



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE INDUSTRIAL INSTRUMENTS N5

1 December 2022

This marking guideline consists of 6 pages.

SECTION A

QUESTION 1

1.1	1.1.1	It is the irregular movement of fluid made up of smaller currents, swirling and moving in all directions.		
	1.1.2	Is the number of times the mass of any value of a substance is greater than the mass of the same value of water under the same temperature and pressure.		
	1.1.3	The measure of a fluid's internal, or intermolecular resistance.		
	1.1.4	When the number of hydrogen ions exceeds the number of hydroxyl ions.		
	1.1.5	It is a balanced condition in a system without a controller.	(5 × 2)	(10)
1.2	1.2.1	Turbulent flow		
	1.2.2	Proportional control		
	1.2.3	Hydrometer		
	1.2.4	Viscosity		
	1.2.5	Hygrometer	(5 × 2)	(10)
1.3	1.3.1	True		
	1.3.2	True		
	1.3.3	True		
	1.3.4	False		
	1.3.5	True	(5 × 1)	(5)
				[25]

TOTAL SECTION A: 25

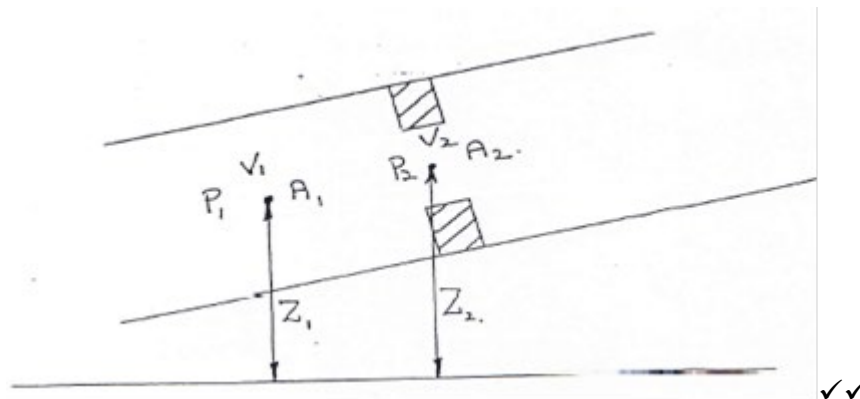
SECTION B

QUESTION 2: FLOW MEASUREMENTS

- 2.1
- V-notch weir
 - Rectangular weir
 - Trapezoidal/Cipoletti weir
 - Parabolic weir
 - Suppressed weir
 - Hyperbolic weir
 - Compound weir

(Any 3 × 1) (3)

2.2



- Potential energy: mgh ✓
- Kinetic energy: $\frac{1}{2}mv^2$ ✓
- Pressure energy: PV ✓
- Internal energy: I ✓

(6)

2.3

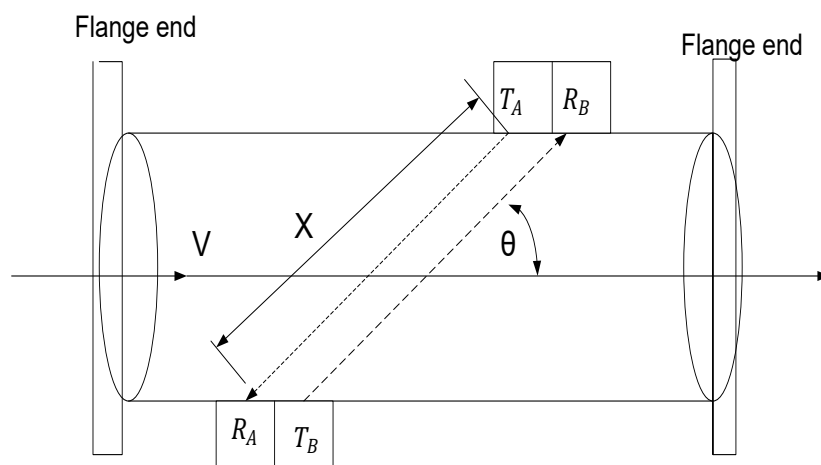
$$Q = \frac{2}{3}BC\sqrt{2gH^3}$$

$$= \frac{2}{3} \times 2 \times 0,76 \times \sqrt{2 \times 10 \times 0,75^3}$$

$$= 2,943 \text{ m}^3/\text{h}$$

(4)

2.4 2.4.1



(4)

2.4.2 Advantages

- No pressure loss
- Can be used with liquids, gasses and solids
- Bi-directional
- Very accurate
- Pipe diameter has no effect

(Any 2 × 1)

Disadvantages

- Expensive
- Limited range

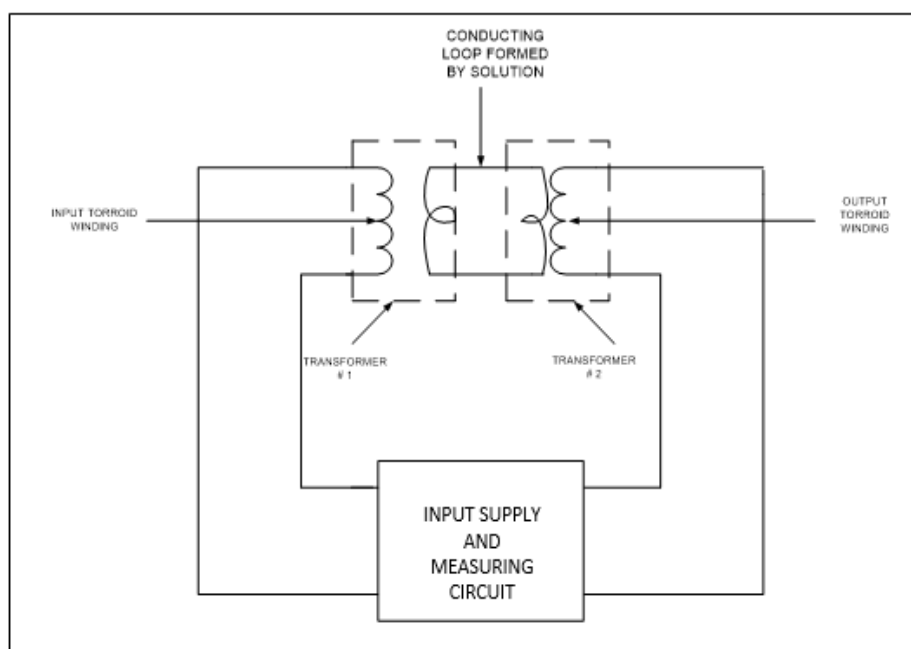
(4)
[21]

QUESTION 3: DENSITY, HUMIDITY AND VISCOSITY

- 3.1
- A fixed-volume vessel is used through which the measured liquid flows continuously.
 - This vessel is weighed automatically by a scale, spring balance, or pneumatic force-balance transmitter.
 - Since the weight of a definite volume of the liquid is known, the instrument can be calibrated to read directly in specific gravity or density units.
 - Either open or closed vessels with flexible connections can be used.
 - High-accuracy measurement results; this is especially useful for automatic density control.

(5)

3.2 3.2.1

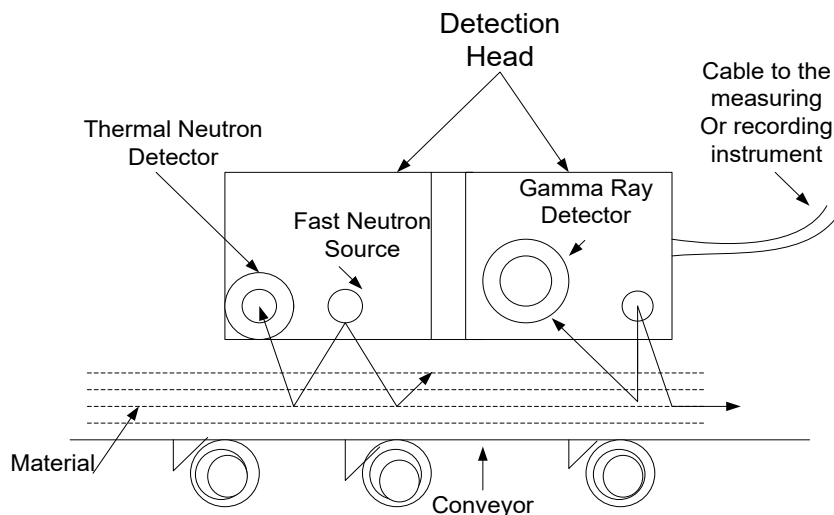


(7)

- 3.2.2
- Strong mineral acid and bases
 - Abrasive slurries
 - Material containing entangling fibres

(3)

3.3



(Each labelling count a mark)

(7)
[22]

QUESTION 4: pH MEASUREMENT

- 4.1 4.1.1 A – Removable cover
B – Cover clamp
C – Glass electrode
D – Reference electrode
E – Removable bowl
F – Drain tap

(6)

- 4.1.2 Flow type pH electrode assembly

(2)

4.2 $\text{pH} = -\log[\text{H}^+]$
 $= -\log (4,6 \times 10^{-8}) \checkmark$
 $= 7.337 \checkmark \checkmark$

The solution is basic, because the pH value is greater than seven. ✓

(4)
[12]

QUESTION 5: AUTO CONTROL

- 5.1 5.1.1 Proportional electronic controller

(1)

- 5.1.2
- Current signal ranging from 4 to 20 mA for control purpose
 - Voltage signal of ± 4 volts for feedback purposes

(2)

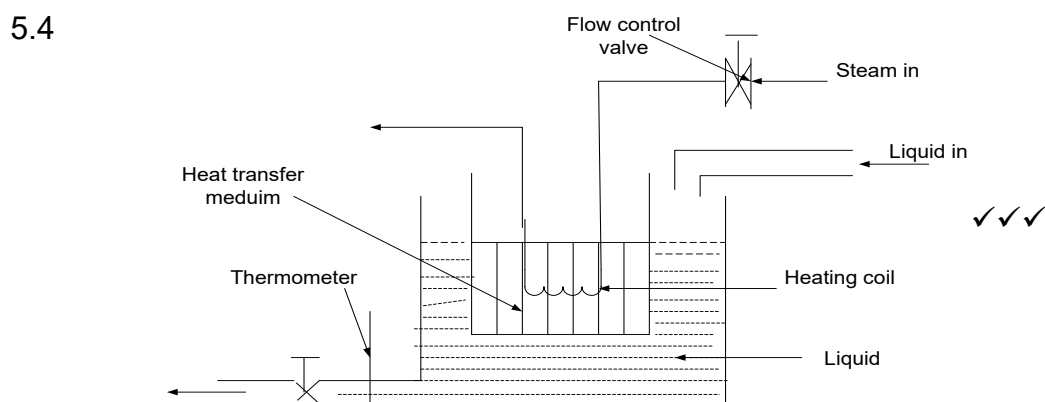
- 5.1.3 With no input signal, the feedback voltage is zero ✓ and the potential at point A, relative to ground, is zero ✓ There will be an output signal of the halfway value between 4 mA and 20 mA. ✓

(3)

5.1.4 The capacitor C_{in} is charged and a potential appears at point A,✓ forming an input signal to the amplifier.✓ A feedback voltage is generated to C_{fb} to counteract this✓ and the potential at A returns to zero.✓ (4)

5.2 That is the percentage of proportional band.✓ The smaller the band the more sensitive the output.✓ The bigger the band, the output becomes slower.✓ (3)

5.3 It is a combination of control units in which the process variable is measured and compared with the desired value or set-point.✓ If the measured value differs from the desired value, a corrective signal✓ is sent back to the final control element to bring the controller variable to the proper value.✓ (3)



Process lag is the time taken for the water to reach the temperature of steam✓

OR

The time taken for a process to rectify the deviation (4)
[20]

TOTAL SECTION B: 75
GRAND TOTAL: 100