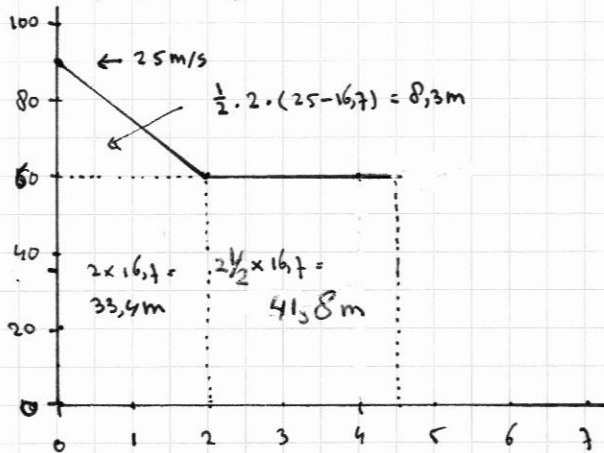


Opgave 1

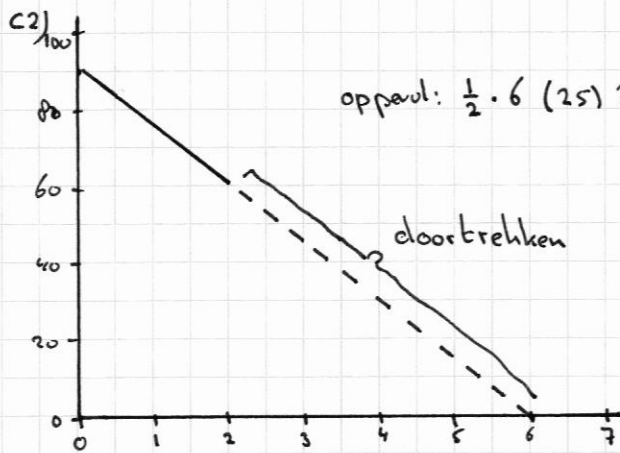
$$\begin{array}{l}
 \text{a) } t=0 \quad v = 90 \text{ km/h} \hat{=} 25 \text{ m/s} \\
 t=2 \quad v = 60 \text{ km/h} \hat{=} 16,7 \text{ m/s}
 \end{array}
 \left. \vphantom{\begin{array}{l} t=0 \\ t=2 \end{array}} \right\} \begin{array}{l} \Delta v = 25 - 16,7 = 8,3 \text{ m/s} \\ \Delta t = 2,0 \text{ s} \end{array}
 \left. \vphantom{\begin{array}{l} \Delta v \\ \Delta t \end{array}} \right\} \begin{array}{l} a = \frac{\Delta v}{\Delta t} = 4,15 \text{ m/s}^2 \\ F = ma \end{array}
 \left. \vphantom{\begin{array}{l} a \\ F \end{array}} \right\} \begin{array}{l} F = 1200 \cdot 4,15 \\ = 4980 \\ \approx 5,0 \cdot 10^3 \text{ N} \end{array}$$

$$\text{b) } F = 0 \Rightarrow a = 0 \Rightarrow \frac{\Delta v}{\Delta t} = 0 \Rightarrow \text{lijn horizontaal (rico = 0)}$$

c) afgelegde weg $\hat{=}$ oppervl. onder v, t -diagram



$$\text{totaal: } 8,3 + 33,4 + 41,8 = 83,5 \text{ m.}$$



De remweg (75 m) is kleiner dan de afstand tot de stilstaande auto (83,5 m) \Rightarrow auto had op tijd stilgestaan

$$\begin{array}{l}
 \text{d) voor botsing: } 60 \text{ km/h} \hat{=} 16,7 \text{ m/s} \quad E_k = \frac{1}{2} m v^2 = \frac{1}{2} 1200 (16,7)^2 = 1,67 \cdot 10^5 \text{ J} \\
 \text{na botsing: } 36 \text{ km/h} \hat{=} 10 \text{ m/s} \quad E_k = \frac{1}{2} m v^2 = \frac{1}{2} (1200 + 800) (10)^2 = 1,00 \cdot 10^5 \text{ J}
 \end{array}
 \left. \vphantom{\begin{array}{l} \text{voor botsing} \\ \text{na botsing} \end{array}} \right\} \Delta E = 0,67 \cdot 10^5 \text{ J}$$

ΔE is gebruikt voor indeuken

Opgave 2

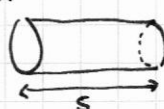
a) C: $T = 350 \text{ K}$, $P = 50 \cdot 10^3 \text{ Pa}$, $V = 7,0 \cdot 10^{-3} \text{ m}^3$

$$PV = nRT \Rightarrow n = \frac{PV}{RT} = \frac{50 \cdot 10^3 \cdot 7,0 \cdot 10^{-3}}{8,31 \cdot 350} = 0,120 \text{ mol}$$

b₁) $P_A = 300 \text{ kPa} = 300 \cdot 10^3 \text{ Pa}$
 oppervlakte = $3,5 \text{ dm} = 3,5 \cdot 10^{-2} \text{ m}^2$
 $P = \frac{F}{O} \Rightarrow F = P \cdot O$

$$F = 300 \cdot 10^3 \cdot 3,5 \cdot 10^{-2} = 10,5 \cdot 10^3 \text{ N}$$

b₂) $V_A = 3,33 \cdot 10^{-3} \text{ m}^3$ $V_B = V_C = 7,0 \cdot 10^{-3} \text{ m}^3$ zodat $\Delta V = 4,67 \cdot 10^{-3}$

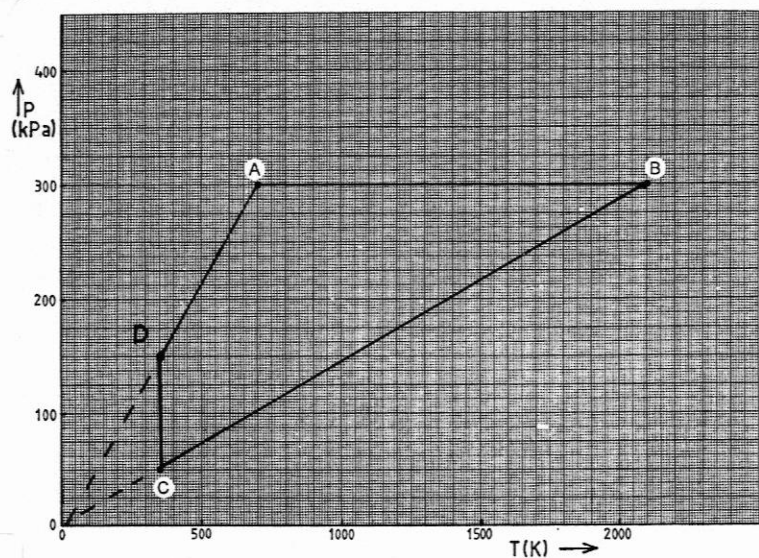


$$\Delta V = s \cdot O \Rightarrow s = \frac{\Delta V}{O} = \frac{4,67 \cdot 10^{-3}}{3,5 \cdot 10^{-2}} = 0,1334 \text{ m}$$

$$W = F \cdot s = 10,5 \cdot 10^3 \cdot 0,1334 \approx 1,401 \cdot 10^3 \approx 1,40 \cdot 10^3 \text{ J}$$

c) $T_D = T_C = 350 \text{ K}$

$$V_A = V_D \Rightarrow \frac{nRT_A}{P_A} = \frac{nRT_D}{P_D} \Rightarrow P_D = \frac{T_D}{T_A} \cdot P_A = \frac{350}{700} \cdot 300 \text{ kPa} = 150 \text{ kPa}$$



| | P (kPa) | V (m ³) | T (K) |
|---|---------|----------------------|-------|
| A | 300 | $2,33 \cdot 10^{-3}$ | 700 |
| B | 300 | $7,00 \cdot 10^{-3}$ | 2100 |
| C | 50 | $7,00 \cdot 10^{-3}$ | 350 |
| D | | $2,33 \cdot 10^{-3}$ | 350 |
| A | 300 | $2,33 \cdot 10^{-3}$ | 700 |

Alle waarden volgen uit de tekst behalve P_D

BC en DA constant volume: $P = \frac{nR}{V} \cdot T \sim "y = ax"$ rechte lijn (door oorsprong)

CD constante T: rechte lijn verticaal

Opgave 3

a) $F = G \cdot A = 180 \cdot 10^6 \cdot 2,50 \cdot 10^{-6} = 450 \text{ N}$

b) rel. rek $\epsilon = \frac{\sigma}{E} = \frac{180 \cdot 10^6}{200 \cdot 10^9} = 9,00 \cdot 10^{-4}$

c) van $t = 0,01 \text{ t/m}$ $t = 1,83 \text{ 7 omwentelingen}$

$$T = \frac{1,87 - 0,01}{7} = 0,2643 \text{ s} \rightarrow f = \frac{1}{T} = 3,7838 \approx 3,78 \text{ Hz}$$

d1) schatten: $\sigma_{\max} - \sigma_{\min} \approx 66 \text{ MPa}$ (met marge van 8 MPa) $\Rightarrow \sigma_A \approx 33 \text{ MPa}$

d2) Bij 100 MPa 10^7 omwentelingen $\sigma_A < 100 \text{ MPa}$ dus wiel kan (minimaal) $1 \cdot 10^7$ omwentelingen maken.

e) $d = 0,66 \text{ m}$ $\frac{2\pi(\frac{1}{2} \cdot 0,66)}{2,0735 \text{ m}} \cdot n = 8300 \cdot 10^3 \text{ m}$

$$n = \frac{8300 \cdot 10^3}{2,0735} \approx 4,0 \cdot 10^6 \xrightarrow{\text{sig 2}} \sigma_A \approx 106 \text{ MPa}$$