



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

FLUÏEDMEGANIKA N6

7 April 2025

Hierdie nasienriglyn bestaan uit 9 bladsye.

VRAAG 1

$$1.1 \quad 1.1.1 \quad (3d)^2 V_1 = d^2 V_2$$

$$V_2 = 9V_1 \checkmark$$

$$\frac{\Delta P}{\rho g} = \frac{V_2^2}{2g} - \frac{V_1^2}{2g} + hL$$

$$\frac{70}{9,81} = \frac{(9V_1)^2}{2 \times 9,81} - \frac{(V_1)^2}{2 \times 9,81} + 0,5 \frac{(9V_1)^2}{(2 \times 9,81)} \checkmark$$

$$7,136 = 6,141 V_1^2$$

$$V_1 = 1,078 \text{ m/s} \checkmark$$

$$V_2 = 9,702 \text{ m/s} \checkmark$$

Alternatief

$$V_1 = 0,111V_2 \checkmark$$

$$\frac{70}{9,81} = \frac{(V_2)^2}{2 \times 9,81} - \frac{(0,111V_2)^2}{2 \times 9,81} + 0,5 \frac{(V_2)^2}{(2 \times 9,81)} \checkmark$$

$$7,136 = 0,0759 V_2^2$$

$$V_2 = 9,696 \text{ m/s} \checkmark$$

$$V_1 = 1,0773 \text{ m/s} \checkmark$$

(4)

$$1.1.2 \quad Q = A_1 V_1$$

$$\frac{150}{3600} = \frac{\pi \times D^2}{4} \times 1,0773 \checkmark$$

$$D = 0,222 \text{ m} \checkmark$$

$$d = \frac{D}{3}$$

$$= \frac{0,222}{3}$$

$$= 0,074 \text{ m} \checkmark$$

(3)

$$1.1.3 \quad \frac{\Delta P}{800 \times 9,81} = 0,0759 V_2^2 \checkmark$$

$$\Delta P = 55,999 \text{ kPa} \checkmark$$

(2)

1.2 Oorweeg pyp 1 en pyp 3

$$V_1 \times A_1 = V_3 \times A_3$$

$$d^2 V_1 = 2,5d^2 \times 3,5 \checkmark$$

$$V_1 = 21,875 \text{ m/s} \checkmark$$

Oorweeg pyp 2 en pyp 3

$$1,5d^2 V_2 = 2,5d^2 \times 3,5 \checkmark$$

$$V_2 = 9,722 \text{ m/s} \checkmark$$

(4)

1.3

$$\begin{aligned} M &= \frac{d}{4} \\ &= \frac{0,15}{4} \\ &= 0,0375 \text{ m} \checkmark \end{aligned}$$

$$\begin{aligned} A &= \frac{\pi d^2}{4} \\ &= \frac{\pi \times 0,15^2}{4} \\ &= 0,0177 \text{ m}^2 \checkmark \end{aligned}$$

$$Q = AC\sqrt{mi}$$

$$\frac{48}{1000} = 0,0177 \times 60 \times \sqrt{0,0375 \times i} \checkmark$$

$$i = 0,0545 \checkmark$$

$$i = \frac{hf}{L}$$

$$\begin{aligned} 0,0545 &= \frac{hf}{500} \\ hf &= 27,25 \text{ m} \checkmark \end{aligned}$$

(5)
[18]

VRAAG 2

2.1

$$\begin{aligned} A &= \frac{d}{\tan 60} \times d \\ &= \frac{2}{\tan 60} \times 2 \checkmark \\ &= 2,309 \text{ m}^2 \checkmark \end{aligned}$$

$$\begin{aligned} p &= 2 \times \frac{d}{\cos 60} \\ &= 2 \times \frac{2}{\cos 60} \checkmark \\ &= 8 \text{ m} \checkmark \end{aligned}$$

$$m = \frac{A}{p}$$

$$\begin{aligned} m &= \frac{2,309}{8} \checkmark \\ &= 0,289 \text{ m} \checkmark \end{aligned}$$

$$\begin{aligned} C &= \frac{87}{1 + \frac{k}{\sqrt{m}}} \\ &= \frac{87}{1 + \frac{0,350}{\sqrt{0,289}}} \\ &= 52,694 \checkmark \end{aligned}$$

$$Q = AC\sqrt{mi}$$

$$\begin{aligned} \frac{360}{60} &= 2,309 \times 52,694 \times \sqrt{0,289 \times i} \checkmark \\ i &= 0,00841 \checkmark \\ &= 1:118,906 \checkmark \end{aligned}$$

(10)

2.2

Dit is die verhouding van die deursnee-oppervlakte van die vloeistofvloeitot die benatte ('wetted') omtrek van die kanaal of pyp en dit word gemeet in meter (m).✓✓

(2)

2.3

2.3.1

$$\begin{aligned} Va &= \sqrt{\frac{gx^2}{2y}} \\ &= \sqrt{\frac{9,81 \times 2,1^2}{2 \times 1,1}} \checkmark \\ &= 4,434 \text{ m/s} \checkmark \end{aligned}$$

2.3.2

$$\begin{aligned}
 t &= \sqrt{\frac{2y}{g}} \\
 &= \sqrt{\frac{2 \times 1,1}{9,81}} \checkmark \\
 &= 0,474 \text{ sek} \checkmark
 \end{aligned}
 \tag{2}$$

2.3.3

$$\begin{aligned}
 C_c &= \frac{d_a^2}{d_t^2} \\
 0,66 &= \frac{d_a^2}{0,06^2} \\
 &= 0,0487 \text{ m} \checkmark \\
 Q &= A \times V \\
 &= \frac{\pi \times 0,0487^2}{4} \times 4,434 \checkmark \\
 &= 0,00826 \\
 &= 29\,733,497 \text{ l/uur} \checkmark
 \end{aligned}
 \tag{3}$$

2.3.4

$$\begin{aligned}
 C_v &= \frac{V_a}{V_t} \\
 0,92 &= \frac{4,434}{V_t} \\
 V_t &= 4,820 \text{ m/s} \checkmark \\
 V_t &= \sqrt{2 \times 9,81 \times h} \\
 h &= 1,184 \text{ m} \checkmark \\
 h_L &= h(1 - C_v^2) \\
 &= 1,184(1 - 0,92^2) \\
 &= 0,182 \text{ m} \checkmark
 \end{aligned}
 \tag{3}$$

[21]

VRAAG 3

3.1 Waterslag word veroorsaak deur die kolom water in die toevoerpyp wat tydens die suighoogte na die silinder terugval. ✓✓ (2)

3.2

3.2.1

$$\begin{aligned}
 Q &= ALSE \frac{N}{60} \\
 &= \frac{\pi \times 0,12^2}{4} \times 0,45 \times 3 \times \frac{45}{60} \checkmark \\
 &= 0,0115 \times 0,95 \\
 &= 0,0109 \text{ m}^3/\text{s} \checkmark \\
 &= 10,879 \text{ l/s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 3.2.2 \quad H_{ad} &= \frac{l \times D^2}{g \times d^2} \times w^2 \times r \\
 &= \frac{30 \times 0,12^2}{9,81 \times 0,05^2} \times \left(\frac{2 \times \pi \times 45}{60} \right)^2 \times \frac{0,45}{2} \checkmark \\
 &= 88,0115 \text{ m} \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 3.2.3 \quad H_{fd} &= \frac{4 \times f \times l}{2 \times g \times d} \left[\frac{D^2}{d^2} \times w \times r \right]^2 \\
 &= \frac{4 \times 0,02 \times 30}{2 \times 9,81 \times 0,05} \left[\frac{0,12^2}{0,05^2} \times \frac{2 \times \pi \times 45}{60} \times \frac{0,45}{2} \right]^2 \checkmark \\
 &= 91,250 \text{ m} \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 3.2.4 \quad \text{Begin} &= H_{at} + H_d + H_{ad} \checkmark \\
 &= 10 + 28 + 88,0115 \checkmark \\
 &= 126,0115 \text{ m} \checkmark
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 3.2.5 \quad \text{Middel} &= H_{at} + h_d + H_{fd} \checkmark \\
 &= 10 + 28 + 91,250 \checkmark \\
 &= 129,25 \text{ m} \checkmark
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 3.2.6 \quad \text{Einde} &= H_{at} + h_d - H_{ad} \checkmark \\
 &= 10 + 28 - 88,0115 \checkmark \\
 &= 50,0115 \text{ m} \checkmark
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 3.3 \quad Q &= \frac{5,71 \times 10^6}{12 \times 3600 \times 1000} \\
 &= 0,132 \text{ m}^3/\text{s} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 hf &= \frac{f l Q^2}{3 d^5} \\
 &= \frac{0,0075 \times 20 \times 10^3 \times 0,132^2}{3 \times 0,4^5}
 \end{aligned}$$

$$\begin{aligned}
 &= 85\,078 \text{ m} \checkmark \\
 P &= \frac{\rho \times g \times hf \times Q}{0,75} \\
 &= \frac{1000 \times 9,81 \times 0,132 \times 85,078}{0,75} \checkmark \\
 &= 146,892 \text{ kW} \checkmark
 \end{aligned} \tag{4}$$

$$3.4 \quad \left(\frac{N_1}{N_2}\right)^2 = \frac{w \cdot g_1}{w \cdot g_2}$$

$$\frac{550^2}{N_2^2} = \frac{50}{60} \checkmark$$

$$N_2 = 602,495 \text{ r/min} \checkmark$$

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$$

$$\frac{600}{Q_2} = \frac{550}{602,495} \checkmark$$

$$Q = 657,267 \text{ m}^3/\text{min} \checkmark \text{ (die waaier kan gebruik word)} \checkmark \quad (5)$$

$$3.4 \quad P_i = \frac{Q \times w g \times g \times \rho_{air}}{\eta}$$

$$= \frac{\frac{900}{60} \times 45.6 \times 9,81 \times 1}{0,7} \checkmark \checkmark$$

$$= 9,586 \text{ kW} \checkmark$$

(3)
[30]

VRAAG 4

$$4.1 \quad 4.1.1 \quad V_A = \sqrt{2 \times g \times h}$$

$$= \sqrt{2 \times 9,81 \times 31} \checkmark$$

$$= 24,662 \text{ m/s} \checkmark$$

(2)

$$4.1.2 \quad U_i = \frac{\pi D N}{60}$$

$$= \frac{\pi \times 2,1 \times 150}{60} \checkmark$$

$$= 19,492 \text{ m/s} \checkmark$$

(2)

$$4.1.3 \quad E = \frac{U_i \times (V_{wi} - V_{wo})}{g}$$

$$= \frac{16,493 \times (18 \times 8)}{9,81} \checkmark$$

$$= 16,812 \text{ mm} \checkmark$$

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

$$= \frac{16,812}{31}$$

$$= 54,2\% \checkmark$$

$$4.1.4 \quad \sin 30 = \frac{V_i}{24,331}$$

$$V_i = 12,33 \text{ m/s} \checkmark$$

$$V_{wi} = U_i + x$$

$$18 = 16,812 + x$$

$$x = 1,188 \text{ m} \checkmark$$

$$\tan \beta_i = \frac{V_i}{x}$$

$$= \frac{12,331}{1,188} \checkmark$$

$$\beta_o = 84,498^\circ \checkmark$$

(4)

$$4.2 \quad 4.2.1 \quad P = \rho gh$$

$$900 \times 10^3 = 1000 \times 9,81 \times h$$

$$h = 91,743 \text{ m}$$

$$V = Cv\sqrt{2gh}$$

$$= 0,95 \times \sqrt{2 \times 9,81 \times 91,743} \checkmark$$

$$= 40,305 \text{ m/s} \checkmark$$

$$U = 0,5V$$

$$= 0,5 \times 40,305$$

$$= 20,153 \text{ m/s} \checkmark$$

$$U = \frac{\pi DN}{60}$$

$$20,153 = \frac{\pi \times 1,9 \times N}{60}$$

$$N = 202,576 \text{ r/min} \checkmark$$

(4)

$$4.2.2 \quad Q = AV$$

$$= \frac{\pi \times 0,1^2}{4} \times 40,305$$

$$= 0,317 \times 2$$

$$= 0,633 \text{ m}^3/\text{s} \checkmark$$

$$P = \rho QU(V - U)[1 + n \cos(180 - \gamma)]$$

$$= 1\,000 \times 0,633 \times 20,153 (40,305 - 20,153)[1 + 0,92 \cos(180 - 160)] \checkmark$$

$$= 479,323 \text{ kW} \checkmark$$

(3)

$$4.2.3 \quad \eta = \frac{U}{gh} (V - U)(1 + n \cos \theta) \times 100\%$$

$$= \frac{20,153}{9,81 \times 91,43} (40,305 - 20,153)(1 + 0,92 \cos 20) \times 100\% \checkmark$$

$$= 84,4\% \checkmark$$

(2)

$$4.2.4 \quad \eta = \frac{P_{out}}{P_{in}}$$

$$0,844 = \frac{479,323 \times 10^3}{P_{in}} \checkmark$$

$$P_{in} = 567,918 \text{ kW} \checkmark \quad (2)$$

4.3 Dit is die draaiende ('whirling') massa vloeistof, veral 'n vloeistof met 'n draaiende of sirkelbeweging wat geneig is om 'n holte of vakuum in die middel van 'n sirkel te vorm. $\checkmark \checkmark$ (1 x 2) (2)

- 4.4
- Gedwonge werwelvloei
 - Vrye werwelvloei
 - Gemengde werwelvloei
- (3)

4.5

$$y = \frac{w^2 \times x^2}{2g} \checkmark$$

$$0,3 = \frac{w^2 \times 0,2^2}{2 \times 9,81} \checkmark$$

$$w = 12,131 \text{ rad/s} \checkmark \quad (3)$$

[30]

TOTAAL: 100