higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

INGENIEURSWETENSKAP N4

1 AUGUSTUS 2019

Hierdie nasienriglyn bestaan uit 14 bladsye.

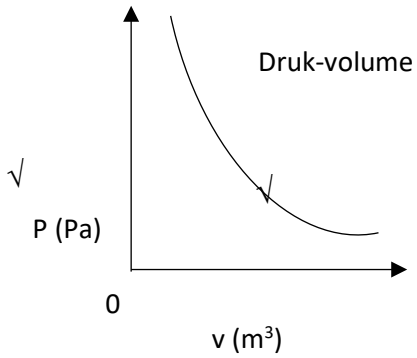
Kopiereg voorbehou

LET OP: √ = ½ punt
✓ = 1 punt

VRAAG 1

1.1 1.1.1 Die druk van die gegewe massa van 'n ideale gas is teen 'n konstante temperatuur omgekeerd eweredig aan die volume daarvan.✓

$P_1V_1 = P_2V_2$√ of $\sqrt{P.V..\alpha..T}$



(3)

1.1.2 Vir elke aksie is daar 'n gelyke en teenoorgestelde reaksie.✓
- 'n Duiker wat uit 'n roeibootjie in die water spring, word vorentoe die water in gestoot. Dieselfde krag wat hom vorentoe stoot, laat die bootjie terug beweeg.✓✓
- Lug wat uit 'n ballon stroom veroorsaak 'n teenoorgestelde reaksie en daarom skiet die ballon die lug in.✓✓
- Die gewig van iemand wat op 'n duikplank spring, druk die duikplank af. ✓✓Die duikplank spring terug en lanseer die persoon die lug in.

(1 punt vir die wet + 2 punte vir enige toepaslike voorbeeld) (3)

1.2 1.2.1 Die som van alle momente links of regs van die draagpunt. (1)

1.2.2 Die eienskap van 'n materiaal wat 'n voorwerp sy oorspronklike vorm opnuut laat aanneem sodra die las wat die vervorming veroorsaak, weggeneem word. (2)

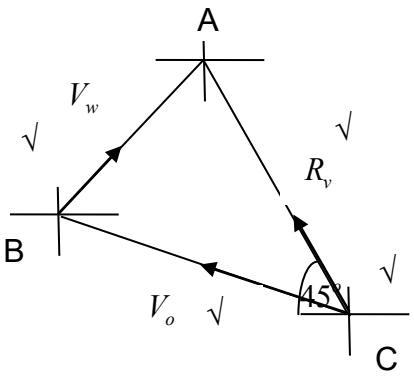
1.2.3 Tempo van hoeksnelheid wat in rad/s2 gemeet word. (1)

1.3.
- Strekspanning
- Skuifspanning
- Drukspanning

(Enige 2 × 1) (2)

Kopiereg voorbehou

1.4



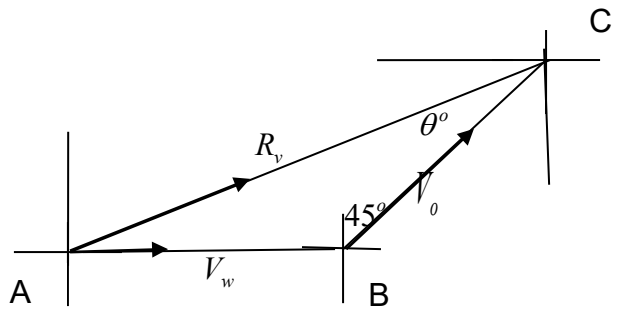
½-punt vir die korrek benoemde kant, die korrekte rigting en die korrekte hoek (2)

1.5
- Lug- of gasakkumulator
- Veerakkumulator
- Massabelaste akkumulator (2 × 1) (2)

[16]

VRAAG 2

2.1 $V_o = 200\ km/h$ E
$V_w = 112\ km/h \quad N43^o E$
$R_v = ...$



$B = 90^\circ + 45^\circ$
$= 135^\circ$

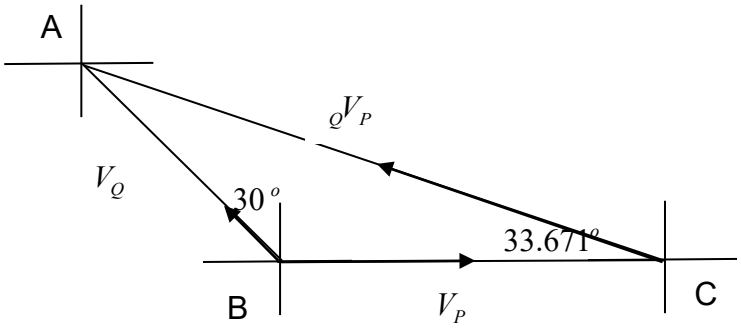
$b = \sqrt{a^2 + b^2 - 2ab\cos B}$
$b = \sqrt{112^2 + 200^2 - 2(112)(200)Cos135}$
$= 290{,}211\ km/h$ ✓

$\frac{SinA}{a} = \frac{SinB}{b}$
$A = \sin^{-1}(\frac{1120.Sin135}{290{,}211})$ ✓
$= 15{,}836^\circ$ ✓
$R_v = 290{,}211\ km/h \quad W15{,}836^\circ N$ ✓ (4)

2.2 $V_P = 120\ km/h$ E

$V_Q = ...\quad N43^\circ W$

${}_QV_P = 234{,}307\ km/h\quad W33{,}671^\circ N$



$C = \sqrt{a^2 + b^2 - 2ab\cos C}$

$b = \sqrt{120^2 + 234{,}367^2 - 2(120)(234{,}367)Cos33.671}$ ✓

$= 150{,}00\ km/h$ ✓

✓

$V_Q = 150{,}00\ km/h\quad N30^\circ W$ ✓ (4)

2.3 $S_h = 1295\ m$

$U = 420\ m/s$

$t = 6s$

$S_h = u.t.Cos\theta$

$\theta = Cos^{-1}(\frac{S_h}{u.t.})$ ✓

$= Cos^{-1}(\frac{1\,295\ m}{420\ m/s(6s).})$ ✓✓

$= 59{,}077^\circ$ ✓ (4)

[12]

VRAAG 3

3.1 3.1.1 B
3.1.2 C

(2 x 2) (4)

3.2 3.2.1 C
3.2.1 B

(2 x 2) (4)

[8]

VRAAG 4

4.1 $m = 1\,200\ kg$
$S_h = 30\ m$
$U = 120\ km/h$
$V = 60\ km/h$
$f_u = 0{,}311\ N/kg$

4.1.1 a

$$v^2 = u^2 + 2aS$$
$$a = \frac{v^2 - u^2}{2S}$$
$$= \frac{(16{,}667)^2 - (33{,}333)^2}{2(30)} \checkmark$$
$$= -13{,}888\ \ m/s \checkmark \quad (2)$$

4.1.2 Remkrag

$$f_a = -(f_B + f_u)$$
$$f_B = -f_a - f_u \surd$$
$$f_u = 0.,311\ N/kg \times (1\,200\ kg)$$
$$= 373{,}2\ N \surd$$
$$f_a = m.a$$
$$= 1\,200\ kg \times (-13{,}888\ m/s^2)$$
$$= -16665{,}6\ N \surd$$

$$f_B = -f_a - f_u$$
$$= -(-16665{,}6\ N) - 373{,}2\ N \surd$$
$$= 16292{,}4\ N \checkmark \quad (3)$$

4.1.3 $v = u + at$

$$t = \frac{v - u}{a}$$
$$= \frac{16{,}667\ m/s - 3{,}333\ m/s}{-13{,}888\ m/s^2} \checkmark$$
$$= 12s \checkmark \quad (2)$$

4.1.4

$$E_K = \frac{1}{2}mv^2$$

$$= \frac{1}{2}(1\,200\ kg).(16{,}667\ m/s)^2 \checkmark$$

$$= 166673{,}333\ J \checkmark$$

(2)

[9]

VRAAG 5: STATIKA

5.1.1

$\Delta \cong A$

$$\sum F_\perp .S(ac) = \sum F_\perp .(c)$$

$$B(7m) + 20\ N(3m) = 193\ N(2m)$$

$$B \Rightarrow \frac{1332\ NMm}{7\ m} = 47{,}429\ N \checkmark$$

$\Delta \cong B$

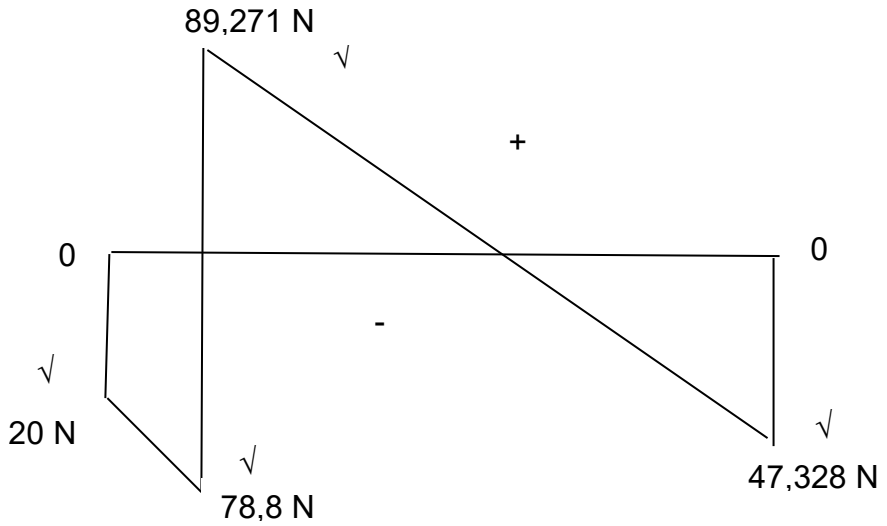
$$\sum F_\perp .S(ac) = \sum F_\perp .(c)$$

$$20\ N(10\ m) + 196\ \ N(5\ m) = A(7\ m)$$

$$A \Rightarrow \frac{1180\ Nm}{7\ m} = 168{,}571\ N \checkmark$$

(2)

5.1.2



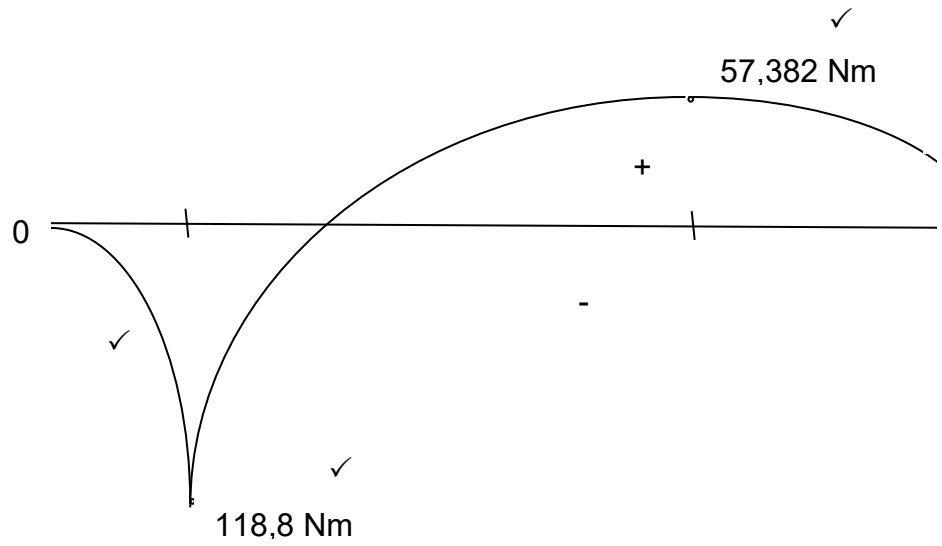
(2)

5.1.3 $BM_{A\rightarrow}$(-20 N).(3 m) – 19,6 N(3 m).(0,5)(3) =-148,2 Nm✓

$$\sum f_s = 0$$
$$-20\ N + (168{,}571\ N) - 19{,}6\ N/m.x = 0$$
$$x = \frac{-148{,}571\ N}{-19{,}6\ N/m}$$
$$= 7{,}580\ m\ \checkmark$$

$BM_{D\rightarrow}$(-20 N).(7,58 m)- (168,571 N(4.5847N)-
19,6 N/m(7,58 m)(0,5)(7,580)
= 57,382 Nm✓ (3)

5.1.4



(3)

Vorm	Oppervlakte (mm2)	Sentroïed	WS
Driehoek	$\frac{1}{2}.b.h = \frac{1}{2}.95(77.942)$ $= 3507{,}39$ √	$\frac{1}{3}.h = \frac{1}{3}.77{,}942$ $= 29.981$ √	(3507,39). (29,981) $= 105155{,}06$ √
Sirkel	$\frac{\pi.d^2}{4} = \frac{\pi.(20)^2}{4}$ $= 314{,}159$ √	h2+ r $45 + 10$ $= 55$ √	(314,159). (55) $= 17278{,}745$ √
	$\sum A = \sum A_1 - \sum A_2$ $= 3507.39 - 314.159$ $= 3193{,}231$ √		$\sum AC = \sum AC_1 - \sum AC_2$ $= 105155{,}06 - 17278{,}745$ $= 87876{,}315$ √
		$y = \frac{87876{,}315}{3193{,}231}$ $= 27{,}52\ mm$ √√	

(5)
[15]

VRAAG 6: HIDROULIKA

6.1 $f_{eff} = 210\ N$
$S_l = 120mm$
$d = 110mm$ $D = 290mm$
$MA = 18$

6.1.1 W_R , $\eta = 93\%$

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

$$f_p = \frac{f_h MA.\eta}{100}$$
$$= \frac{210\ N.(18).(93)}{100} \checkmark$$
$$= 38.73N \checkmark$$
$$W_R = \frac{D^2.f_p}{d^2}$$
$$= \frac{(0{,}29\ m)^2.(38{,}73\ N)}{(0{,}11)^2} \checkmark$$

$$= 269{,}19\ \ N \checkmark \qquad (5)$$

6.1.2 n , $S_L = 480\ mm$ $\eta = 93\%$

$$V_a = \frac{\pi.D^2}{4}.S_L$$
$$= \frac{\pi(0{,}29\ m)^2}{4}.(0{,}41\ m)$$
$$= 0.027081314\ m^3 \checkmark$$
$$V_S = V_a \frac{100}{\eta}$$
$$= 0.027081314\ m^3 \frac{100}{93}$$
$$= 0.029119692\ m^3 \checkmark$$
$$\therefore \frac{\pi.d^2.S_l.n}{4} = 0{,}029119692\ m^3$$
$$\frac{\pi.(0{,}11\ m)^2.(0{,}12\ m)n}{4} = 0{,}038541326\ m^3$$
$$\therefore n = \frac{0{,}029119692\ m^3}{0{,}001140398\ m^3}$$
$$= 25{,}535 \Rightarrow 26 \checkmark \qquad (3)$$

6.2 $n = 1$
$S_l = ...$
$d = 210 \quad mm$
$V_a = 0{,}042\ m^3$

6.2.1 S_l

$V_s = V_a$ omdat die rendement 100% is
$= 0{,}042\ m^3$ √

$$V_s = \frac{\pi.d^2.}{4} S_l n$$
$$= \frac{\pi(0{,}21\ m)^2.(S_l).1}{4} = 0{,}042\ m \ \surd$$

$$S_l = \frac{4(0{,}042\ m^3)}{\pi.(0{,}21\ m)^2} \ \checkmark$$
$= 1{,}213\ m$ ✓ (3)

6.2.2 W

$W = f_h.(S_l)$
$= 7\ 500\ N.(1{,}213\ m)$ ✓

$= 9094{,}568\ J$ ✓ (2)

6.3 $W = 250{,}248\ kJ$
$d = 20\ m$
$P = 860kPa$

h

$a = \frac{\pi}{4}d^2 = \frac{\pi}{4}(20m)^2$
$= 314{,}159\ m^2$ ✓

$W = P.V$
$V = \frac{W}{P}$

$V = \frac{250248\ J}{380\ P_a}$
$= 658{,}54737\ m^3$ ✓
$V = a.h$
$h = \frac{V}{a}$
$h = \frac{658{,}5737\ m^3}{314{,}159\ m^2}$
$= 2{,}096\ m$ ✓ (3)
[16]

VRAAG 7: SPANNING EN VERVORMING

7.1 $d_o = 20\ mm$ $d_f = 49{,}22\ mm$
$l_o = 196\ mm$ $l_g = 211{,}310\ mm$

$E = 230GPa$

7.1.1 % verlenging

$\%Extension = \frac{l_g - l_o}{l_o}.100$ ✓
$= \frac{211{,}310\ mm - 196\ mm}{196\ mm}.10($ ✓

$= 7{,}811\%$ ✓ (3)

7.1.2 % oppervlaktereduksie

$$\%area_{reduction}\ \frac{a_o - a_g}{a_g}.100 \checkmark$$

$$= \frac{\frac{\pi}{4}(d_o{}^2 - d_n{}^2)}{\frac{\pi}{4}d_o{}^2}.100$$

$$= \frac{\frac{\pi}{4}([0{,}02\ m]^2 - [0{,}01313\ m]^2)}{\frac{\pi}{4}(0{,}02\ m)^2}.100 \checkmark$$

$$= 63{,}336\% \checkmark$$ (3)

7.2 $F = 90\ kN$
$d = 80\ mm$
$\Delta l = 0{,}1181\ \ mm$
$l = 981\ \ mm$
$E = 230\ \ GPa$

7.2.1 Spanning

$$\delta = \frac{f}{a}$$

$$= \frac{4(90\ 000\ N)}{\pi.(0{,}08\ m)^2} \checkmark$$

$$= 17904931{,}1\ Pa \checkmark$$

7.2.2 Vervorming

$$\varepsilon = \frac{\Delta l}{l}.$$

$$= \frac{0{,}1181\ mm}{981\ mm} \checkmark$$

$$= 1{,}204 \times 10^{-4} \checkmark$$

7.2.3 E

$$E = \frac{\delta}{\varepsilon}.$$
$$= \frac{17904931.1Pa}{1.204\times10^{-4}} \checkmark$$

$$= 1.4871205\times10^{11}$$
$$= 148.712GPa \checkmark$$

(3 x 2) (6)
[12]

VRAAG 8: HITTE

8.1 Afmetings = 500 m × 200 mm × 600 mm
$t = 20\ ^oC$
$\Delta t = 245\ ^oC$
$\alpha = 12{,}5\times10^{-6}/K$

$E = 230\ GPa$

8.1.1 Syverlenging

$$\Delta T = 245\ ^oC + 273$$
$$= 518K \surd$$
$$T_1 = 2\ ^oC + 273$$
$$= 293\ K \surd$$
$$\Delta l = l_o.\alpha.\Delta T$$
$$= 0{,}6\ m(12{,}5\times10^{-6}/K).518\ K \checkmark$$

$$= 0{,}03885\ m \checkmark$$ (3)

8.1.2 Syverlenging

$$V_o = (0.5m).(0.2m).(0.6m)$$
$$= 0.6m^3 \surd$$

$$\Delta V = 3V_o.\alpha.\Delta T$$
$$= 3(0.06m^3).12.5\times10^{-6}/K.(518K) \surd$$
$$= 0{,}0011655m^3 \checkmark$$ (2)

8.2 $V_1 = 0.208\ m^3$ $V_2 = ...$
$t_1 = 30\ ^oC$ $t_2 = 6\ ^oC$
$P = 185\ kPa$

8.2.1 V_2

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

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

$$= \frac{279\ K.(0{,}208\ m^3)}{303\ K} \checkmark$$

$$= 0{,}191\ m^3 \checkmark \quad (2)$$

8.2.2 V_2

$$\frac{V_1.P_1}{T_1} = \frac{V_2.P_2}{T_2}$$

$$P_2 = \frac{P_1 T_2 V_1}{T_1 V_2} \checkmark$$

$$= \frac{185\ kPa.(279\ K).(0{,}208\ m^3)}{303\ K.(0{,}089\ m^3)} \checkmark$$

$$= 389{,}113\ kPa \checkmark \quad (3)$$

8.3
- Kombinasie van Boyle se wet en Charles se wet.
- Nie die druk, temperatuur of volume is konstant nie. (2)

[12]

TOTAAL: 100

Kopiereg voorbehou