higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

FLUID MECHANICS N6

9 April 2020

This marking guideline consists of 6 pages.

QUESTION 1

1.1 F
1.2 H
1.3 P
1.4 Q
1.5 O
1.6 B
1.7 M
1.8 L
1.9 N
1.10 J
1.11 D
1.12 A
1.13 C
1.14 G
1.15 I
1.16 K
1.17 E

(17 × 1) **[17]**

QUESTION 2

2.1

$Q = \frac{4,35}{60}$

$= 0,0725\ m^3/s$✓

$m = \frac{d}{4}$

$= \frac{0,35}{4}$✓

$= 0,0875\ m$✓

$C = \sqrt{\frac{2g}{f}}$

$= \sqrt{\frac{2\ x\ 9,81}{0,02}}$✓

$= 31,321$✓

$Q = AC\sqrt{mi}$

$0,0725 = \frac{\pi}{4}(0,35)^2 \times 31,321 \times \sqrt{0,0875\ x\ i}$✓

$i = 0,00661$✓

$h_f = 0,00661 \times 3\ 000$✓

$= 19,846\ m$✓ (9)

2.2 2.2.1 $A = [½\pi(3,42)^2] + [6,84(0,1)]$✓ **OR** $A = ½ \times \frac{\pi}{4}(6,84)^2 + [6,84(0,1)]$✓

$= 19,057\ m^2$✓ $= 19,057\ m^2$✓

2.2.2 $P = [½ \times 2\pi(3,42)] + [2(0,1)]$✓ **OR** $P = [½\pi(6,84)] + [2(0,1)]$✓

$= 10,944\ m$✓ $= 10,944\ m$✓

2.2.3 $m = \frac{19,057}{10,944}$✓

$= 1,741\ m$✓

2.2.4 $Q = AC\sqrt{mi}$

$= 19{,}057 \times 75 \times \sqrt{1{,}741\ x\ \frac{1}{7800}}$ ✓

$= 21{,}355\ m^3/s$

$= 21\ 354{,}592\ \ell/s$ ✓

(4 × 2) (8)

2.3 2.3.1 $V_A = \sqrt{\frac{gx^2}{2y}}$ $A_A = C_C \times A_{th}$ $Q_A = V_A \times A_A$

$= \sqrt{\frac{9{,}81\ x\ 3^2}{2\ x\ 1{,}5}}$ ✓ $= 0{,}75 \times 600$ ✓ $= 5{,}425 \times 450 \times 10^{-6}$ ✓

$= 5{,}425\ m/s$ ✓ $= 450\ mm^2$ ✓ $= 0{,}00244\ m^3/s$ ✓ (6)

2.3.2 $F_{reaction} = \rho Q V_A$

$= 10^3 \times 0{,}00244 \times 5{,}425$ ✓

$= 13{,}244\ N$ ✓ (2)

2.3.3 $V_{th} = \sqrt{2gh}$ $h_L = h\ (1 - C_v^2)$

$\frac{V_A}{C_v} = \sqrt{2gh}$ $= 1{,}852(1 - 0{,}9^2)$ ✓

$\frac{5{,}425}{0{,}9} = \sqrt{2\ x\ 9{,}81\ x\ h}$ ✓ $= 0{,}352\ m$ ✓

$h = 1{,}852\ m$ ✓ (4)

2.4 2.4.1 $a = \frac{\pi}{4}d^2$

$= 0{,}785d^2$ ✓ (1)

2.4.2 $v = \frac{Q}{a}$

$= \frac{7}{0{,}785\ d^2}$ ✓

$= \frac{8{,}913}{d^2}$ ✓ (2)

2.4.3 $S = \pi dL$

$= \pi \times 52 \times d$ ✓

$= 163{,}363\ d$ ✓ (2)

2.4.4 $P_r = \frac{k\ S\ v^2}{a}$

$200 = \frac{0{,}003\ x\ 163{,}363\ d\ x\ \left(\frac{8{,}913}{d^2}\right)^2}{0{,}785\ d^2}$ ✓

$320{,}513 = \frac{79{,}436}{d^5}$ ✓

$d = 756{,}544\ mm$ ✓ (3)

[37]

QUESTION 3

3.1 3.1.1 $Q = A\,L\,S\,E\,\frac{N}{60}$

$= \frac{\pi}{4}0{,}2^2 \times 0{,}6 \times 1 \times 3 \times \frac{55}{60}$✓

$= 0{,}0518\ m^3/s$✓

$= 51{,}836\ l/s$✓ (3)

3.1.2 $P = \frac{\rho g Q H}{\eta}$

$= \frac{10^3 x\ 9{,}81\ x\ 0{,}0518\ x\ 700}{0{,}82}$✓✓

$= 434{,}097\ kW$✓ (3)

3.2
- Reduced capacity or pressure and failure to deliver water
- Loses water after starting
- Pump overloads driver
- Pump vibrates
- Water hammer
- Slip
- Cavitation (Any 5 × 1) (5)

3.3 3.3.1 $H_a = \frac{l}{g}\left(\frac{D}{d}\right)^2 \times \omega^2 R$

$= \frac{1{,}6}{9{,}81}\left(\frac{0{,}255}{0{,}18}\right)^2 \times \left(\frac{2\pi x\,50}{60}\right)^2 \times 0{,}2275$✓✓

$= 0{,}567\ m$✓ (3)

3.3.2 $hf = \frac{4fl}{2gd} \times \left(\frac{D^2}{d^2}\ x\ \frac{2\pi N}{\pi x 60}\ R\right)^2$

$= \frac{4\ x\ 0{,}005\ x\ (8-1{,}6)}{2\ x\ 9{,}81\ x\ 0{,}18}$✓ $\times \left(\frac{0{,}255^2}{0{,}18^2}\ x\ \frac{2\ x\ 50}{60}\ x\ \frac{0{,}455}{2}\right)^2$✓

$= 0{,}00525\ m$✓✓

OR

$Q = Va$

$ALSE\frac{N}{60} = Va$

$\frac{\pi\ x\ (0{,}255)^2}{4} \times 0{,}2275 \times 1 \times 1 \times \frac{50}{60} = V \times \frac{\pi\ x\ (0{,}18)^2}{4}$✓

$V = 0{,}38\ m/s$✓

$hf = \frac{4flv^2}{2gd}$

$= \frac{4\ x\ 0{,}005\ x\ (8-1{,}6)\ x\ (0{,}38)^2}{2\ x\ 9{,}81\ x\ 0{,}18}$✓

$= 0{,}00525\ m$✓ (4)

3.3.3 $H_a = \frac{l}{g}\left(\frac{D}{d}\right)^2 \times \omega^2 R$

$= \frac{8}{9,81}\left(\frac{0,255}{0,18}\right)^2 \times \left(\frac{2\pi x 50}{60}\right)^2 \times 0,2275$✓✓

$= 0,567$ m✓ (3)

3.3.4 $Q = Va$

$ALSE\frac{N}{60} = Va$

$\frac{\pi x (0,255)^2}{4} \times 0,2275 \times 1 \times 1 \times \frac{50}{60} = V \times \frac{\pi x (0,18)^2}{4}$✓

$v = 0,38$ m/s✓

$h_f = \frac{4flv^2}{2gd}$

$= \frac{4 x 0,005 x 8 x (0,38)^2}{2 x 9,81 x 0,18}$✓

$= 0,00656$ m✓ (4)

[25]

QUESTION 4

4.1 4.1.1 $V_1 = \frac{0,417 \ x \ 4}{\pi \ x \ d^2}$✓ $V_2 = \frac{0,417 \ x \ 4}{\pi \ x \ (1,2)^2}$ ✓

$= \frac{0,531}{d^2}$ m/s✓ $= 0,368$ m/s✓

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

$\frac{150}{9,81} + \frac{\left(\frac{0,531}{d^2}\right)^2}{2 x 9,81} + 2 - 24$✓ $= \frac{-10}{9,81} + \frac{0,368^2}{2 x 9,81} + 0$✓

$d_1 = 224$ mm✓ (8)

4.1.2 $P = \rho g Q H_e$✓

$= 1\,000 \times 9,81 \times 0,417 \times 24$✓

$= 98,1$ kW✓ (3)

4.2 4.2.1 $V_A = C_v\sqrt{2gh}$

$= 0,97\sqrt{2 \ x \ 9,81 \ x \ 350}$✓

$= 80,381$ m/s✓ (2)

4.2.2 $U = 0{,}5\ V$

$= 0{,}5(80{,}381)$✓

$= 40{,}191\ m/s$✓

$Q = VA$

$= 80{,}381 \times \frac{\pi}{4}0{,}15^2$ ✓

$= 1{,}420\ m^3/s$ ✓

$P = \rho QU(V - U)(1 + n\cos y)$

$= 10^3 \times 1{,}420 \times 40{,}191(80{,}381 - 40{,}191)\{1 + 0{,}9\cos(180° - 160°)\}$✓

$= 4{,}235\ MW$✓ (6)

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

$= \frac{40{,}191}{9{,}81\ x\ 350}(80{,}381 - 40{,}191)(1 + 0{,}9\cos(180° - 160°)) \times 100\%$✓

$= 86{,}832\%$✓ (2)

[21]

TOTAL: 100