambda$ muss numerisch gelöst werden

Benutzereingabe: t_{0-100}; b; c; t_{b-c};

$a<0$:

$$a_{Bremse}(v) = \frac{c_w \cdot A \cdot \rho_L}{2m} \cdot v^2 + \frac{(d-c)}{2 s_{d-c}} + a_{Rollw}$$

Benutzereingaben: c_w; A; ρ_L; m; d; c; s_{d-c}; a_{Rollw}

Kurven:

$v_{Max} = \sqrt{\mu g r}$

Benutzereingaben: μ; g