higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

INGENIEURSWETENSKAP N4

30 JULIE 2018

Hierdie nasienriglyn bestaan uit 14 bladsye.

Kopiereg voorbehou

VRAAG 1: ALGEMEEN

1.1 1.1.1 Resulterende snelheid: 'n enkele snelheid wat twee of meer snelhede voorstel wat op 'n punt inwerk, en wat dieselfde uitwerking het as hierdie snelhede.

1.1.2 Skuifkrag: die som van alle kragte na links of regs van 'n deel op 'n balk.

(2 × 1) (2)

1.2 Newton se tweede bewegingswet: die tempo van momentum is direk eweredig aan en in dieselfde rigting as die krag wat uitgeoefen word. (2)

1.3 1.3.1 Dit is op die moment wat die veer elasties is.
OF
Dit is die moment waarop die veer tot sy oorspronklike vorm of grootte terugkeer wanneer die eksterne krag verwyder word. (1)

1.3.2 Elastisiteitsgrens: dit is die punt waar die veer nie na sy oorspronklike vorm of grootte terugkeer nie wanneer die eksterne krag voor permanente vervorming verwyder word. (2)

1.4 Suid 45 grade Oos OF S45° O (1)

1.5 1.5.1 Die hoeveelheid vloeistof wat van die pers geglip het

1.5.2 Hoe hoer die druk hoe joër die diepte van die volume.

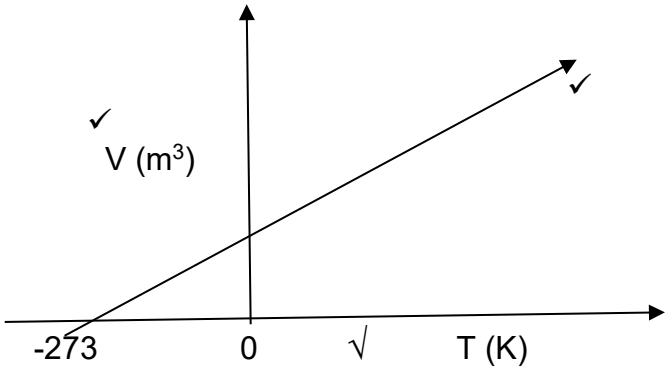
(2 × 1) (2)

1.6 Funksionele hidroulika: om hidrouliese energie te akkumuleer en dit met tussenposes te verbruik. (2)

1.7 Charles se gas-wet: by 'n konstante druk is die volume gas direk eweredig aan die temperatuur.✓

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \checkmark$$

Snelheid – Temperatuur



(4)
[16]

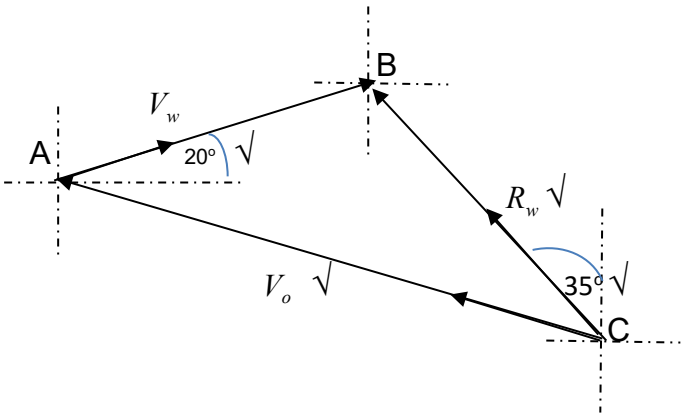
VRAAG 2: KINEMATIKA

2.1 $V_o = 300Km/h$

$V_w = 100Km/h\ E20^0N\ V_w$

$R_v = ?\qquad N35^0W$

2.1 2.1.1



(2)

2.1.2 $B = 35^o + 70^0$

$= 105^0$

$$\frac{SinC}{c} = \frac{SinB}{b}$$

$$C = \sin^{-1}(\frac{cSinB}{a})$$

$$= \sin^{-1}(\frac{100Sin105}{300})$$

$= 18.782^0$ √

$A = 180^o - (105^o + 18.782^o)$

$= 56.218^0$ √

$a = \sqrt{b^2 + c^2 - 2bc\cos A}$

$= \sqrt{(300)^2 + (100)^2 - 2(300)(100)Cos105}$

$= 339.896km/h$ ✓

$\therefore R_v = 339.896km/h\ \ N35^0W$ ✓

(3)

2.1.3 Die vlugrigting

$\beta = 90^o - (25^o + 18.782^o)$

$= 36.218^0$

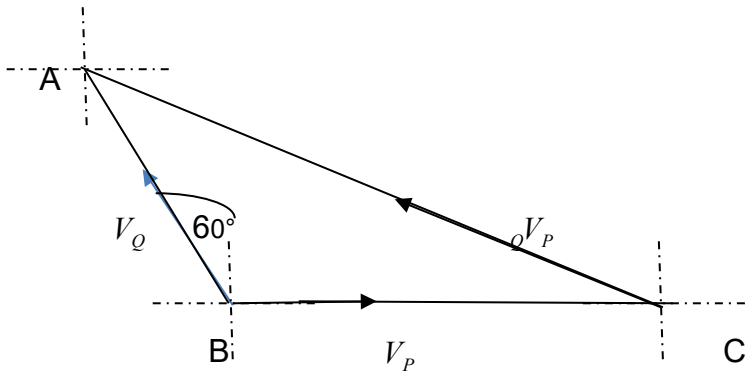
Vlugrigting = W 36.218°N✓ OF N 53.782° N✓

(1)

2.2 $V_P = 220km/h \ \ E$

$V_Q = 220km/h \ W30^0 N$

${}_PV_Q = ?$



$B = 60^o + 90^o$

$= 150^0$

$B = \sqrt{a^2 + c^2 - 2acCosB}$

$= \sqrt{(220)^2 + (220)^2 - 2(220)(220)Cos150}$ ✓

$= 425.007km/h$ ✓

$$\frac{SinC}{c} = \frac{SinB}{b}$$

$$C = \sin^{-1}(\frac{cSinB}{a})$$

$$= \sin^{-1}(\frac{220Sin150}{425.007})$$ ✓

$= 15^0$ ✓

${}_QV_P = 425.007km/h \ \ W15^0 N$ (4)

2.3 $S_h = 210m$

$V = 730km/h$

$t = 3s$

$S_h = t.V.Sin\theta$ ✓

$$Sin\theta = \frac{S_h}{t.V.}$$

$$\theta = \sin^{-1}(\frac{S_h i}{t.V})$$

$$\theta = \sin^{-1}(\frac{210}{3(202.778)})$$ ✓

$= 20.194^0$ ✓ (3)

[13]

VRAAG 3: HOEKBEWEGING

3.1 B
3.2 C
3.3 B
3.4 D

(4 × 2) **[8]**

VRAAG 4: DINAMIKA

4.1 4.1.1

$m = 780kg$
$slope = 7\%$
$S = 25m$

$\theta = \tan^{-1}(\frac{7}{100})$
$= 4.004^0 \surd$

$E_p = mgh$

$= 780kg(9.8m/s2)25Sin(4.004)$

$= 13343.771J \surd$

$E_{k(bottom)} = E_{p(top)} \surd$
$= 13343.771J$
$V = \sqrt{\frac{4(13343.771)}{789}} \surd$

$= 8.225m/s$ ✓ (3)

4.1.2

$V^2 = u + 2aS$
$a = \frac{0^2 - (8.225m/s)^2}{2(35)}$ ✓

$= -0.966m/s^2$ ✓ (2)

4.1.3 $E_K = 0$ m/s✓ (1)

4.2 4.2.1

$m = 1.8ton$
$plane = horizontal$
$S = 35m$
$f_u = 110N/ton$
U = 20 m/s
V = 0 m/s✓

$V^2 = u + 2aS$
$a = \frac{0^2 - (20m/s)^2}{2(35)}$ ✓

$= -5.714m/s^2$ ✓

4.2.2

f_{brake}
$f_{app} = -(f_B + f_u)\surd$
$f_{app} = 1800kg(-5.714m/s^2)$
$= -10285.714N\surd$
$f_u = 1.8ton(110N/ton)$
$= 198N\surd$
$f_B = -f_{app} - f_u)$
$= -(-10285.714N) - 198N\surd$
$= 10087.714N$ ✓

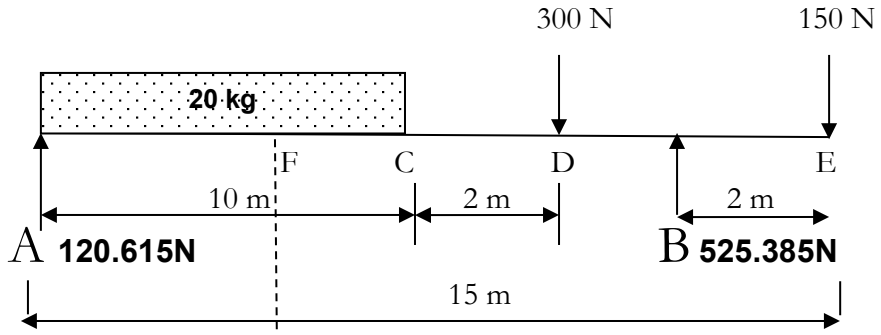
(2 × 3) (6)
[12]

VRAAG 5: STATIKA

5.1 5.1.1

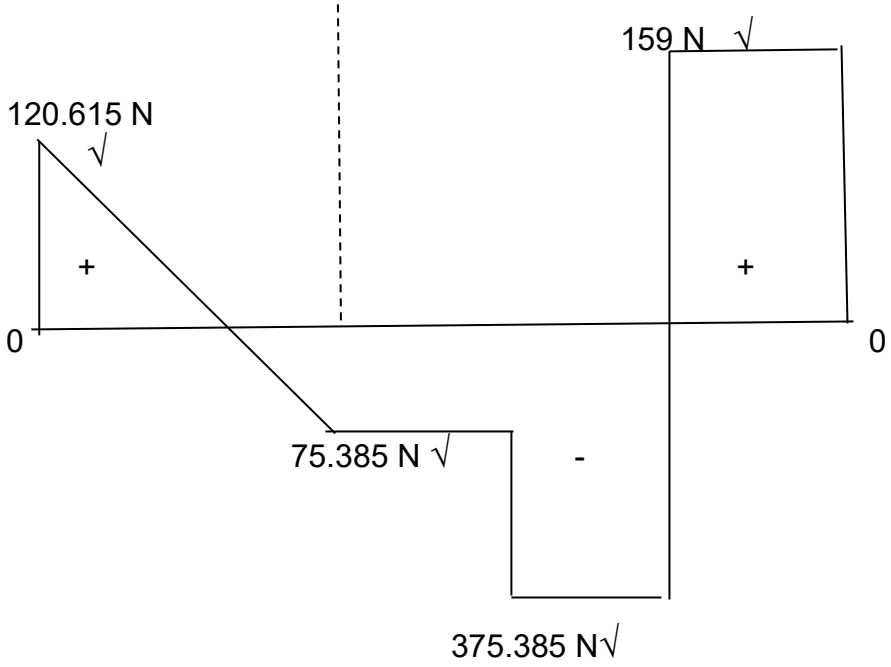
$spring = (20Kg)(98m/s^2)$
$f_{spring} = \frac{(20Kg)(98m/s^2)}{10m}$
$= 19{,}6N/m$
Δ≅A
$\sum F_\perp .S(ac) = \sum F_\perp .(c)$
$B(13m) = 196N(5m) + 300N(12m) + 150N(15M)$
$B \Rightarrow \frac{6830\ Nm}{13\ m} = 525{,}385\ N$ ✓
Δ≅B
$\sum F_\perp .S(ac) = \sum F_\perp .(c)$
196 N(8 m) + 300 N(1 m) =150 N(2 m)+A(13 m)
$A \Rightarrow \frac{1568\ Nm}{13\ m} = 120.615\ N$ ✓

(2)



Bereken:

5.1.2



(2)

5.1.3 $BM_{A\rightarrow}$(120.615 N).(o m) = 0

$BM_{C\rightarrow}$(120.615N).(10 m)-(196N).(5m) =226.15 Nm✓

$BM_{D\rightarrow}$(120.615 N).(12 m)-(196 N).(7m) =75.38 Nm✓
$BM_{B\rightarrow}$(120.615 N).(13 m)-(196 N).(8m)-300 N(1 m) =-300.005 Nm✓

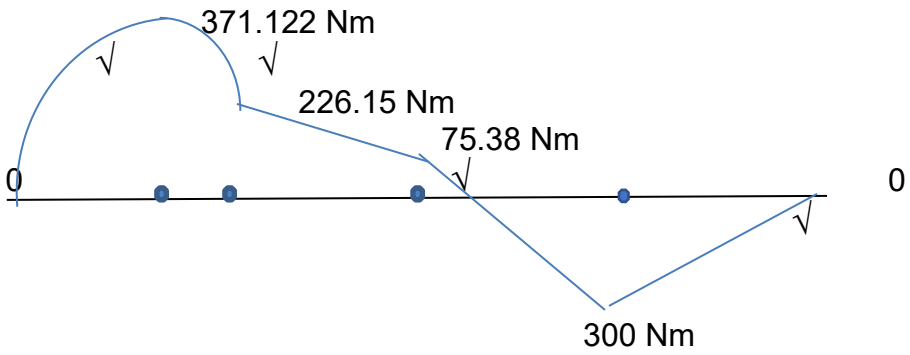
$BM_{E\rightarrow}$(120.615 N).(15 m)-(196 N).(10 m)-
(300 N).(3 m)-(130 N).(0 m) = 0

$$\sum f_s = 0$$
$$120.615N - (19.6N/m).x = 0$$
$$x = \frac{-120.615N}{-19.6N/m}$$
$$= 6.154m \checkmark$$

$BM_{F\rightarrow}$(120.615 N).(6.154 m)-
(19.6 N).(6.154 m)(0,5)(2,333 m)
= 371.122 Nm✓

(5)

5.1.4



(2)

5.2

Vorm	V (mm³)	G (mm)	VG (mm⁴)
Silinder A	$V_A = \frac{\pi D^2}{4} H$ $= \frac{\pi 50^2}{4} 20$ = 39269.908√	$G = \frac{H}{2}$ $= \frac{20}{2}$ =10√	39269.908(10) = 392699.08√
Silinder B	$V_B = \frac{\pi d^2}{4} h$ $= \frac{\pi 30^2}{4} 80$ = 56548.668√	$G = H + \frac{h}{2}$ $= 20 + \frac{80}{2}$ = 60√	56548.668(60) = 3392920.066√
	$\sum v. = 39269.908 + 56548.668$ = 95818.576√	$y = \frac{\sum v.G}{\sum V}$ = 39.508 mm√	$\sum v.G = 392699.08 + 3392920.$ = 3785619.146√

(4)
[15]

VRAAG 6: HIDROULIKA

6.1 6.1.1 d = 90 mm D = 180 mm
Sl = 480 mm
MA = 18
$\eta = 85\%$

f_h , m=4.2Mg $\eta = 96\%$

$\frac{W_R}{f_p} = \frac{D^2}{d^2}$ and $MA = \frac{f_p}{f_h}.\frac{100}{\eta}$

$W_R = 4.2 \times 10^3 kg(9.8m/s^2)$
$= 41160N$ √

$f_p = \frac{d^2 W_R}{D^2}$
$f_p = \frac{(0.09m)^2 41160N}{(0.18m)^2}$ ✓
$= 10290N$ √

$f_h = \frac{f_p}{MA}.\frac{100}{\eta}$
$= \frac{10290N}{18}.\frac{100}{96}$ ✓
$= 595.486N$ ✓ (5)

6.1.2 n, m = 4.2 Mg SL = 520 mm $\eta = 96\%$

$V_a = \frac{\pi.D^2 S_L.}{4}$
$= \frac{\pi(0.180m)^2(0.520m)}{4}$

$= 0.0132324m^3$ ✓
$V_s = V_a.\frac{100}{\eta}$
$= 0.0132324m^3 \frac{100}{96}$
$= 0.01378374m^3$
$\frac{\pi.d^2 sl.n.}{4} = 0.01378374m^3$

$n = 4.513 \approx 4.5$ ✓ (3)

6.2 6.2.1 N = 120 r/min
d = 150 mm
S_l = 250 mm
C = 2

V_a (Werklike volume in l/s), $S_L = 300mm$

$$V_s = \frac{\pi.d^2 sl.n.C.}{4}.\frac{N}{60}$$

$$= \frac{\pi.(0{,}150m)^2.0{,}25m.1.(2)}{4}.\frac{120r/\min}{60} \checkmark$$

$$= 0{,}0176715m^3/s \checkmark$$

$$V_a = V_s.\frac{\eta}{100}$$

$$= 0{,}0176715m^3/s.\frac{100}{100} \checkmark$$

$$= 0{,}0176715m^3/s(1000l/m^3)$$

$$= 17{,}671\,l/s \checkmark$$ (4)

6.2.2

$$Slip\% = \frac{V_s - V_a}{V_s}.100$$

$$= \frac{17.671l/s - 16.789l/s}{17.671/s}.100 \checkmark$$

$$= 5.037\% \quad \checkmark$$

$$\approx 5\%$$ (2)

[14]

VRAAG 7: SPANNING, VERVORMING EN YOUNG SE ELASTISITEITSMODULUS

7.1 $D_{ext} : d_{\text{int}}$

$3:1$

$F = 620kN$

$\Delta l = 0.771mm$

$E = 209GPa$

$l = 3m$

$\Delta l = 0.771mm$

$D_{ext} = ?$

$d_{\text{int}} = ?$

$\varepsilon = \dfrac{\Delta l}{l}$

$= \dfrac{0.7771mm}{3000mm}$

$= 0.000257$ ✓

$E = \dfrac{\delta}{\varepsilon}$

$\delta = E.\varepsilon$

$= 209 \times 10^9 Pa.(0.000257)$

$= 53713000Pa$ ✓

$\delta = \dfrac{F}{a}$

$\therefore a = \dfrac{F}{\delta}$

$= \dfrac{620000N}{53713000Pa}$

$= 0.0115428m^2$ ✓

$a = \dfrac{\pi}{4}(D^2_{ext} - d^2_{\text{int}})$

$= \dfrac{\pi}{4}((3d)^2_{\text{int}} - d^2_{\text{int}})$ ✓

$= \dfrac{\pi}{4}8d^2_{\text{int}}$

$= 6.283185d^2_{\text{int}}$

$d_{\text{int}} = \sqrt{\dfrac{0.0115427m^2}{6.2831853`N}}$

$= 0.04286m$ ✓ or (42.861 mm)

(6)

$D_{ext} = 0.128583m$ ✓ or (128.583 mm)

7.2 7.2.1

$F = 38kN$
$a = 8000mm^2$
$l = 3m$
$\Delta l = 0.51mm$
$a = \frac{800mm^2(1m^2)}{1\times10^6 mm^2}$
$a = 0.008m^2$ ✓
$\delta = \frac{F}{a}$
$= \frac{38000N}{0.008m^2}$

$= 4750000Pa$ ✓

7.2.2 vervorming

$\varepsilon = \frac{\Delta l}{l}$
$= \frac{0.51mm}{4000mm}$ ✓

$= 1.275\times10^{-4}$ ✓

7.2.3 E

$E = \frac{\delta}{\varepsilon}$
$= \frac{4750000Pa}{1.275\times10^{-4}}$ ✓

$= 3.7255\times10^{10}Pa$
$= 37.255\times GPa$ ✓

(3 × 2) (6)
[12]

VRAAG 8: HITTE

8.1 $V = 0.77m^3$
$\gamma = 17 \times 10^{-7} / K$
$\Delta T = 233K$
$\Delta V = V_o.\gamma.\Delta T$
$\Delta V = 0.77m^3.17 \times 10^{-3} / K.(233K)$

$= 0.00304997m^3$ ✓
$\Delta V = V_2 - V_o.$
$V_2 = \Delta V + V_o.$
$= 0.00304997m^3 + 0.77m^3$
$= 0.773m^3$ ✓ (3)

8.2 8.2.1 A

$V_A = 2m^3$
$t_A = 25^oC$
$P_A = 580kPa$

$m_B = 6kg$
$V_B = ?$
$t_A = 35^oC$
$P_B = 580kPa$

R=287J/kg.K

$t_{eqil} = 20^oC$

$T_A = 298K$ √ $T_{equi} = 293K$ $T_B = 308K$ √

$V_B = ?$
$P_B V_B = m_B R T_B$
$V_B = \dfrac{m_B R T_B}{P_B}$
$= \dfrac{6kg(287J/kg.K).(308K)}{580000Pa}$ ✓

$= 0.914m^3$ (3)

8.2.2 $P_{equi} = ?$

$P_{equi}V_{equi} = m_{equi}RT_{equi}$

$V_{equi} = V_A + V_B$

$= 2m^3 + 0.914m^3$

$= 2.914m^3$ ✓

$P_AV_A = m_ART_A$

$m_A = \frac{P_AV_A}{RT_A}$

$= \frac{580000Pa(2m^3)}{(287J/kg.K).(298K)}$ ✓

$= 13.563\ kg$ ✓

$P_{equi} \Rightarrow \frac{m_{equi}RT_{equi}}{V_{equi}} = \frac{13.563(287).(293K)}{2.914}$ ✓

$P_{equi} = 391.395kPa$ ✓

(4)
[10]

TOTAAL: 100

Kopiereg voorbehou