



# higher education & training

---

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

## **NASIENRIGLYN**

**NASIONALE SERTIFIKAAT**

**MEGANOTEGNIEK N5**

**8 Desember 2025**

**Hierdie nasienriglyn bestaan uit 9 bladsye.**

### VRAAG 1: EPISILIESE RATTE EN RATSTELSELS

| Toestand                               | B               | C                                                         | D                                                                                                | Arm E     |
|----------------------------------------|-----------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------|
| Bevestig Arm L & roteer A +1 rev       | +1              | $\frac{T_B}{T_C} = \frac{120}{35}$<br>$= 3,429\checkmark$ | $\frac{T_B}{T_C} \times \frac{T_C}{T_D} = \frac{120}{35} \times \frac{35}{-50} = -2,4\checkmark$ | 0         |
| Vermenigvuldig met X & tel Y by        | $x + y$         | $3,429x + y\checkmark$                                    | $-2,4x + y\checkmark$                                                                            | $y$       |
| $N_B = -24$<br>$N_D = 30$<br>$N_E = ?$ | $-24\checkmark$ |                                                           | $30\checkmark$                                                                                   | $N_E = ?$ |

$$\begin{aligned}
 x + y &= -24 \dots\dots\dots(1)\checkmark \\
 -2,4x + y &= 30 \dots\dots\dots(2)\checkmark \\
 3,4x + 0 &= -54\checkmark \quad (\text{Vgl 1 - Vgl 2}) \\
 x &= \frac{-54}{3,4} \\
 x &= \boxed{-15,882}\checkmark
 \end{aligned}$$

Vervang  $x$  in verg1

$$\begin{aligned}
 -15,882 + y &= -24\checkmark \\
 y &= \boxed{-8,118}\checkmark
 \end{aligned}$$

$$\begin{aligned}
 N_E &= y \\
 N_E &= -8,118
 \end{aligned}$$

$$NE = 8,118 \text{ r/min (antikloksgewys)} \checkmark$$

[10]

### VRAAG 2: VERVOERBANDE EN BANDAANDRYWINGS

- 2.1
- Magnetiese katrol
  - Hangende elektromagneet
- (2)

2.2

2.2.1

$$\begin{aligned}
 Wd_F &= F_\mu \times S \\
 Wd_F &= 3\,800 \times \frac{85}{60} \\
 Wd_F &= 5\,383,3 \text{ J} \\
 Wd_F &= \boxed{5,383 \text{ kJ}}
 \end{aligned}$$

(3)

$$\begin{aligned}
 2.2.2 \quad \sin 16^\circ &= \frac{h}{120} \\
 h &= 120 \sin 16^\circ \\
 h &= \boxed{33,1 \text{ m}} \\
 Wd_L &= \frac{F}{s} \times h \\
 Wd_L &= \frac{(300 \times 1\,000 \times 9,81)}{60 \times 60} \times 33,1 \\
 Wd_L &= 27\,059,25 \text{ J} \\
 Wd_L &= \boxed{27,059 \text{ kJ}} \quad (3)
 \end{aligned}$$

$$\begin{aligned}
 2.2.3 \quad Wd_{\text{Total}} &= (T_1 - T_2) \times V \\
 (5\,383 + 27\,059) &= (T_1 - T_2) \times \frac{85}{60} \\
 T_1 - T_2 &= \frac{32\,442 \times 60}{85} \\
 T_1 - T_2 &= 22\,900,24 \text{ N} \\
 T_1 - T_2 &= \boxed{22,9 \text{ kN}} \quad (3)
 \end{aligned}$$

$$\begin{aligned}
 2.2.4 \quad \frac{T_1}{T_2} &= e^{\mu\theta} \\
 \frac{T_1}{T_2} &= e^{0,3(220^\circ)} \\
 \frac{T_1}{T_2} &= 3,164 \\
 T_1 &= \boxed{3,164 T_2} \\
 \text{Van } V_{2.2.3} \\
 T_1 - T_2 &= 22\,900,24 \text{ N} \\
 3,164T_2 - T_2 &= 22\,900,24 \\
 2,164T_2 &= 22\,900,24 \\
 T_2 &= \boxed{10,582 \text{ kN}} \\
 \therefore T_1 &= 3,164 T_2 \\
 T_1 &= 3,164(10,582) \\
 \therefore T_1 &= \boxed{33,483 \text{ kN}} \quad (3)
 \end{aligned}$$

$$\begin{aligned}
 2.2.5 \quad P &= \frac{Wd_F + Wd_L}{s} \\
 P &= \frac{5\,383 + 27\,059}{1} \\
 P &= 32\,442 \text{ W} \\
 P &= \boxed{32,44 \text{ kW}} \quad (3)
 \end{aligned}$$

[20]

### VRAAG 3: EMMERHYSERS

3.1

$$M_L = \frac{400 \times 10^3}{3\,600} \checkmark$$

$$M_L = \boxed{111,11 \text{ kg/s}} \checkmark$$

$$\text{Volume/sek} = \frac{\text{ladmassa}}{\text{lasdigtheid}}$$

$$\text{Volume/sek} = \frac{111,11}{950} \checkmark$$

$$\text{Volume/sek} = \boxed{0,117 \text{ m}^3/\text{s}} \checkmark$$

(4)

3.2

$$\text{Aantal emmers/sek} = \frac{\text{Kettingspoed}}{\text{Spasiëring van emmers}}$$

$$\text{Aantal emmers/sek} = \frac{0,3}{1,3} \checkmark$$

$$\text{Aantal emmers/sek} = \boxed{0,23} \text{ emmers/s} \checkmark$$

$$\text{Volume/emmer} = \frac{\text{Volume van las/s}}{\text{Aantal emmers/sek}}$$

$$\text{Volume/emmer} = \frac{0,117}{0,23} \checkmark$$

$$\text{Volume/emmer} = \boxed{0,509 \text{ m}^3} \checkmark$$

(4)

3.3

$$P_{out} = m \times g \times h$$

$$P_{out} = 111,11 \times 9,81 \times 60 \checkmark$$

$$P_{out} = 65\,399,346 \text{ W}$$

$$P_{out} = \boxed{65,399 \text{ kW}} \checkmark$$

(2)

3.4

$$\eta = \frac{P_o}{P_i} \times 100$$

$$\eta = \frac{65,399}{95} \times 100 \checkmark$$

$$\eta = \boxed{68,8 \%} \checkmark$$

(2)

$$\begin{aligned}
 3.5 \quad v &= \sqrt{g \times \cos\theta \times r} \\
 \cos\theta &= \frac{v^2}{g \times r} \\
 \cos\theta &= \frac{(0,3)^2}{9,81 \times 0,225} \checkmark \\
 \cos\theta &= 0,04077 \checkmark \\
 \theta &= \cos^{-1} 0,04077 \\
 \theta &= \boxed{87,66^\circ} \checkmark
 \end{aligned}$$

(3)  
[15]

#### VRAAG 4: HYSERS

##### Vir versnelling

$$\begin{aligned}
 T_1 &= m_1 g + m_1 a + F\mu \\
 T_1 &= (1\,000)(9,81) + 1000(2,5) + 0 \checkmark \\
 T_1 &= 12\,310\,N \checkmark
 \end{aligned}$$

$$\begin{aligned}
 T_2 &= m_2 g - m_2 a - F\mu \\
 T_2 &= 500(9,81) - 500(2,5) - 0 \checkmark \\
 T_2 &= 3\,655\,N \checkmark
 \end{aligned}$$

##### Bereken wringkrag

$$\begin{aligned}
 T_{load} &= (T_1 - T_2)r \\
 T_{load} &= (12\,310 - 3\,655)0,6 \\
 T_{load} &= \boxed{5\,193\,Nm} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 T_{drum} &= I \times \alpha \\
 T_{drum} &= I \times \frac{a}{r} \\
 T_{drum} &= 110 \times \frac{2,5}{0,6} \checkmark \\
 T_{drum} &= \boxed{458,3\,Nm} \checkmark
 \end{aligned}$$

$$T_{Total} = \frac{5\,193 + 458,3}{0,9}$$

$$T_{Total} = \frac{5\,651,3}{0,9} \checkmark = \boxed{6\,279,22\,Nm} \checkmark$$

$$\begin{aligned}
 T_{motor} &= T_{Total} \times \text{Reduksie} \\
 \tau &= 6\,279,22 \times \left(\frac{1}{25}\right) \\
 &= \boxed{251,2\,Nm} \checkmark
 \end{aligned}$$

### VRAAG 5: SPOOR- EN PADTREKKRAG

5.1

$$V = \frac{65}{3,6} = 18,056 \text{ m/s}$$

$$F_R = 0,7\% \times M_L \times g$$

$$F_R = 0,007 \times (300 \times 10^3) \times 9,81 \checkmark$$

$$F_R = 20601 \text{ N}$$

$$F_a = \boxed{20,601 \text{ kN}} \checkmark$$

$$F_g = M_T \times g \times \sin \theta$$

$$F_g = (300 \times 10^3) \times 9,81 \times \frac{1}{120} \checkmark$$

$$F_g = 24525 \text{ N}$$

$$F_g = \boxed{24,525 \text{ kN}} \checkmark$$

$$F_a = M_T \times a$$

$$F_a = (300 \times 10^3) \times 0,05$$

$$F_a = 15\,000 \text{ N}$$

$$F_a = \boxed{15 \text{ kN}} \checkmark$$

$$T_E = F_a + F_a + F_g$$

$$T_E = 20,601 + 15 + 24,525 \checkmark$$

$$T_E = \boxed{60,126 \text{ kN}} \checkmark$$

$$P_{Loco} = 60\,126 \times 18,056$$

$$P_{Loco} = 1\,085\,635 \text{ W}$$

$$P_{Loco} = \boxed{1\,085,635 \text{ kW}} \checkmark$$

(8)

5.2

$$E_K = \frac{1}{2} m \times v^2$$

$$E_K = \frac{1}{2} (300 \times 10^3) \times (18,056)^2 \checkmark$$

$$E_K = 48\,902\,870,4 \text{ J}$$

$$E_K = \boxed{48,903 \text{ MJ}} \checkmark$$

(2)  
[10]

### VRAAG 6: Vliegwiele

$$\omega_1 = \frac{2\pi N_1}{60} = \frac{2\pi(165)}{60} = \boxed{17,279 \text{ rad/s}} \checkmark$$

$$\omega_2 = \frac{2\pi N_2}{60} = \frac{2\pi(225)}{60} = \boxed{23,562 \text{ rad/s}} \checkmark$$

$$\alpha = \frac{\omega_2 - \omega_1}{t}$$

$$\alpha = \frac{23,562 - 17,279}{40}$$

$$\alpha = \boxed{0,157 \text{ rad/s}^2} \checkmark$$

$$T = I \times \alpha$$

$$T = m \times k^2 \times \alpha$$

$$T = 900 \times (0,5)^2 \times 0,157 \checkmark$$

$$T = \boxed{35,33 \text{ Nm}} \checkmark$$

[5]

### VRAAG 7: HYSERS

- 7.1
- Die spoed van die sleepwerk
  - Die massa van die bakke en die las
  - Die lengte van die helling
  - Die gradiënt van die helling
  - Die tipe tou wat gebruik word
  - Die krag van die motor

(Enige 5 × 1)

(5)

7.2      7.2.1      *Touspoed is*  $3,6 \text{ km/h} = \frac{3,6 \times 1000}{60} = 60 \text{ m/min} = \frac{3,6}{3,6} = 1 \text{ m/s}$

$$\text{Bakke per minuut} = \frac{\text{ton per skof}}{60 \times \text{hrs} \times \text{ton/bak}}$$

$$\text{Bakke per minuut} = \frac{600}{60 \times 7,5 \times 1} \checkmark$$

$$\text{Bakke per minuut} = \boxed{1,3 \text{ bakke/min}} \checkmark$$

$$\text{Spasiëring van bakke} = \frac{\text{touspoed}}{\text{Bakke per minuut}}$$

$$\text{Spasiëring van bakke} = \frac{60}{1,3} \checkmark$$

$$\text{Spasiëring van bakke} = \boxed{46,15 \text{ m}} \checkmark$$

7.2.2

$$\text{Gem. aantal bakke per kant} = \frac{\text{Lengte van sleepwerk}}{\text{Spasiëring van bakke}}$$

$$\text{Gem. aantal bakke per kant} = \frac{700}{46,15} \checkmark$$

$$\text{Gem. aantal bakke per kant} = 15,17 = 15 \text{ bakke aan elke kant} \checkmark$$

$$\text{Totale aantal bakke} = 30 \text{ bakke} \checkmark$$

(3)

7.2.3

$$\text{Trek teen gravitsie} = \text{ongebalanseerde las} \times \sin \theta$$

$$\text{Trek teen gravitsie} = (\text{aantal bakke elke kant} \times \text{las} \times g) \times \sin \theta$$

$$\text{Trek teen gravitsie} = 15 \times 1500 \times 9,81 \times \sin \theta \checkmark$$

$$\text{Trek teen gravitsie} = 60\,840,06 \text{ N}$$

$$\text{Trek teen gravitsie} = \boxed{60,84 \text{ kN}} \checkmark = \text{Krag opgaande bakke}$$

$$\text{Totale massa in sleepwerk} = \text{massa van bakke} + \text{massa van las}$$

$$\text{Totale massa in sleepwerk} = (30 \times 500) + (15 \times 1\,000) \checkmark$$

$$\text{Totale massa in sleepwerk} = 30\,000 \text{ kg}$$

$$\text{Totale massa in sleepwerk} = \boxed{30 \text{ ton}} \checkmark$$

$$\text{Totale rolweerstand} = \text{ton in sleepwerk} \times \text{spoorweerstand}$$

$$\text{Totale rolweerstand} = 30 \times 180$$

$$\text{Totale rolweerstand} = \boxed{5\,400 \text{ N}} \checkmark$$

$$\text{Totale krag} = \text{Krag opgaande bakke} + \text{totale rolweerstand} + \frac{\text{Totale Wrywing}}{2}$$

$$\text{Totale krag} = 60,84 + 5,4 + \frac{15}{2} \checkmark$$

$$\text{Totale krag} = \boxed{73,74 \text{ kN}} \checkmark$$

$$\text{Breekspanning} = \text{Totale krag} \times \text{veiligheidsfaktor}$$

$$\text{Breekspanning} = 73,74 \times 4$$

$$\text{Breekspanning} = \boxed{294,96 \text{ kN}} \checkmark$$

(8)

[20]

## VRAAG 8: REDUKSIERATKAS

- 8.1
- Reguittandratte
  - Heliese tandratte
  - Dubbelheliese tandratte
- (3)

8.2 8.2.1 1 200 draaie van wurmas sal  $1\,200 \times 2 = \boxed{2\,400 \text{ tande}}$  verplaas✓

$$N_{\text{Wurmrat}} = \frac{T_{\text{aan wurm verplaas}}}{T_{\text{Wurmrat}}}$$

$$N_{\text{Wurmrat}} = \frac{2\,400}{36} \checkmark$$

$$Wurmrat = \boxed{66,667 \text{ r/min}} \checkmark$$

$$\therefore N_E = N_A = 66,667 \text{ r/min}$$

$$\frac{N_{\text{in}}}{N_{\text{out}}} = \frac{\text{produk van gedrewe ratte}}{\text{produk van dryfratte}}$$

$$\frac{N_A}{N_D} = \frac{T_B \times T_D}{T_A \times T_C}$$

$$\frac{66,667}{N_D} = \frac{44 \times 75}{26 \times 23} \checkmark$$

$$N_D = \frac{26 \times 23 \times 66,667}{44 \times 75}$$

$$N_D = \boxed{12,08 \text{ r/min}} \checkmark$$

(5)

8.2.2

$$\text{Snelheidsverhouding} = \frac{N_{\text{wurmas}}}{N_D}$$

$$\text{Snelheidsverhouding} = \frac{1200}{12,08} \checkmark$$

$$\text{Snelheidsverhouding} = \boxed{99,34}$$

$$\text{Snelheidsverhouding} = \boxed{99,34:1} \checkmark$$

(2)

[10]

**TOTAAL: 100**