higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N2

16 April 2021

This marking guideline consists of 7 pages.

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SECTION A

QUESTION 1

1.1 C
1.2 C
1.3 B
1.4 B
1.5 C

(5 × 1) **[5]**

QUESTION 2

2.1 False
2.2 False
2.3 True
2.4 True
2.5 True

(5 × 1) **[5]**

QUESTION 3

3.1 E
3.2 G
3.3 L
3.4 C
3.5 A
3.6 B
3.7 D
3.8 I
3.9 J
3.10 F

(10 × 1) **[10]**

TOTAL SECTION A: 20

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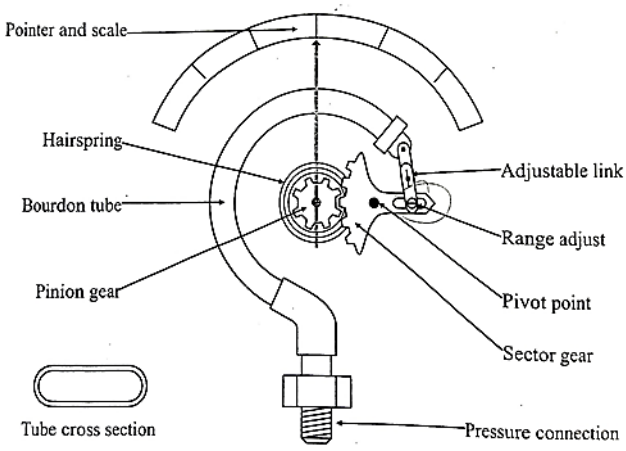
SECTION B

QUESTION 4: PRESSURE MEASUREMENT

4.1 Specific gravity is defined as the number of times the mass of any volume of a substance is greater (or smaller) than the mass of the same volume of water under identical conditions. (2)

4.2



(3 for correctness + 4 for any correct labelling) (7)

4.3
- Gauge pressure is measured relative to atmospheric pressure.
- Absolute pressure is measured with the zero point at the absolute zero pressure mark.
- Vacuum pressure is below atmospheric pressure.
- Differential pressure is the difference between two pressures. (Any 3 × 2) (6)

4.4 $A_{well} = l \times b = 5 \times 4 = 20\ m^2$

$A = \frac{\pi d^2}{4} = \frac{\pi(1\times10^{-3})^2}{4} = 0{,}785 \times 10^{-6}\ m^2$✓

$\Delta P = \rho g h \left[\frac{A_2}{A_1} + 1\right]$✓✓

$= 13\,600 \times 10 \times 10 \times 10^{-3} \left[\frac{0{,}785\times10^{-6}}{20} + 1\right]$✓

$= 1{,}36\ kPa$✓ (5)

[20]

QUESTION 5: TEMPERATURE MEASUREMENT

5.1 Null Balance

- Variable resister is calibrated with temperature scale. ✓
- If temperature change, re-balance the bridge and read the new temperature from the variable resister scale. ✓

Out of balance

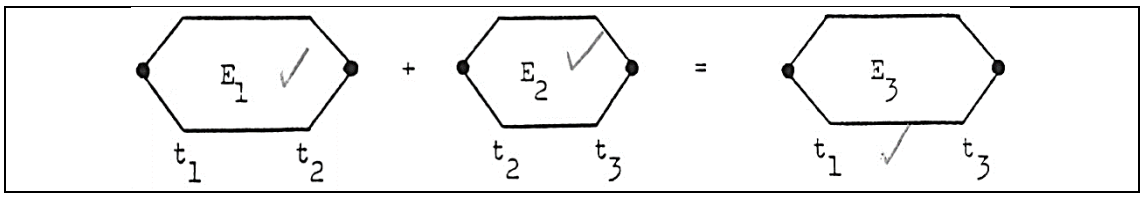
- Meter is calibrated with temperature scale. ✓
- If temperature change read new temperature off the meter scale. ✓ (4)

5.2 5.2.1 A – Capillary tube
B – Invar rod inside steel chamber
C – Steel chamber and mercury
D – Outer casing
E – Capillary tube (5 × 1) (5)

5.2.2 When there is a change in ambient temperature, there is a change in volume of the annular space✓ due to the expansion of the outer casing. This change is sufficient to compensate for the expansion✓ and will not exert any pressure on the bourdon tube.✓ (3)

5.2.3
- Double capillary link
- Bimetallic link (2)

5.3



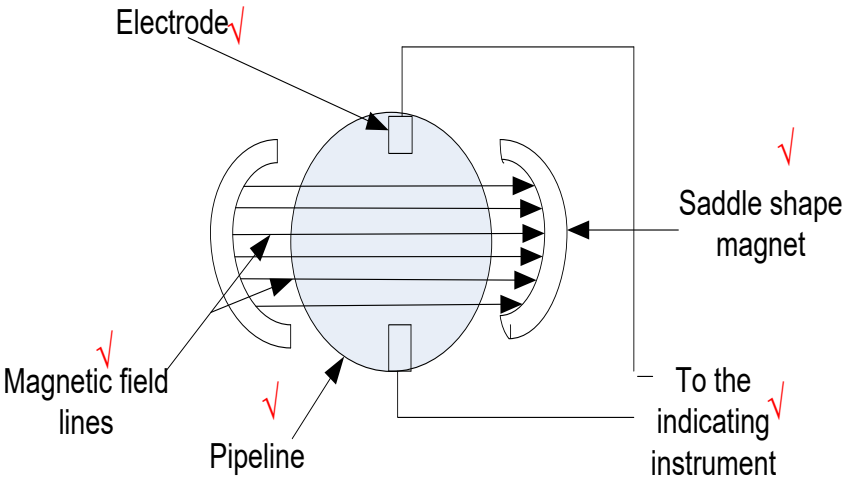
(3)

5.4 $R_T = R_0(1 + \propto T + \beta T^2)$✓
$R_T = 27{,}2[1 + 4 \times 10^{-3} \times 490 + 5{,}6 \times 10^{-7} \times (490)^2]$✓
$R_T = 84{,}16\ \Omega$✓ (3)

[20]

QUESTION 6: FLOW MEASUREMENT

6.1



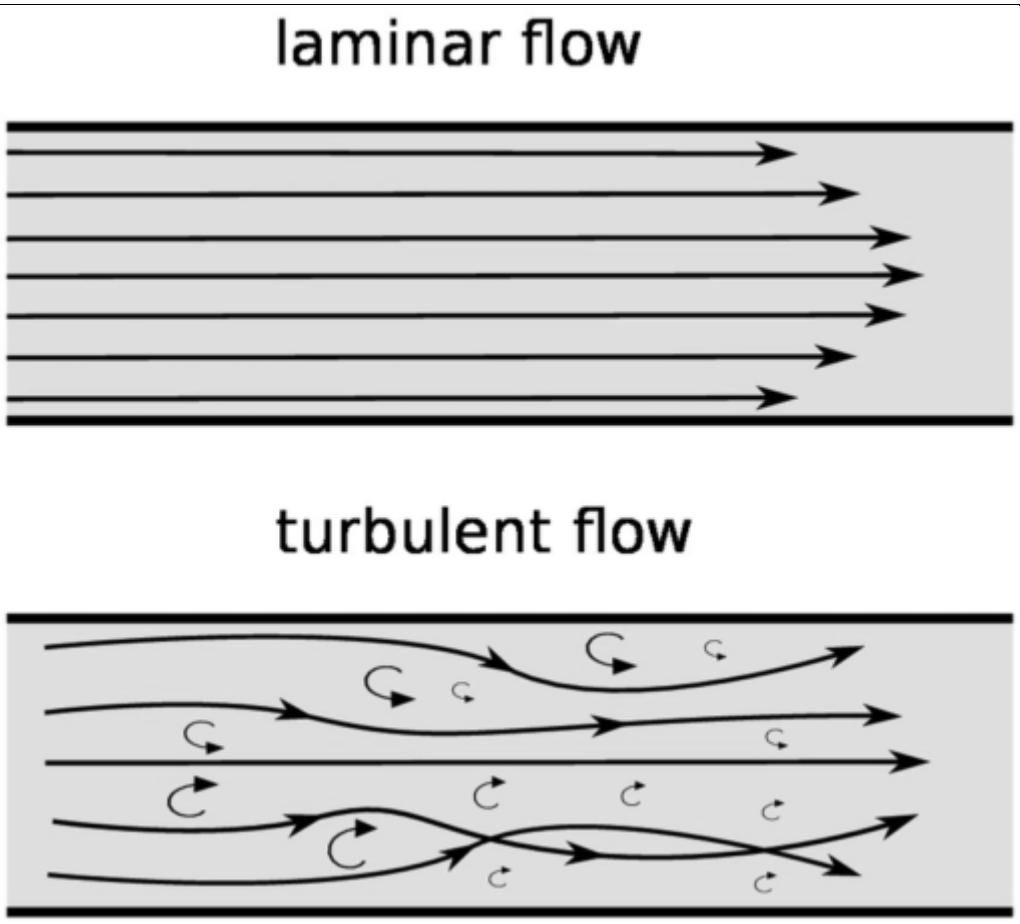
The magnetic flowmeter uses the principle of Faraday's law.✓ (6)

6.2 These measurement devices trap a known volume of fluid✓ and allow it to pass from the meter inlet to the outlet.✓ The number of trapped volumes passing through the meter is counted to obtain the total flow.✓ The counting operation is usually performed by an output shaft that drives a local display.✓

OR

Positive displacement-type flowmeters operate by passing the fluid to be measured through the meter in distinct (known) quantities by filling and emptying compartments of known volumetric capacities. The quantity of flow is then determined simply by totalising the number of times the instrument has measured that specific volume. (4)

6.3



(3 + 3) (6)

6.4 As the fluid approaches the impact hole of the pitot tube, its velocity decreases until it reaches zero at the point where it impinges it.✓ There is no flow through the tube✓ and the high pressure reading is noted at the point of zero velocity (impact hole).✓ A static pressure is taken upstream, a little way from the tube. The differential pressure across the tube is used to calculate the flow.✓ (4)

[20]

QUESTION 7: LEVEL MEASUREMENT

7.1 It works like a capacitor.✓ The tank wall and the electrode are similar to the plates of a capacitor.✓ The instrument converts the total capacitances into an electrical signal with a range of 4 mA to 20 mA.✓ The fuller the tank, the greater the measured capacitance will be. The electrical signal is used to calculate the level of the tank's content.✓ (4)

7.2 $H_L = H + h[1 - \frac{\rho_m}{\rho_L}]$

$H_L = 4 + 0{,}08[1 - \frac{14 \times 10^3}{0{,}7 \times 10^3}]$

$H_L = 2{,}48\ \text{m}$ (4)

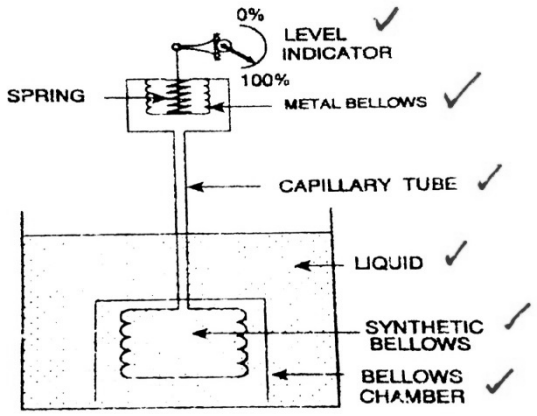
7.3 $\Delta P = \rho g h$

$85\ 000 = 3\ 000 \times 9{,}8 \times h$

$h = 2{,}891\ \text{m}$

$\therefore h_{total} = 2{,}891 + 0{,}04 = 2{,}931\ \text{m}$ (4)

7.4



(2 marks for correct sketch) (8)

[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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