



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL INSTRUMENTS N5

12 APRIL 2018

This marking guideline consists of 8 pages.

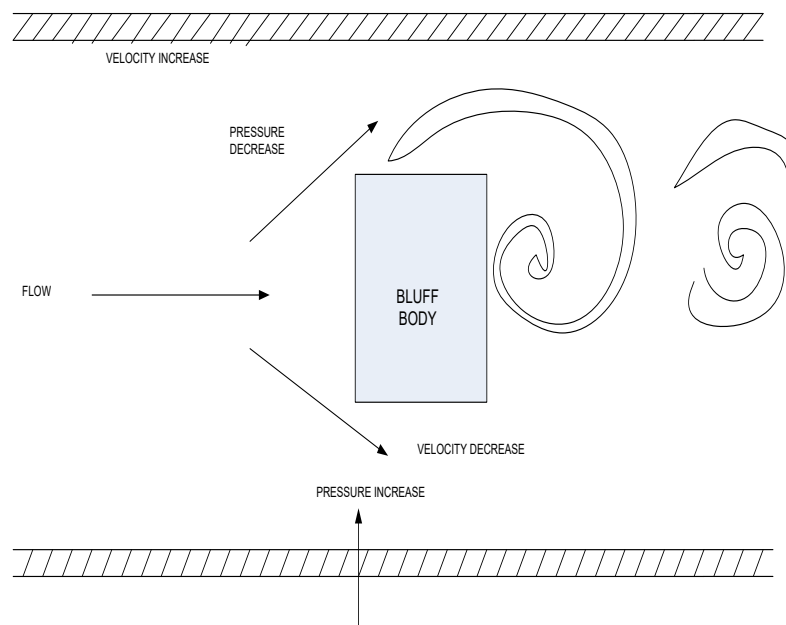
SECTION A: FLOW MEASUREMENTS**QUESTION 1**

- | | |
|-----|---|
| 1.1 | C |
| 1.2 | D |
| 1.3 | D |
| 1.4 | B |
| 1.5 | C |
| 1.6 | A |
| 1.7 | C |
| 1.8 | B |

(8 × 1) [8]

QUESTION 2

2.1 2.1.1



(6)

- 2.1.2
- Liquid suspension
 - Steam measurements
 - Natural gas measurement
 - Liquid chemicals

(Any 3 × 1) (3)

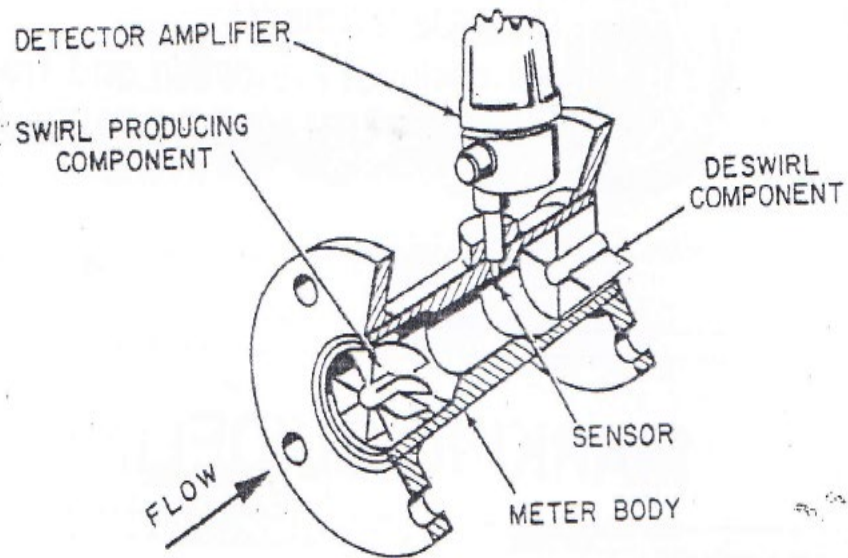
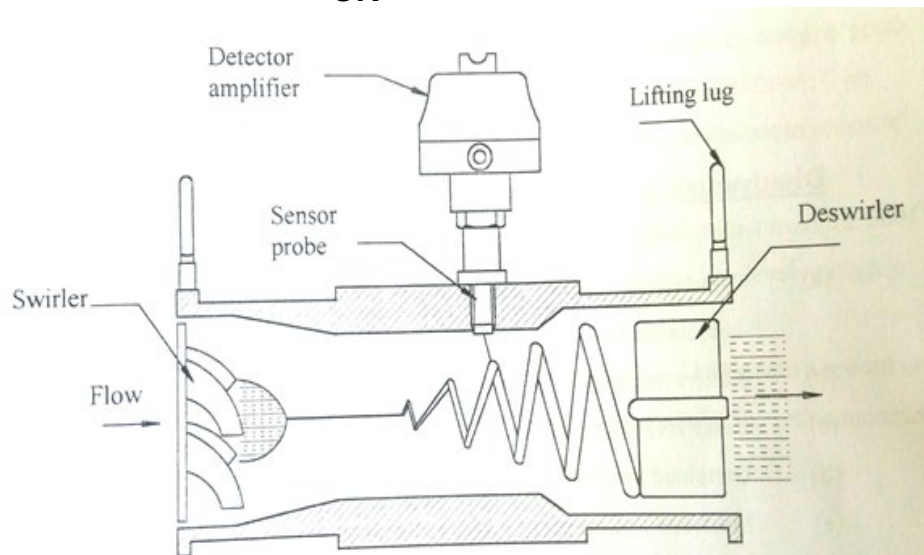
- 2.2 2.2.1
- A - Heater
B - Flow
C - Temperature sensor
D - Temperature sensor

(4)

- 2.2.2 Externally heated tube/External elements and heater

(2)

2.3 2.3.1

**OR**

(6)

2.3.2 Advantages

- No moving parts
- Low-pressure losses
- High accuracy

Disadvantages

- Expensive
- In-mounting requirement
- Not accurate in slurry application

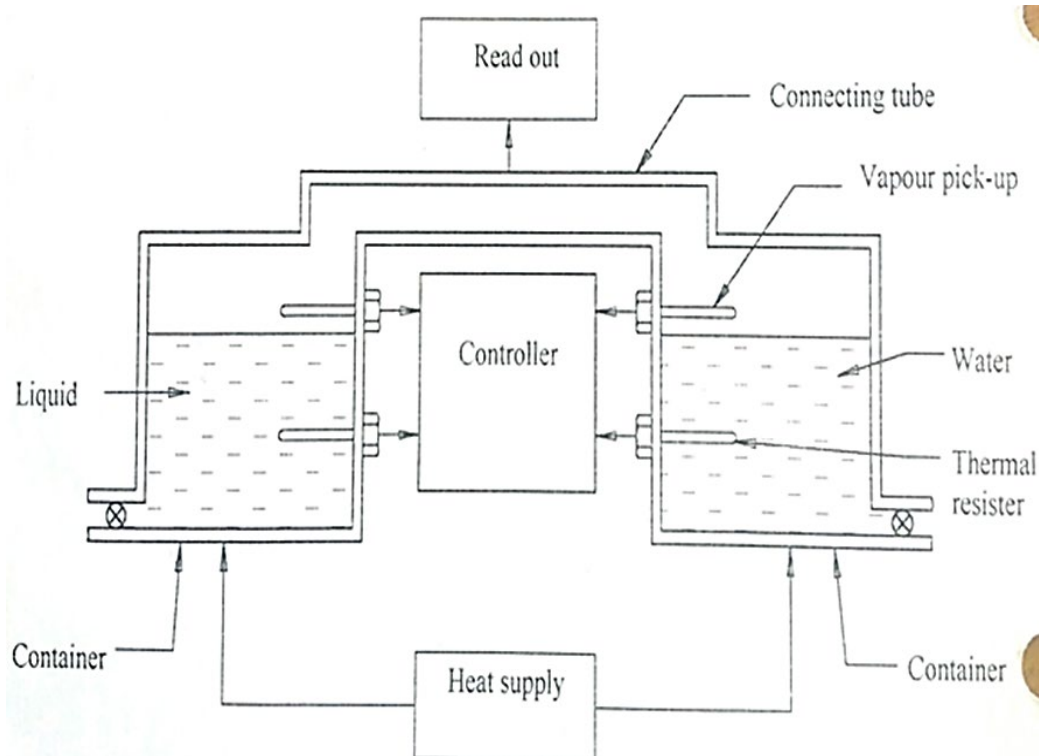
(3 + 3)

(6)

[27]

TOTAL SECTION A:**35****SECTION B: DENSITY, HUMIDITY AND VISCOSITY MEASUREMENT****QUESTION 3**

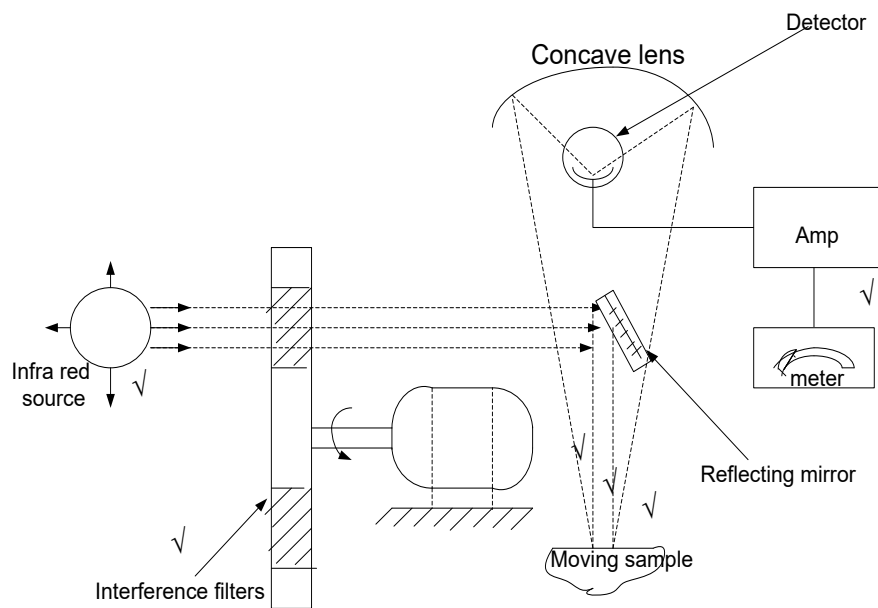
3.1



- Liquid and water must be boiled.✓
- When liquid and water starts to boil, vapour will be formed.✓
- This vapour will be picked up and sent to the controller to record the temperature measured with a thermal resistor.✓
- If the temperature of the liquid at boiling point differs from the boiling point of the water, the difference in temperature will be directly proportional to the density of the liquid.✓
- The pressure of both containers is kept constant with a connecting tube connecting the container.✓

(10)

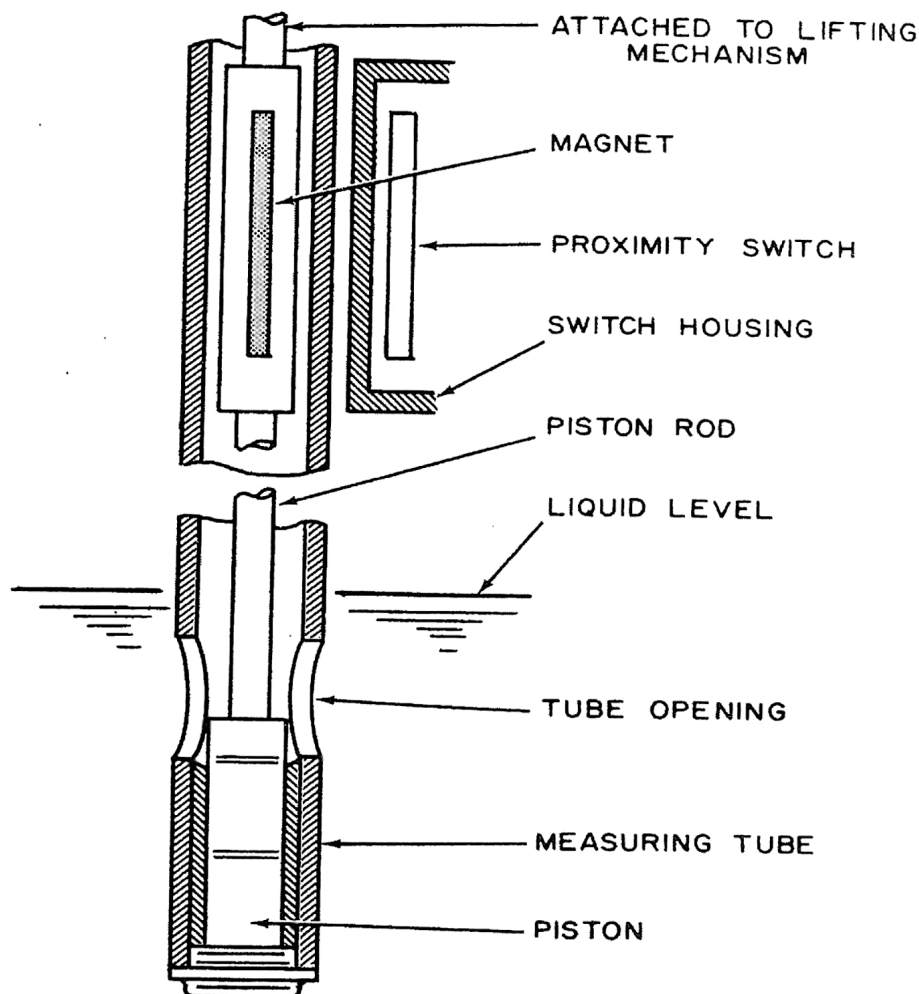
3.2



- The instrument consists of a light source, filters to separate the measuring and reference wave lengths, lenses to concentrate the beam on the sample and a concave mirror to reflect the beam onto a photocell.✓
- The reference filter will measure a specific wavelength and will be compared with a measured wavelength obtained from the measuring lens.✓
- These wavelengths will be picked up by the photocell and induce two current pulses.✓
- The relation between the two signals will be a function of the vapour present on the surface of the sample.✓

(10)

3.3

(9)
[29]

TOTAL SECTION B: 29

SECTION C: pH MEASUREMENT**QUESTION 4**

4.1 $\text{pH}_1 = \log\left(\frac{1}{0,15}\right) = 0,824\checkmark$

$\text{pH}_2 = \log\left(\frac{1}{(0,0025)}\right) = 2,6\checkmark$

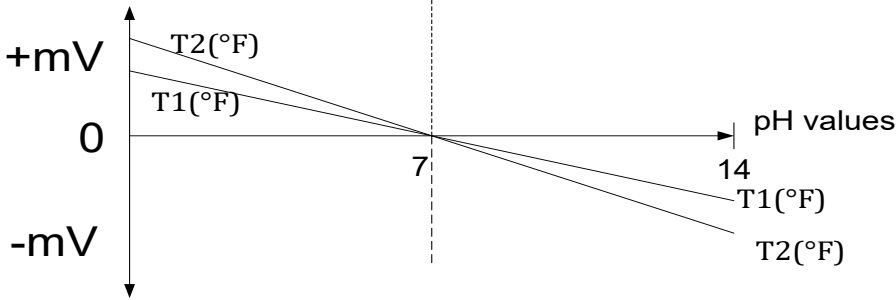
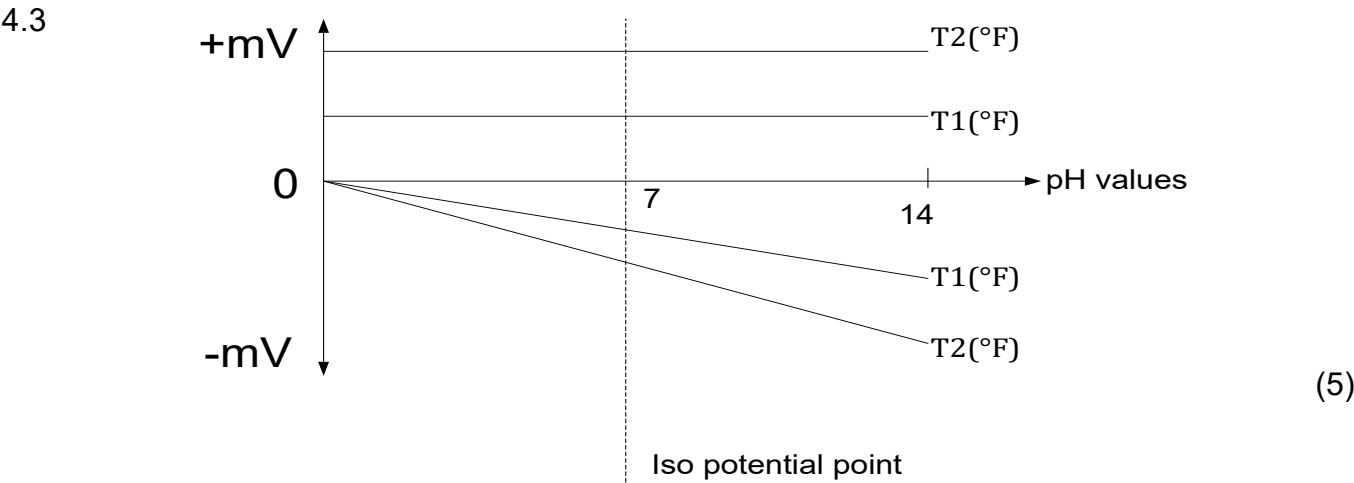
Change in pH = $0,824 - 2,6\checkmark$
 $= -1,776\checkmark$

(4)

- 4.2 4.2.1 A conductivity cell constant is a function of the area of the electrodes, ✓ the distance between the electrodes ✓ and the electric field pattern between the electrodes. ✓

(3)

4.2.2 The electrodes acquire a certain surface potential✓ due to loss or gain of electrons✓ when an electric current is passed between electrodes in a solution of electrolysis.✓ (3)



[20]

TOTAL SECTION C: 20

SECTION D: AUTOMATIC CONTROL**QUESTION 5**

- 5.1 5.1.1
- All four bellows will have the same pressure.
 - The motion pin will be on its true centre line.
 - No control actions will be generated.
- (3)

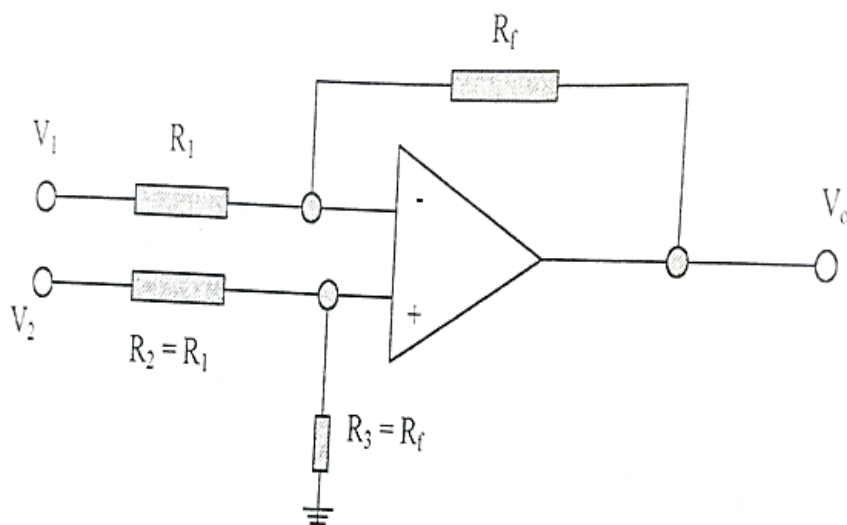
- 5.1.2
- The output will increase by ± 10 kPa if the gain is direct or decrease by ± 10 kPa should the gain be indirect.✓
 - This would be due to a pressure increase in the process bellows while the pressure in the other bellows stays constant.✓
 - The motion pin will move off its centre line causing the flapper to move either towards or away from the nozzle.✓
 - This should cause the nozzle feedback pressure to either increase or decrease, thus causing the output to change accordingly.✓
- (4)

5.1.3 $PB = \frac{100}{\text{gain}} = \frac{100}{1,0} = 100$ ✓

(1)

- 5.1.4 By swivelling the gain adjustment dial from direct to reverse
- (1)

5.2



(4)

- 5.3
- Wheatstone bridge
 - Linear variable differential transformer
 - Linear variable capacitive transducer
- (3)

[16]

TOTAL SECTION D: 16
GRAND TOTAL: 100