higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

KRAGMASJIENE N3

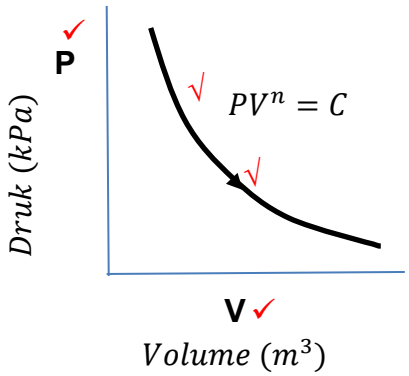
21 April 2021

Hierdie nasienriglyn bestaan uit 5 bladsye.

Kopiereg voorbehou

VRAAG 1

1.1



$\frac{1}{2}$ punt vir die grafiek en $\frac{1}{2}$ punt vir 'n pyl in die regte rigting
1 punt vir elke as (Moenie kandidate vir die eenhede penaliseer nie)

(3)

1.2 Warmte vloei spontaan vanaf 'n stof teen 'n hoër temperatuur na 'n stof met 'n laer temperatuur en vloei nie spontaan in die teenoorgestelde rigting nie. (2)

1.3 1.3.1 spoed
1.3.2 dieselfde OF konstant OF uniform (2)

1.4 1.4.1 A
1.4.2 C
1.4.3 A

(3×1) (3)
[10]

VRAAG 2

2.1
$\frac{V_1}{V_2} = \frac{3}{1}$
$\frac{4,2}{V_2} = \frac{3}{1}$
$V_2 = 1,4\ m^3$ (3)

2.2
$P_1V_1 = mRT_1$
$m = \frac{120 \times 4,2}{0,288 \times 295}$
$m = 5,932\ kg$ (3)

2.3
$P_1V_1 = P_2V_2$
$P_2 = \frac{120 \times 4,2}{1,4}$
$P_2 = 360\ kPa$

OF

$P_2V_2 = mRT_2$
$P_2 = \frac{5,932 \times 0,288 \times 295}{1,4}$
$P_2 = 359,988\ kPa \approx 360\ kPa$ (3)

2.4
$WD = P_1V_1 ln \frac{V_2}{V_1}$
$WD = (120)(4,2) ln \left(\frac{1}{3}\right)$
$WD = -553,701\ kJ$ (3)

2.5 $\Delta U = mC_v(T_2 - T_1)$
$\Delta U = 5{,}932(0{,}712)(295 - 295)$ ✓
$\Delta U = 0\ kJ$ ✓ (2)

2.6 $\Delta U = 0\ kJ$
$Q = WD$ ✓
$Q = -553{,}701\ kJ$ ✓ (2)

2.7 $\Delta S = m\left[Rln\frac{V_2}{V_1} + C_V ln\frac{T_2}{T_1}\right]$
$\Delta S = 5{,}932\left(0{,}288ln\frac{1}{3} + 0\right)$ ✓
$\Delta S = 5{,}932kg \times (-0{,}316\frac{kJ}{kg.K})$ ✓
$\Delta S = -1{,}875\ {}^{kJ}/_{K}$ ✓ (4)
[20]

VRAAG 3

3.1

T_1 = 26,7 °C	Hitte-verhaler	T_2 = 47,7 °C	Verdam-per	P_3 = 1 500kPa	Oorver-hitter	P_4=1 500 kPa	
h_1 =112kJ/kg ✓		h_2 =200kJ/kg ✓		x = 0,92 ✓		t_{ss}=200°C ✓	h_4 =2796kJ/kg

(6)

3.2 $\frac{m_s}{m_f} = \frac{2500}{200}$
$\frac{m_s}{m_f} = 12{,}5\ \frac{kg\ stoom}{kg\ brandstof}$ ✓ (1)

3.3 $Warmte\ na\ die\ hitteverhaler\ oorgedra = \frac{m_s}{m_f}(h_2 - h_1)$
$= \frac{12{,}5}{1}(200 - 112)$ ✓
$= 1100\ kJ/kg$ ✓ (2)

3.4 $h_3 = h_f + xh_{fg}$ ✓
$h_3 = 845 + (0{,}92)(1845)$ ✓
$h_3 = 2634{,}4\ kJ/kg$ ✓

$Warmte\ na\ die\ verdamper\ oorgedra = \frac{m_s}{m_f}(h_3 - h_2)$
$= \frac{12{,}5}{1}(2634{,}4 - 200)$ ✓
$= 30430\ kJ/kg$ ✓ (5)

3.5 $Warmte\ na\ die\ oorverhitter\ oorgedra = \frac{m_s}{m_f}(h_4 - h_3)$

$= \frac{12,5}{1}(2796 - 2634,4)$ ✓

$= 2020\ kJ/kg$ ✓ (2)

3.6 $\eta = \frac{m_s}{m_f}(h_4 - h_1)$

$= \frac{12,5}{1}\frac{(2796-112)}{35000} \times 100\ \%$ ✓ ✓

$= 95,857\ \%$ ✓ (4)

✓ **[20]**

VRAAG 4

4.1 $Warmte\ deur\ stoom\ vrygestel = Warmte\ deur\ water\ geabsorbeer$

$m_s\left[\left(xh_{fg}\right) + c_p(t_{ss} - t_s)\right] = mc_p(T_2 - T_1)$

$100[(0,75 \times 2393) + 4,187(45,8 - 43,8)] = 1850 \times 4,187(T_2 - 22)$ ✓ ✓ ✓ ✓

$100[(1794,75) + 8,375] = 7745,95(T_2 - 22)$

$\frac{180312,4}{7745,95} = (T_2 - 22)$ ✓

$T_2 = 45,278\ ℃$ ✓

Alternatiewe Metode

$Warmte\ deur\ stoom\ vrygestel = Warmte\ deur\ water\ geabsorbeer$

$m_s\left[\left(h_f + xh_{fg}\right) - (h_c)\right] = mc_p(T_2 - T_1)$

$100[192 + (0,75 \times 2393) - (183)] = 1850 \times 4,187(T_2 - 22)$ ✓ ✓ ✓ ✓

$100[1803,75] = 7745,95(T_2 - 22)$

$\frac{180375}{7745,95} = (T_2 - 22)$ ✓

$T_2 = 45,286\ ℃$ ✓ (6)

4.2 4.2.1 $CH_4 + (1 + \frac{4}{4})O_2 = CO_2 + \frac{4}{2}H_2O$ √

$CH_4 + 2O_2 = CO_2 + 2H_2O$ √

$H_2 + O_2 = H_2O$ √

$H_2 + \frac{1}{2}O_2 = H_2O$ √ OF $2H_2 + O_2 = 2H_2O$ √

$CO + O_2 = CO_2$ √

$CO + \frac{1}{2}O_2 = CO_2$ √ OF $2CO + O_2 = 2CO_2$ √ (3)

4.2.2 $V_{O_2} = (2 \times 0,32) + \left(\frac{1}{2} \times 0,4\right) + (\frac{1}{2} \times 0,2)$ ✓ ✓ ✓

$= 0,94\ m^3 suurstof \Big/ m^3 brandstof$ ✓ (4)

4.2.3

$V_{air} = \frac{100}{21} \times 0,94$ √

$V_{air} = 4,476\ {}^{m^3 lug}/_{m^3 brandstof}$ ✓

$V_{N_2} = \left(\frac{79}{100} \times 4,476\right) + 0,08$ ✓

$V_{N_2} = 3,616\ {}^{m^3 Stikstof}/_{m^3 brandstof}$ √

$V_{CO_2} = 0,32 + 0,2$ √

$V_{CO_2} = 0,52\ {}^{m^3 CO_2}/_{m^3 brandstof}$ √

$V_{H_2O} = (2 \times 0,32) + (0,4)$ √

$V_{H_2O} = 1,04\ {}^{m^3 H_2O}/_{m^3 brandstof}$ √ (5)

4.2.4

$N_2 = \frac{3,616}{5,176} \times 100 = 69,861\ \%$ √

$H_2O = \frac{1,04}{5,176} \times 100 = 20,093\ \%$ √

$CO_2 = \frac{0,52}{5,176} \times 100 = 10,046\%$ √

$Totaal = 100\%$ √ (2)

[20]

VRAAG 5

5.1

$S_v = V_1 - V_C$ .....(1)

$V_c = 0,03S_V$ ✓.....(2) *Vervang (2) in (1)*

$S_v = V_1 - 0,03S_v$ ✓

$\therefore V_1 = 1,03S_v$ ✓.....(3)

$V_4 = V_3 \left(\frac{P_2}{P_1}\right)^{\frac{1}{n}}$.....(4) *Vervang (2) in (4)*

$V_4 = 0,03S_V \left(\frac{780}{102}\right)^{\frac{1}{1,35}}$ ✓

$\therefore V_4 = 0,135S_V$ ✓.....(5)

$V_e = V_1 - V_4$ .....(6) *Vervang (3) en (5) in (6)*

$2 = 1,03S_V - 0,135S_V$

$2 = 0,895S_V$ ✓

$S_V = 2,235\ \frac{m^3}{min}$ ✓ $\times \frac{min}{300\ rev}$ ✓

$\therefore S_V = 0,00745\ m^3$ ✓ (9)

Alternatiewe metode

$V_c = 0{,}03S_V$

$\eta_{vol} = \left[1 - \frac{V_c}{S_V}\left[\left(\frac{P_2}{P_1}\right)^{\frac{1}{n}} - 1\right]\right] \times 100\%$ ✓

$\eta_{vol} = \left[1 - \frac{0{,}03S_V}{S_V}\left[\left(\frac{780}{102}\right)^{\frac{1}{1{,}35}} - 1\right]\right] \times 100\%$

$\eta_{vol} = 89{,}462\%$ ✓

$\eta_{vol} = \frac{V_e}{S_V} \times 100\%$ ✓

$S_V = \frac{2}{0{,}89462}\frac{m^3}{min} \times \frac{min}{300\ rev}$ ✓✓

$S_V = 0{,}00745\ m^3$ ✓

5.2

$P = P_1V_e\left(\frac{n}{n-1}\right)\left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right]$

$P = (102)\left(\frac{2}{60}\right)\left(\frac{1{,}35}{1{,}35-1}\right)\left[\left(\frac{780}{102}\right)^{\frac{1{,}35-1}{1{,}35}} - 1\right]$ ✓✓

$P = 9{,}109\ kW$ ✓ (3)

5.3

$WD = 9{,}109\ \frac{kJ}{s} \times \frac{min}{300\ rev} \times \frac{60\ s}{1\ min}$ ✓✓

$WD = 1{,}822\ kJ$ ✓ (3)

[15]

VRAAG 6

6.1 Kyk diagram op bladsy 7.

6.2 6.2.1 32^0 ✓ (1)

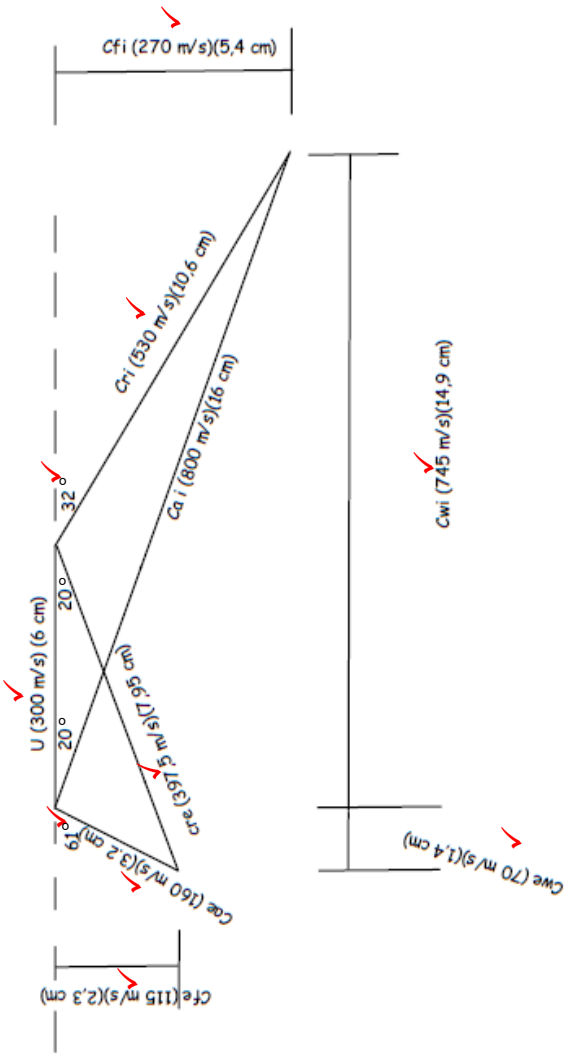
6.2.2 61^0 ✓ (1)

6.2.3 $P = mU\left(C_{we} - (-C_{wi})\right)$

$P = 2 \times 300 \times (70 - (-740))$ ✓✓

$P = 486\ kW$ ✓ (3)

6.1



(10)
[15]

TOTAAL: 100

Kopiereg voorbehou