higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

MEGANOTEGNIEK N6

27 November 2023

Hierdie nasienriglyn bestaan uit 12 bladsye.

Kopiereg voorbehou

VRAAG 1: KOPPELAARS

1.1 $$T = \frac{\mu \times F_A \times R_f}{\sin \alpha}$$

$$= \frac{0{,}3 \times 340 \times 0{,}11}{\sin(17)} \checkmark\checkmark$$

$$= 38{,}376\ N.m \checkmark$$ (3)

1.2 $$I = m \times k^2$$
$$= 25 \times (0{,}21)^2$$
$$= 1{,}103\ kg.m^2 \checkmark$$

$$T = I \times \alpha$$

$$\alpha = \frac{T}{I} = \frac{38{,}376}{1{,}103}$$

$$= 34{,}792\ rad/s^2 \checkmark$$

$$t = \frac{\omega}{\alpha}$$

$$\omega = \frac{2\pi N}{60} = \frac{2\pi \times 1100}{60}$$

$$= 115{,}191\ rad/s \checkmark$$

$$\therefore t = \frac{115{,}191}{34{,}792} \checkmark$$

$$= 3{,}31\ s \checkmark$$

(5)
[8]

VRAAG 2: REMME

2.1 $$210^o \times \frac{\pi}{180}$$

$$= 3{,}67\ rads \checkmark$$

$$\mu = \frac{\ln\left(\frac{T_1}{T_2}\right)}{\theta}$$

$$= \frac{\ln\left(\frac{450}{120}\right)}{3{,}67} \checkmark$$

$$= 0{,}36 \checkmark$$ (3)

2.2 $\omega = \frac{2\pi N}{60}$

$= \frac{2\pi \times 200}{60}$

$= 20{,}9\ rad/s$ ✓

$P = T\omega$

$T = \frac{P}{\omega} = \frac{250}{20{,}9}$

$= 11{,}96\ N.m$ ✓

$WD = T \times \omega$

$= 11{,}96 \times \left(\frac{20{,}9 + 0}{2}\right)$

$= 125\ J/s$ ✓

$E_k = I \times \omega^2$

$= 12 \times (20{,}9)^2$

$= 5242\ J$ ✓

$t = \frac{E_{k\ (brake)}}{WD/s}$

$= \frac{5242}{125}$ ✓

$= 41{,}9\ s$ ✓ (6)

2.3 $\theta = \omega_{mean} \times t$

$= 10{,}45 \times 41{,}9$ ✓

$= 437{,}9\ rads$ ✓

$N = \theta \times \frac{180}{\pi} \times \frac{1}{360}$

$= 437{,}9 \times \frac{180}{\pi} \times \frac{1}{360}$ ✓

$= 69{,}69\ rev/s$ ✓ (4)

[13]

VRAAG 3: LYNASTE

3.1 $P = \frac{2\pi N_p T_p}{60}$

$\therefore T_p = \frac{P \times 60}{2\pi N_p} = \frac{26 \times 10^3 \times 60}{2\pi \times 1050}$ ✓

$= 236{,}459\ N.m$ ✓ (2)

3.2 $P = \frac{2\pi N_G T_G}{60}$

$\therefore T_G = \frac{P \times 60}{2\pi N_G} = \frac{26 \times 10^3 \times 60}{2\pi \times 480}$

$= 517{,}253\ N.m$ ✓

$T_G = (T_1 - T_2) \times R$

$\frac{T_1}{T_2} = 2{,}718^{\left(0{,}23 \times \frac{170^o}{57.3}\right)}$ ✓

$T_1 = 1.978 T_2$ ✓

$517{,}253 = (1{,}978 T_2 - T_2) \times 0{,}6$

$\therefore T_2 = \frac{517{,}253}{0{,}978 \times 0{,}6}$ ✓

$= 881{,}481\ N$ ✓

En $T_1 = 1{,}978 \times 881{,}481$

$= 1743{,}569\ N$ ✓ (6)

3.3 $F_t = \frac{Torque \times 2}{PCD} = \frac{236{,}459 \times 2}{0{,}1}$ ✓

$= 4729{,}18\ N$ ✓ (2)

3.4 $F_r = F_t \times tan\,\theta$

$F_r = 4729{,}18 \times tan(20^o)$ ✓

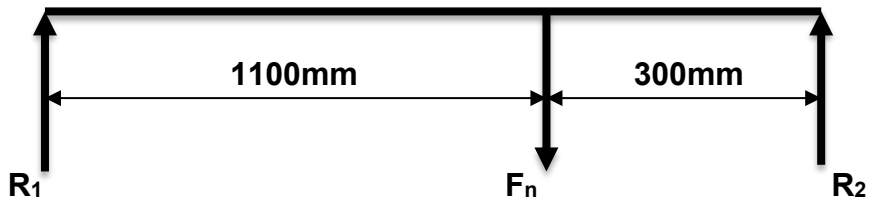
$= 1721{,}281\ N$ ✓ (2)

3.5 $F_n = F_t \times \sec\theta$

$F_n = 4729{,}18 \times \frac{1}{\cos(20^o)}$ ✓

$= 5032{,}688\ N$ ✓ (2)

3.6



Neem momente om R_1

$\sum \circlearrowright M = \sum \circlearrowleft M$

$(F_n \times 1{,}1) = (R_2 \times 1{,}4)$

$\therefore R_2 = \frac{(F_n \times 1{,}1)}{1{,}4}$

$= \frac{(5032{,}688 \times 1{,}1)}{1{,}4}$ ✓

$= 3954{,}255\ N$ ✓

Neem momente om R_2

$\sum \circlearrowleft M = \sum \circlearrowright M$

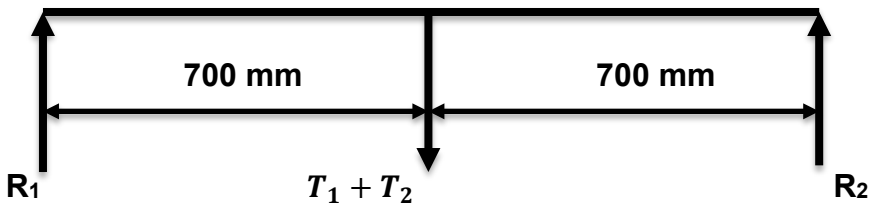
$(F_n \times 0{,}3) = (R_1 \times 1{,}4)$

$\therefore R_1 = \frac{(F_n \times 0{,}3)}{1{,}4}$

$= \frac{(5032{,}688 \times 0{,}3)}{1{,}4}$ ✓

$= 1078{,}433\ N$ ✓ (4)

3.7



Neem momente om R_1

$$\sum \circlearrowright M = \sum \circlearrowleft M$$

$((T_1 + T_2) \times 0{,}7) = (R_2 \times 1{,}4)$

$\therefore R_2 = \frac{((T_1 + T_2) \times 0{,}7)}{1{,}4}$ ✓

$= \frac{((1743{,}569 + 881{,}481) \times 0{,}7)}{1{,}4}$ ✓

$= 1312.525\ N$ ✓

Neem momente om R_2

$$\sum \circlearrowleft M = \sum \circlearrowright M$$

$((T_1 + T_2) \times 0{,}7) = (R_1 \times 1{,}4)$

$\therefore R_1 = \frac{((T_1 + T_2) \times 0{,}7)}{1{,}4}$ ✓

$= \frac{((1743{,}569 + 881{,}481) \times 0{,}7)}{1{,}4}$ ✓

$= 1312{,}525\ N$ ✓ (5)

[23]

VRAAG 4: VLIEGWIELE

4.1 $P = \frac{W_D}{t}$

$E_K = Pmotor \times Operation\ time$

$E_{K(motor)} = 10\ X\ 0.7$ ✓

$E_{K(motor)} = 7\ kJ$ ✓ (2)

4.2 $E_{K(reduction)} = E_{K(per\ stroke)} - E_{K(motor)}$

$E_{K(per\ stroke)}$ @ $25\%loss = \left(\frac{9}{0.8}\right)$ ✓

$E_{K(per\ stroke)} = 11.25\ kJ$ ✓

$E_{K(reduction)} = 11.25 - 7 = 4.25kJ$ ✓ (3)

4.3 $E_k = \frac{1}{2}\ \mathrm{I} \times \omega^2$

$E_K = 0.5 \times 60 \times 28.274^2 = 23{,}983kJ$ ✓✓ (2)

4.4 $E_{k(2)} = \frac{1}{2}\ \mathrm{I} \times {\omega_2}^2$

$\omega_2 = \sqrt{\frac{2 \times E_{k(2)}}{\mathrm{I}}}$

$\omega_2 = \sqrt{\frac{2 \times 19{,}733 \times 10^3}{60}} = 25.647\ \mathrm{rad/s}$ ✓

Maar:

$N_2 = \frac{\omega_2 \times 60}{2\pi}$

$= \frac{25{,}647 \times 60}{2\pi}$ ✓

$= 244.911\ \mathrm{r/min}$ ✓ (3)

4.5 $\mathrm{n} = \frac{\mathrm{p}}{E_{K(per\ stroke)}}$

$= \frac{10}{11.25}$ ✓

$= 0{,}889\ \mathrm{stroke/sec} = 53.34\ \mathrm{strokes/min}$ ✓ (2)

4.6 $E_{K(per\ stroke)} = F_{(AVERAGE)} \times stroke\ length(S)$

$$F_{(AVERAGE)} = \frac{E_{K(per\ stroke)}}{S}$$

$$= \frac{11{,}25 \times 10^3}{0{,}045} \checkmark$$

$$= 250\ \text{kN} \checkmark$$ (2)

[16]

VRAAG 5: REDUKSIERATKASTE

5.1
- Planeetratkaste✓
- Wurmratreduseerders✓
- Ratreeksratreduseerders✓
- Keëlratreduseerders✓

(Enige 3) (3)

5.2 5.2.1

$$\omega_2 = \frac{N_B \times 2\pi}{60}$$

$$= \frac{450 \times 2\pi}{60}$$

$$= 43{,}982\ rad/s \checkmark$$

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

$$= \frac{43{,}982 - 0}{35}$$

$$= 1{,}257 rad/s^2 \checkmark$$

$$\therefore T_B = I_B \times \alpha_B$$

$$= 500 \times 1{,}257 \checkmark$$

$$= 628{,}5\ N.m \checkmark$$ (2)

5.2.2 $\frac{N_A}{N_B} = \frac{\alpha_A}{\alpha_B}$

$\alpha_A = \frac{1{,}257 \times 1200}{420}$

$= 3{,}591 rad/s^2$ ✓

$I_A = I_A \times \alpha_A$

$= 215 \times 3{,}591$

$= 772\ N.m$ ✓ (2)

5.2.3 Om die ekwivalente inersiemoment te bepaal

$k = \frac{0{,}6}{2} = 0{,}3\ m$

Bepaal die inersiemoment van die massa wat deur die trommel verhef is

$I = m \times k^2$

$= 300 \times 0{,}3^2$

$= 27\ kg.m^2$ ✓

Bepaal die snelheidsverhouding

$V_R = \frac{N_B}{N_A}$

$= \frac{420}{1200}$ ✓ $= 0{,}35$

Bepaal I_{Tot}

$\mathrm{I}_{Tot} = I_A + (I_B + I)VR^2$

$= 215 + (500 + 27) \times 0{,}35^2$

$= 279{,}558\ kg.m^2$ ✓ (2)

5.2.4 $E_{k\,(Tot)} = 0{,}5 I_{Tot} \omega^2$

$= 0{,}5 \times 279{,}558 \times 125{,}664$ ✓

$= 2207\ kJ$ ✓ (2)

5.2.5 $T = I_{Tot} \times \alpha$

$= 279{,}558 \times 1{,}257$ ✓

$= 351{,}4\ N.m$ ✓ (2)

[13]

VRAAG 6: SPOORTREKKRAG EN VOERTUIGDINAMIKA

6.1 $T_E = F_R - F_g$

$= 200 - 50$✓

$= 150\ kN$✓ (2)

6.2 Versnelling

$F_a = T_E - F_R + F_g$

$= 150 - 120 + 330$✓

$= 360\ kN$✓

Spoedvermindering

$F_a = T_E - F_g + F_R$

$= 150 - 330 + 120$✓

$= -60kN$✓ (4)

6.3 **Stap 1:** Bereken die totale lokomotiewe wringkrag.

$T = T_E \times radius\ of\ the\ driving\ wheels$

$= 150 \times 10^3 \times 300 \times 10^{-1}$

$= 45\ 000\ Nm$✓

Stap 2: Bereken die wringkrag van die dryfwiele.

$$T_{wheels} = \frac{T}{n_{wheels}}$$

$$= \frac{45000}{8}$$ ✓

$= 5\ 625\ Nm\ per\ wiel$✓ (3)

6.4 $$\text{Wielspoed} = \frac{\text{enjinspoed}}{\text{ratverhouding}}$$

$$= \frac{1800}{4} ✓$$

$$= 450 \text{ r/min} ✓$$ (2)

[11]

VRAAG 7: BALANSERING

7.1 $F_C = m_a \omega^2 r_a$

$= 7 \times 252 \times 0{,}09 ✓$

$= 393{,}75\ N ✓$ (2)

7.2 $m_b r_b = m_a r_a$

$1{,}5 \times r_b = 7 \times 0{,}09 ✓$

$r_b = 0{,}42 = 420\ mm ✓$

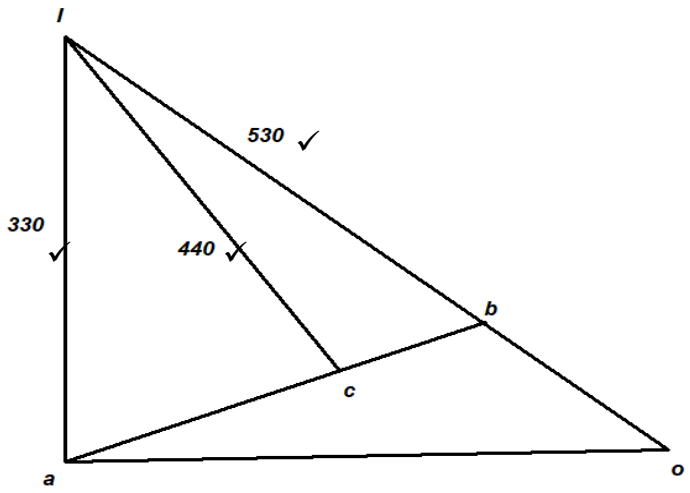
Die balansmassa van 1,5 kg moet diametraal teenoorgesteld tot die gietstuk teen 420 mm vanaf die draaipunt geplaas word. (2)

7.3 Waar die twee skakels van 'n masjien met mekaar in kontak is. (2)

7.4
- Lae paar
- Hoër paar (2)

[8]

VRAAG 8: KINEMATIKA



$V_B = wr$

$= \left(\frac{2\pi(100)}{60}\right) \times (0{,}12)$

$= 1{,}257\ m/s$ ✓

$V_A = \frac{V_B}{I_B} \times I_A$

$= \frac{1{,}257}{530} \times 330$ ✓

$= 0{,}783\ m/s$ ✓

$V_C = \frac{V_B}{I_B} \times I_C$

$= \frac{1{,}257}{530} \times 440$ ✓

$= 1{,}044\ m/s$ ✓

OF

$V_C = \frac{V_A}{I_A} \times I_C$

$= \frac{0{,}783}{330} \times 440$ ✓

$= 1{,}044\ m/s$ ✓ **[8]**

TOTAAL: 100

Kopiereg voorbehou