



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

FLUÏEDMEGANIKA N6

3 Desember 2025

Hierdie nasienriglyn bestaan uit 8 bladsye.

VRAAG 1

1.1 In enige vloeistofstelsel moet die totale hoeveelheid vloeistof wat die stelsel binnegaan gelyk wees aan die hoeveelheid wat die stelsel verlaat.✓✓ (2)

1.2 1.2.1 $\rho = 1\,000 \times 0,72 = 720 \text{ kg/m}^3$ ✓ (1)

$$1.2.2 \quad Q = A \times V$$

$$\frac{50}{3\,600} = \frac{\pi \times d^2}{4} \times 6$$

$$d = 0,0543 \text{ m} \checkmark$$

$$\begin{aligned} \text{Wrywingsoppervlak} &= \pi \times d \times L \\ &= \pi \times 0,0543 \times 30 \checkmark \\ &= 5,118 \text{ m}^3 \checkmark \end{aligned} \quad (3)$$

$$1.2.3 \quad f = 0,005 \left(1 + \frac{1}{40 \times 0,0543} \right)$$

$$= 7,302 \times 10^{-3} \checkmark$$

$$\begin{aligned} hf &= \frac{f l Q^2}{3 d^5} \\ &= \frac{7,302 \times 10^{-3} \times 30 \times 0,0139^2}{3 \times 0,0543^5} \checkmark \\ &= 29,886 \text{ m} \checkmark \end{aligned} \quad (3)$$

$$1.3 \quad V_1 = \frac{0,15^2}{0,08^2} \times V_2$$

$$V_1 = 3,516 V_2 \checkmark$$

$$h_{IT} = \frac{4 f l V_1^2}{2 g d} + \frac{4 f l V_2^2}{2 g d} + \frac{0,5 V_1^2}{2 g} + \frac{(V_1 - V_2)^2}{2 g} + \frac{V_2^2}{2 g}$$

$$12 = \frac{4 \times 0,007 \times 20 \times (3,516 V_2)^2}{2 \times 9,81 \times 0,08} \checkmark + \frac{4 \times 0,007 \times 30 \times V_2^2}{2 \times 9,81 \times 0,15} \checkmark + \frac{0,5(3,516 V_2)^2}{2 \times 9,81} \checkmark + \frac{(3,516 V_2 - V_2)^2}{2 \times 9,81} \checkmark + \frac{V_2^2}{2 \times 9,81} \checkmark$$

$$12 = 4,524 V_2^2 + 0,285 V_2^2 + 0,315 V_2^2 + 0,323 V_2^2 + 0,051 V_2^2$$

$$12 = 5,498 V_2^2$$

$$V_2 = 1,477 \text{ m/s} \checkmark$$

$$Q_2 = A_2 V_2 \dots$$

$$= \frac{\pi \times 0,15^2}{4} \times 1,477 \checkmark$$

$$= 26,101 \text{ l/s} \checkmark$$

(10)

VRAAG 2

$$2.1 \quad 0,5b + d = 1,414d \\ b = 0,828d \checkmark$$

$$p = b + 2(1,414d) \\ = 0,828d + 2,828d \\ = 3,656d \checkmark$$

$$A = (d \times d) + (b \times d) \\ = d^2 + 0,828d^2 \\ = 1,828d^2 \checkmark$$

$$m = \frac{1,828d^2}{3,656d} \checkmark \\ = 0,5d \checkmark$$

(5)

$$2.2 \quad Q = AC\sqrt{mi} \\ \frac{19000}{3600} = 1,828d^2 \times 60 \times \sqrt{0,5d \times \frac{1}{8000}} \checkmark \\ 27,854 = 12029,702d^4 \times 0,5d \times \frac{1}{8000} \checkmark \\ d = 2,059 \text{ m} \checkmark$$

$$A = 1,828 \times 2,059^2 \\ = 7,751 \text{ m}^2 \checkmark$$

(4)

$$2.3 \quad b = 0,828 \times d \\ = 0,828 \times 2,059 \\ = 1,705 \text{ m} \checkmark$$

(1)

[10]

VRAAG 3

$$3.1 \quad 3.1.1 \quad t = \sqrt{\frac{2y}{g}} \\ = \sqrt{\frac{2 \times 1,25}{9,81}} \checkmark \\ = 0,505 \text{ sek} \checkmark$$

(2)

$$3.1.2 \quad V_a = \sqrt{\frac{9,81 \times 3,9^2}{2 \times 1,25}} \checkmark \\ = 7,726 \text{ m/s} \checkmark$$

(2)

3.1.3

$$C_c = \frac{d_a^2}{d_t^2}$$

$$0,65 = \frac{d_a^2}{0,072^2}$$

$$d_a = 0,058 \text{ m} \checkmark$$

$$\begin{aligned} Q_a &= V_a \times A_a \\ &= \frac{\pi \times 0,058^2}{4} \times 7,726 \\ &= 20,413 \text{ } \ell/\text{s} \checkmark \end{aligned}$$

(2)

3.1.4

$$C_v = \frac{V_a}{V_t}$$

$$0,95 = \frac{7,726}{V_t}$$

$$V_t = 8,133 \text{ m/s} \checkmark$$

$$V_t = \sqrt{2 \times 9,81 \times h}$$

$$8,133 = \sqrt{2 \times 9,81 \times h}$$

$$h = 3,371 \text{ m} \checkmark$$

$$\begin{aligned} h_L &= h(1 - C_v^2) \\ &= 3,371(1 - 0,95^2) \\ &= 0,329 \text{ m} \checkmark \end{aligned}$$

(4)

[10]

VRAAG 4

4.1 Dis die vorming van 'n vakuum in die silinder of suigpyp. ✓

(1)

4.2 4.2.1

$$\begin{aligned} Q &= ALSE \frac{N}{60} \\ &= \frac{\pi \times 0,31^2}{4} \times 0,6 \times 1 \times 2 \times \frac{96}{60} \checkmark \\ &= 0,145 \times 0,95 \\ &= 0,138 \text{ m}^3/\text{s} \checkmark \end{aligned}$$

$$\begin{aligned} Hfs &= \frac{4 \times f \times l}{2 \times g \times d} \left[\frac{D^2}{d^2} \times w \times r \right]^2 \\ &= \frac{4 \times 0,0075 \times 40}{2 \times 9,81 \times 0,15} \left[\frac{0,31^2}{0,15^2} \times \frac{2 \times \pi \times 96}{60} \times \frac{0,6}{2} \right]^2 \checkmark \\ &= 67,657 \text{ m} \checkmark \end{aligned}$$

$$\begin{aligned} P_1 &= \rho g Q \frac{2}{3} Hfs \\ &= 1\,000 \times 9,81 \times 0,138 \times \frac{2}{3} \times 67,657 \checkmark \\ &= 61,062 \text{ kW} \checkmark \end{aligned}$$

$$\begin{aligned}
 4.2.2 \quad Hfs &= \frac{4 \times f \times l}{2 \times g \times d} \left[\frac{D^2}{d^2} \times \frac{w}{\pi} \times r \right]^2 \\
 &= \frac{4 \times 0,0075 \times 40}{2 \times 9,81 \times 0,15} \left[\frac{0,31^2}{0,15^2} \times \frac{2 \times \pi \times 96}{60 \times \pi} \times \frac{0,6}{2} \right]^2 \checkmark \\
 &= 6,855 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 P_2 &= \rho g Q Hfs \\
 &= 1\,000 \times 9,81 \times 0,138 \times 6,855 \checkmark \\
 &= 9,280 \text{ kW} \checkmark
 \end{aligned} \tag{4}$$

$$\begin{aligned}
 4.2.3 \quad P_{\text{saved}} &= P_1 - P_2 \\
 &= 61,062 - 9,280 \checkmark \\
 &= 51,782 \text{ kW} \checkmark
 \end{aligned} \tag{2}$$

$$4.3 \quad 4.3.1 \quad \text{Begin} = Ha_t - hs + Ha_s \checkmark$$

$$4.3.2 \quad \text{Middel} = Ha_t - hs + Hf_s \checkmark$$

$$4.3.3 \quad \text{Einde} = Ha_t + h_d - Ha_d \checkmark$$

$$(3 \times 1) \tag{3}$$

$$\begin{aligned}
 4.4 \quad \tan 36 &= \frac{V_{fo}}{x} \\
 \tan 36 &= \frac{1,5}{x} \\
 x &= 2,065 \text{ m/s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 U_o &= V_{wo} + x \\
 9,2 &= V_{wo} + 2,065 \checkmark \\
 V_{wo} &= 7,135 \text{ m/s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 T &= F \times R \\
 180 &= F \times \frac{1,2}{2} \\
 F &= 300 \text{ N} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 F &= \rho Q V_{wo} \\
 300 &= 1\,000 \times Q \times 7,135 \checkmark
 \end{aligned}$$

$$Q = 42,046 \text{ l/s} \checkmark \tag{6}$$

[22]

VRAAG 5

5.1 $a = l^2 \checkmark$

$$S = 4l \times 50$$

$$= 200 l \checkmark$$

$$Q = av$$

$$9 = l^2 \times v$$

$$v = \frac{9}{l^2} \checkmark$$

$$P = \frac{KSV^2}{a}$$

$$250 = \frac{0,00452 \times 200l \times \left(\frac{9}{l^2}\right)^2}{l^2} \checkmark$$

$$250 = \frac{73,224l}{l^6}$$

$$l^5 = 0,293$$

$$l = 0,732 m \checkmark$$

$$a = 0,782^2$$

$$= 0,611 m^2 \checkmark$$

(6)

- 5.2
- Instandhoudingskoste is gewoonlik hoër. ✓
 - Hulle is raseriger as sentrifugale waaiers. ✓

(2)

[8]

VRAAG 6

6.1 $Vi = 0,154 \sqrt{2 \times 9,81 \times h}$

$$= 0,154 \sqrt{2 \times 9,81 \times (16 \times 0,95)} \checkmark$$

$$= 2,659 m/s \checkmark$$

$$\eta = \frac{E}{H}$$

$$0,86 = \frac{E}{16}$$

$$E = 13,76 m \checkmark$$

$$E = \frac{Ui^2}{g}$$

$$13,76 = \frac{Ui^2}{9,81}$$

$$Ui = 11,618 m/s \checkmark$$

$$\begin{aligned}\tan\theta_i &= \frac{V_i}{U_i} \\ &= \frac{2,659}{11,618} \checkmark \\ \theta_i &= 12,891^\circ \checkmark\end{aligned}\quad (6)$$

6.2

$$\begin{aligned}U_o &= \frac{1}{2} U_i \\ &= 0,5 \times 11,618 \\ &= 5,809 \text{ m/s} \checkmark\end{aligned}$$

$$\begin{aligned}\tan\beta_o &= \frac{V_o}{U_o} \\ &= \frac{2,659}{5,809} \checkmark \\ \beta_o &= 24,595^\circ \checkmark\end{aligned}\quad (3)$$

6.3

$$\begin{aligned}U_i &= \frac{\pi D N}{60} \\ 11,618 &= \pi \times D \times 6 \checkmark \\ D &= 616,354 \text{ mm} \checkmark\end{aligned}$$

$$\begin{aligned}D &= 2d \\ 0,616 &= 2 \times d \\ d &= 308 \text{ mm} \checkmark\end{aligned}$$

(3)
[12]

VRAAG 7

7.1 Geforseerde werwelvloei ✓
Voorbeeld: gooi water in 'n glas, ✓ menger, waterdrein

Vry werwelvloei ✓
Voorbeeld: water wat uit opwasbak vloei, ✓ vloei in 'n maalkolk

Gemengde vloei
Voorbeeld: turbomasjiene, hidrouliese strukture

(Enige 2 × 2) (4)

7.2

$$\begin{aligned}h &= \frac{\omega^2 R^2}{2g} \checkmark \\ &= \frac{5^2 \times 0,6^2}{2 \times 9,81} \checkmark \checkmark \\ &= 0,459 \text{ m} \checkmark\end{aligned}$$

(4)
[8]

VRAAG 8

$$\begin{aligned}
 8.1 \quad V &= Cv\sqrt{2gh} \\
 &= 1 \times \sqrt{2 \times 9,81 \times (300 \times 0,88)} \checkmark \\
 &= 71,970 \text{ m/s} \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 8.2 \quad U &= 0,45V \\
 &= 0,45 \times 71,970 \\
 &= 32,387 \text{ m/s} \checkmark \\
 U &= \frac{\pi DN}{60} \\
 32,387 &= \frac{\pi \times D \times 500}{60} \checkmark \\
 D &= 1,237 \text{ m} \checkmark
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 8.3 \quad \eta &= \frac{P_{uit}}{P_{in}} \\
 0,85 &= \frac{5\,000}{P_{in}} \\
 P_{in} &= 5882,353 \text{ kW} \checkmark \\
 P_{in} &= \rho g Q h \\
 5882,352 \times 10^3 &= 1\,000 \times 9,81 \times Q \times 264 \checkmark \\
 Q &= 2,271 \text{ m}^3/\text{s} \checkmark \\
 Q &= a_j \times V \\
 \frac{2,271}{3} &= \frac{\pi \times dj^2}{4} \times 71,970 \checkmark \\
 dj &= 115,725 \text{ mm} \checkmark
 \end{aligned}
 \tag{5}$$

$$\begin{aligned}
 8.4 \quad hf &= \frac{f l Q^2}{3 d^5} \\
 (300 - 264) &= \frac{0,006 \times 600 \times 2,271^2}{3 \times d^5} \checkmark \\
 d &= 703,174 \text{ mm} \checkmark
 \end{aligned}
 \tag{2}$$

[12]

TOTAAL: 100