



**higher education  
& training**

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **NASIENRIGLYN**

**NATIONALE SERTIFIKAAT  
FLUÏEDMEGANIKA N6**

**6 AUGUSTUS 2019**

**Hierdie nasienriglyn bestaan uit 7 bladsye.**

**VRAAG 1**

1.1 'n Vloei waarin deeltjies op 'n geordende manier beweeg en hul relatiewe posisies in opeenvolgende dwarsnitte behou (2)

1.2 Gedeelte van pyp in kontak met vloeistof (1)

1.3 1.3.1 
$$Q = \frac{820}{1000 \times 60} \checkmark$$
  

$$= 0,014 \text{ m}^3/\text{s} \checkmark$$

1.3.2 
$$S = \pi DL$$
  

$$= \pi \times 0,36 \times 45 \checkmark$$
  

$$= 50,894 \text{ m}^2 \checkmark$$

1.3.3 
$$A = \frac{\pi D^2}{4}$$
  

$$= \frac{\pi(0,36)^2}{4} \checkmark$$
  

$$= 0,102 \text{ m}^2 \checkmark$$

1.3.4 
$$h = 45 \sin 35^\circ \checkmark$$
  

$$= 25,811 \text{ m} \checkmark$$

1.3.5 
$$V = \frac{Q}{A}$$
  

$$= \frac{0,014}{0,102} \checkmark$$
  

$$= 0,134 \text{ m/s} \checkmark$$

(5 × 2) (10)

1.4 
$$V_1 = \frac{0,08 \times 4}{\pi \times (0,35)^2} \checkmark = 0,832 \text{ m/s} \checkmark$$

$$V_2 = \frac{0,08 \times 4}{\pi \times (0,15)^2} \checkmark = 4,527 \text{ m/s} \checkmark$$

$$Q = \frac{288}{3600} = 0,08 \text{ m}^3/\text{s} \checkmark$$

$$\frac{Pr_1}{\rho g} + \frac{v^2}{2g} + z_1 = \frac{Pr_2}{\rho g} + \frac{v^2}{2g} + z_2$$

$$\frac{Pr_1}{9,81} + \frac{0,832^2}{2 \times 9,81} + 0 = \frac{Pr_2}{9,81} + \frac{4,527^2}{2 \times 9,81} + 0 \checkmark$$

$$Pr_1 - Pr_2 = 19,803 \text{ kPa} \checkmark$$

Alternatief

$$Pr_2 - Pr_1 = -19,803 \text{ kPa} \checkmark$$

(7)

$$\begin{aligned}
 1.5 \quad C &= \sqrt{\frac{2g}{f}} \\
 &= \sqrt{\frac{2 \times 9,81}{0,02}} \checkmark \\
 &= 31,321 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 m &= \frac{d}{4} \\
 &= \frac{0,4}{4} \\
 &= 0,1 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 Q &= \frac{2,37}{60} \\
 &= 0,0395 \text{ m}^3/\text{s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 A &= \frac{\pi d^2}{4} \\
 &= \frac{\pi \times 0,4^2}{4} \\
 &= 0,126 \text{ m}^2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 Q &= AC\sqrt{mi} \\
 0,0395 &= 0,126 \times 31,321 \sqrt{0,1 \times i} \checkmark \\
 i &= 0,001 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 i &= \frac{h_f}{L} \\
 0,001 &= \frac{h_f}{1500} \checkmark \quad h_f = 1,512 \text{ m} \checkmark
 \end{aligned}$$

(9)  
[29]**VRAAG 2**

$$\begin{aligned}
 2.1 \quad A &= \frac{1}{2} \times B \times H \\
 &= \frac{1}{2} \times 4 \times 3 \checkmark \\
 &= 6 \text{ m}^2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 P &= 2(\sqrt{2^2 + 3^2}) \checkmark \\
 &= 7,211 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 m &= \frac{A}{P} & i &= \frac{1}{2550} \\
 &= \frac{6}{7,211} \checkmark & &= 0,392 \times 10^{-3} \checkmark \\
 &= 0,832 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 Q &= AC\sqrt{mi} \\
 &= 6 \times 50 \times \sqrt{0,832 \times 0,392 \times 10^{-3}} \checkmark \\
 &= 5,419 \text{ m}^3/\text{s} \\
 &= 5419,908 \text{ l/s} \checkmark
 \end{aligned}$$

(9)

$$\begin{aligned}
 2.2 \quad Q &= Cd \times \frac{8}{15} \times \sqrt{2g} \tan \frac{\theta}{2} \times H^{2,5} \checkmark \\
 &= 0,8 \times \frac{8}{15} \times \sqrt{2 \times 9,81} \tan \frac{90}{2} \times 0,895^{2,5} \checkmark \\
 &= 1,432 \text{ m}^3/\text{s} \checkmark
 \end{aligned}$$

(3)

2.3 2.3.1

$$\begin{aligned}
 V_A &= \sqrt{\frac{gx^2}{2y}} \\
 &= \sqrt{\frac{9,81 \times 1,87^2}{2(0,77)}} \checkmark \\
 &= 4,72 \text{ m/s} \checkmark
 \end{aligned}$$

Reaksie van die straal =  $\rho Q V_A \checkmark$

$$\begin{aligned}
 &= 10^3 \times 0,24 \times 4,72 \checkmark \\
 &= 1132,732 \text{ N} \checkmark
 \end{aligned}
 \tag{5}$$

2.3.2

$$\begin{aligned}
 V_A &= C_v \sqrt{2gh} \\
 4,72 &= 0,98 \sqrt{2 \times 9,81 \times h} \checkmark \\
 h &= 1,182 \text{ m} \checkmark
 \end{aligned}
 \tag{2}$$

2.3.3

$$\begin{aligned}
 Q_{th} &= V_{th} \times A_{th} \\
 &= \sqrt{2gh} \times \frac{\pi d^2}{4} \\
 &= \sqrt{2 \times 9,81 \times 1,182} \checkmark \times \frac{\pi(0,05)^2}{4} \checkmark \\
 &= 9,456 \text{ l/s} \checkmark
 \end{aligned}
 \tag{3}$$

**[22]**

**VRAAG 3**

- 3.1
- Aksiale waaiers
  - Sentrifugale waaiers
- (2)

3.2

$$\begin{aligned}
 a &= \frac{\pi(0,75)^2}{4} \checkmark \\
 &= 0,442 \text{ m}^2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 S &= \pi DL \\
 &= \pi \times 0,75 \times 60 \checkmark \\
 &= 141,372 \text{ m}^2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 Pr &= \frac{kSV^2}{a} \\
 180 &= \frac{0,005 \times 141,372 \times Q^2}{0,442^3} \checkmark \\
 &= 4,686 \text{ m}^3/\text{s} \checkmark
 \end{aligned}
 \tag{6}$$

3.3 3.3.1

$$\begin{aligned}
 Q &= \frac{42300}{1000 \times 3600} \checkmark \\
 &= 0,01175 \text{ m}^3/\text{s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 P &= \frac{\rho gQH}{\eta} \\
 &= \frac{10^3 \times 9,81 \times 0,01175 \times 258,5}{0,85} \checkmark \\
 &= 35,055 \text{ kW} \checkmark
 \end{aligned}
 \tag{4}$$

$$3.3.2 \quad H_{f1} = 258,5 - 206 \\ = 52,5 \text{ m} \checkmark$$

$$\frac{h_{f2}}{h_{f1}} = \left(\frac{Q_2}{Q_1}\right)^2 \\ = \left(\frac{0,0235}{0,01175}\right)^2 \times 52,5 \checkmark \\ = 210 \text{ m} \checkmark$$

$$H = 210 + 206 = 416 \text{ m} \checkmark$$

$$P = \frac{\rho g Q H}{\eta} \\ = \frac{10^3 \times 9,81 \times 0,0235 \times 416}{0,85} \checkmark \\ = 112,827 \text{ kW} \checkmark$$

(6)

- 3.4
- Suierpomp suig en lewer vloeistof met behulp van 'n stuwër
  - Sentrifugale pomp suig en lewer vloeistof met behulp van 'n suier

(2)

3.5 3.5.1 Snelheid van water relatief tot stuwër

3.5.2 Snelheid van water relatief tot pompomhulsel

(2 × 1) (2)

$$3.6 \quad Q = \frac{12,24 \times 10^6}{24 \times 10^3 \times 3600} \checkmark \\ = 0,142 \text{ m}^3/\text{s} \checkmark$$

$$h_f = \frac{f l Q^2}{3 d^5} \\ = \frac{0,007 \times 26000 \times 0,142^2}{3 \times 0,45^5} \checkmark \\ = 65,982 \text{ m} \checkmark$$

$$P = \frac{\rho g Q H}{\eta} \\ = \frac{10^3 \times 9,81 \times 0,142 \times 65,982}{0,78} \checkmark \\ = 117,561 \text{ kW} \checkmark$$

(6)  
[28]

**VRAAG 4**

4.1. 4.1.1

$$\begin{aligned}\sin 60^\circ &= \frac{V_{wi}}{36} \checkmark \\ V_{wi} &= 31,177 \text{ m/s} \checkmark\end{aligned}$$

Alternatief

$$\begin{aligned}\cos 30^\circ &= \frac{V_{wi}}{36} \checkmark \\ V_{wi} &= 31,177 \text{ m/s} \checkmark\end{aligned}$$

$$\begin{aligned}\cos 60^\circ &= \frac{V_{wo}}{3} \checkmark \\ V_{wo} &= 1,5 \text{ m/s} \checkmark\end{aligned}$$

Alternatief

$$\begin{aligned}\sin 30^\circ &= \frac{V_{wo}}{3} \checkmark \\ V_{wo} &= 1,5 \text{ m/s} \checkmark\end{aligned}$$

(4)

4.1.2

$$\begin{aligned}U_i &= \frac{\pi D N}{60} \\ &= \frac{\pi \times 1,2 \times 300}{60} \checkmark \\ &= 18,849 \text{ m/s} \checkmark\end{aligned}$$

$$\begin{aligned}\cos 60^\circ &= \frac{V_i}{36} \checkmark & \text{Alternatief} \\ V_i &= 18 \text{ m/s} \checkmark\end{aligned}$$

$$\begin{aligned}\sin 30^\circ &= \frac{V_i}{36} \checkmark \\ V_i &= 18 \text{ m/s} \checkmark\end{aligned}$$

$$\begin{aligned}x &= V_{wi} - U_i \\ &= 31,177 - 18,849 \checkmark \\ &= 12,327 \text{ m/s} \checkmark\end{aligned}$$

$$\begin{aligned}\tan \beta_i &= \frac{V_i}{x} \\ \beta_i &= \tan^{-1} \frac{18}{12,327} \checkmark \\ &= 55,595^\circ \checkmark\end{aligned}$$

(8)

$$\begin{aligned}
 4.2 \quad 4.2.1 \quad V_A &= C_V \sqrt{2gh} \\
 &= \sqrt{2 \times 9,81 \times 245} \checkmark \\
 &= 69,332 \text{ m/s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{Vir maksimum rendement: } U &= 0,5 V_A \\
 &= 0,5 (69,332) \checkmark \\
 &= 34,666 \text{ m/s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 U &= \frac{\pi D N}{60} \\
 34,666 &= \frac{\pi \times 0,9 \times N}{60} \checkmark \\
 &= 735,633 \text{ r/min} \checkmark
 \end{aligned} \tag{6}$$

$$\begin{aligned}
 4.2.2 \quad \eta &= \frac{U}{gh} (V - U) (1 + \cos (180^\circ - y)) \times 100\% \checkmark \\
 &= \frac{34,666}{9,81 \times 245} (69,332 - 34,666) [1 + \cos (180^\circ - 160^\circ)] \times 100\% \checkmark \\
 &= 96,985\% \checkmark
 \end{aligned} \tag{3}$$

[21]

**TOTAAL: 100**