higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

KRAGMASJIENE N5

12 August 2021

Hierdie nasienriglyn bestaan uit 6 bladsye.

Kopiereg voorbehou

VRAAG 1

1.1
- Naam van die vervaardiger
- Fabrieknommer
- Jaar van vervaardiging
- Ontwerpdruk

(Enige 3 × 1) (3)

1.2
- Koolstof
- Waterstof

(Enige 2 × 1) (2)

1.3 1.3.1 Reëlaar
1.3.2 Verbrandings

(2 × 1) (2)

1.4 1.4.1 C
1.4.2 B
1.4.3 D

(3 × 1) (3)
[10]

VRAAG 2

2.1 $Q = mc_p(T_2 - T_1)$✓
$100 = m(1)(350 - 288)$✓
$m = 1{,}612\ \text{kg}$✓ (3)

2.2 $R = C_p - C_v$
$R = 1 - 0{,}707$✓
$R = 0{,}293\ \frac{\text{kJ}}{\text{kg}}.\text{K}$✓ (2)

2.3 $P_1 = \frac{mRT_1}{V_1}$
$P_1 = \frac{1{,}612 \times 0{,}293 \times 288}{0{,}5}$✓
$P_1 = 272{,}054\ \text{kPa}$✓ (2)

2.4 $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ ✓
$V_2 = \frac{350 \times 0{,}5}{288}$✓
$V_2 = 0{,}608\ \text{m}^3$ (3)

2.5 $WD = P_1(V_2 - V_1)$ ✓
$WD = 272{,}054(0{,}608 - 0{,}5)$ ✓ ✓
$WD = 29{,}382\ \text{kJ}$ (4)

2.6 $Q = WD + \Delta U$✓
$\Delta U = 100 - 29{,}382$✓
$\Delta U = 70{,}618\ \text{kJ}$✓ (3)

Commented [L1]: Please place the ticks after the answers throughout.

2.7 $\Delta s = m\left(C_v ln\frac{T_2}{T_1} + Rln\frac{V_1}{V_2}\right)$
$\Delta S = 1{,}612\left(0{,}707ln\frac{350}{288} + 0{,}293ln\frac{0{,}5}{0{,}608}\right)$
$\Delta S = 1{,}612(0{,}138 - 0{,}057)$
$\Delta S = 0{,}131\ \text{kJ}$ (3)
[20]

VRAAG 3

3.1 $h_1 = h_g + c_p(t_{ss} - t_s)$
$= 2\,800 + 2(230 - 219{,}6)$
$= 2\,820{,}8\ \text{kJ/kg}$ (3)

3.2 $V_1 = \frac{n-1}{n}\left(\frac{h_{su}-1941}{P}\right)$
$V_1 = \frac{1{,}3-1}{1{,}3}\left(\frac{2\,820{,}8-1\,941}{2\,300}\right)$
$V_1 = 0{,}088\ \text{m}^3/\text{kg}$ (3)

3.3 $U_1 = h_1 - p_1V_1$
$U_1 = 2\,820{,}8 - (2\,300 \times 0{,}088)$
$U_1 = 2\,618{,}4\ \text{kJ/kg}$ (3)

3.4 $h_2 = h_f + xh_{fg}$
$h_2 = 551 + (0{,}85)(2\,170)$
$h_2 = 2\,395{,}5\ \text{kJ/kg}$ (3)

3.5 $V_2 = xV_g$
$V_2 = 0{,}85 \times 0{,}6460$
$V_2 = 0{,}549\ \text{m}^3/\text{kg}$ (3)

3.6 $U_2 = h_2 - p_2V_2$
$U_2 = 2\,395{,}5 - (280 \times 0{,}549)$
$U_2 = 2\,241{,}752\ \text{kJ/kg}$ (3)

3.7 $\Delta U = U_2 - U_1$
$\Delta U = 2\,241{,}752 - 2\,618{,}4$
$\Delta U = -376{,}648\ \text{kJ/kg}$ (2)
[20]

VRAAG 4

4.1 4.1.1

$$P = (P_{barometer} - P_{manometer})\frac{101,3}{760}$$
$$P = (775 - 680)\frac{101,3}{760}\checkmark$$
$$P = 12,663\ kPa\checkmark$$

$$P_s = 5\ kPa$$ (2)

4.1.2

$$P = (P_a + P_s)$$
$$P_a = 12,663 - 5\checkmark$$
$$P_a = 7,663\ \text{kPa}\checkmark$$

$$m = \frac{PV}{RT}$$
$$m = \frac{7,663 \times 1,3}{0,293 \times 307}\checkmark$$
$$m = 0,116\ \text{kg/min}\checkmark$$ (4)

4.2 4.2.1

$$HHV = \left[CV_C.C + CV_{H_2}.\left(H_2 - \frac{O_2}{8}\right) + CV_S.S\right]\ \checkmark$$
$$HHV = \left[35 \times 0,8 + 145\left(0,10 - \frac{0,05}{8}\right) + 9 \times 0,05\right] \times m\ \checkmark$$
$$HHV = \left[35 \times 0,8 + 145\left(0,10 - \frac{0,05}{8}\right) + 9 \times 0,05\right] \times 0,116\ \checkmark$$

$$HHV = 42,044\ \text{MJ/kg}\ \checkmark$$
$$HHV = 4,877\ \text{MJ}\ \checkmark$$ (5)

4.2.2

$$LHV = HHV - \left(h_{fg}.9.H_2\right)\checkmark$$
$$LHV = 42,044 - \left(\frac{2\,433}{1\,000}.9 \times 0,1\right)$$
$$LHV = 43,927\ \frac{\text{MJ}}{\text{kg}} \times 1,05\ \text{kg}\ \checkmark$$
$$LHV = 39,854\ \text{MJ}\ \checkmark$$ (5)

4.2.3

$$AHV = LHV - mC_p\Delta T$$
$$AHV = 43,927 - 0,5 \times \frac{1,45}{1\,000} \times 10\ \checkmark$$
$$AHV = 43,919\ \frac{\text{MJ}}{\text{kg}}$$ (4)

[20]

VRAAG 5

5.1
$$\eta = 1 - \frac{V_C}{S_V}\left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right]$$ ✓
$$73 = 1 - \frac{0{,}014}{S_V}\left[\left(\frac{600}{100}\right)^{\frac{1{,}3-1}{1{,}3}} - 1\right] \times 100$$ ✓

$S_V = \frac{0{,}007}{0{,}27}$ ✓
$S_V = 0{,}026\ \text{m}^3$ ✓ (5)

5.2
$\eta = \frac{V_e}{S_V} \times 100\%$
$73 = \frac{V_e}{0{,}026} \times 100\%$ ✓
$V_e = 0{,}019\ \text{m}^3$ ✓ (4)

5.3
$$WD = \left(\frac{n}{n-1}\right) P_1 V_e \left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right]$$ ✓
$$WD = \left(\frac{1{,}3}{1{,}3-1}\right) 100 \times 0{,}019 \left[\left(\frac{600}{100}\right)^{\frac{1{,}3-1}{1{,}3}} - 1\right]$$ ✓
$WD = 4{,}216\ \text{kJ}$ ✓ (4)

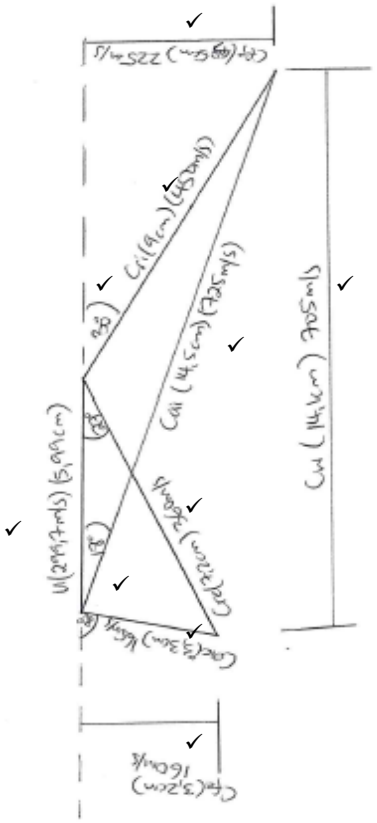
5.4
$WD = WD \times N$
$WD = 4{,}216\ \text{kJ} \times \frac{320\ r}{min}$ ✓
$WD = 1\,349{,}12\ \text{kJ/min}$ ✓ (2)

[15]

VRAAG 6

6.1 $U = \pi DN$✓
$U = \pi \times 0{,}318 \times 300$✓
$U = 299{,}7 \text{ m/s}$✓ (3)

6.2



(10)

6.3 6.3.1 $\alpha = 18^{\circ}$
6.3.2 $\emptyset = 27^{\circ}$

(2 × 1) (2)
[15]

TOTAAL: 100

Kopiereg voorbehou