higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL INSTRUMENTS N5

6 AUGUST 2018

This marking guideline consists of 6 pages.

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SECTION A: FLOW MEASUREMENT

QUESTION 1

1.1 1.1.1 $H = V^2_2/2g - V^2_1/2g$ where $V_2 = 0$✓

Therefore $H = -V^2_1/2g$✓

i.e. the pressure increases by $V^2_1/2g$✓

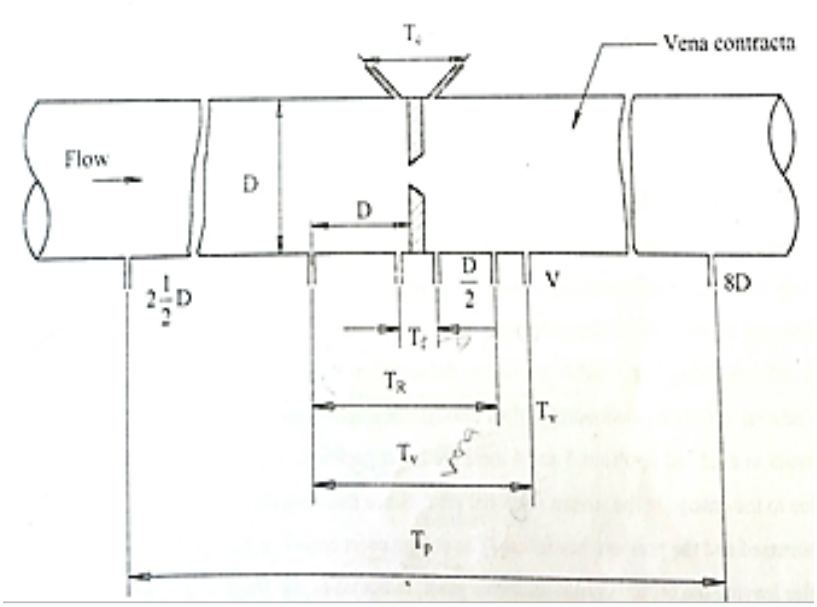
The negative sign indicates that it is an increase in pressure and not a decrease.✓

Increase in head $H = V^2_1/2g$ or $V^2_1 = 2gh$✓

$V_1 = \sqrt{2gh}$ ✓

Introduce pitot coefficient $V_1 = C\sqrt{2gh}$ ✓ (7)

1.1.2



T_C	.	T =	Corner taps
T_F	.	T =	Flange taps
T_R	.	T =	Radius taps
T_V	.	T =	Vena - contracta taps
T_P	.	T =	Pipe taps

(6)

1.1.3 Advantages
- Pressure loss caused by pitot tube is very small
- Low cost

Disadvantages
- Fluid must be moving at high velocity to produce measurerable differential pressure
- Small opening may be blocked (2 + 2) (4)

1.2
- Laminar flow must be ensured at a point where measurement is taken.
- Obstruction of tube and static connections must be prevented.
- Minimum slope of the tip to the direction of the flow of fluid must be ensured. (3)

1.3
- Head
- Viscosity
- Frictional resistance (3)

[23]

QUESTION 2

2.1
- It is a vertical tube of conical shape with a gradually expanding area from bottom to top.
- In the tube there is a fluid flowing in an upward direction and a disc is placed in it acting as a float.
- An orifice is set up between the disc and the inside surface of the tube creating a pressure drop.
- A change in flow will affect the pressure drop causing the disc to move up or down until forces acting on the disc are again at equilibrium.
- The position of the float in the tube is a measure of the rate of flow. (5)

2.2 Spiral grooves can be machined into the floats to cause a rotation. This rotation action will discard the sticky fluids from the float by centrifugal force. (3)

2.3 The density of the float must be very large compared to the density of the fluid. This results in reducing the density errors to reasonable proportions. (2)

2.4
- Flow velocity
- Fluid viscosity
- Fluid specific gravity
- Size and the smoothness of the pipe (4)

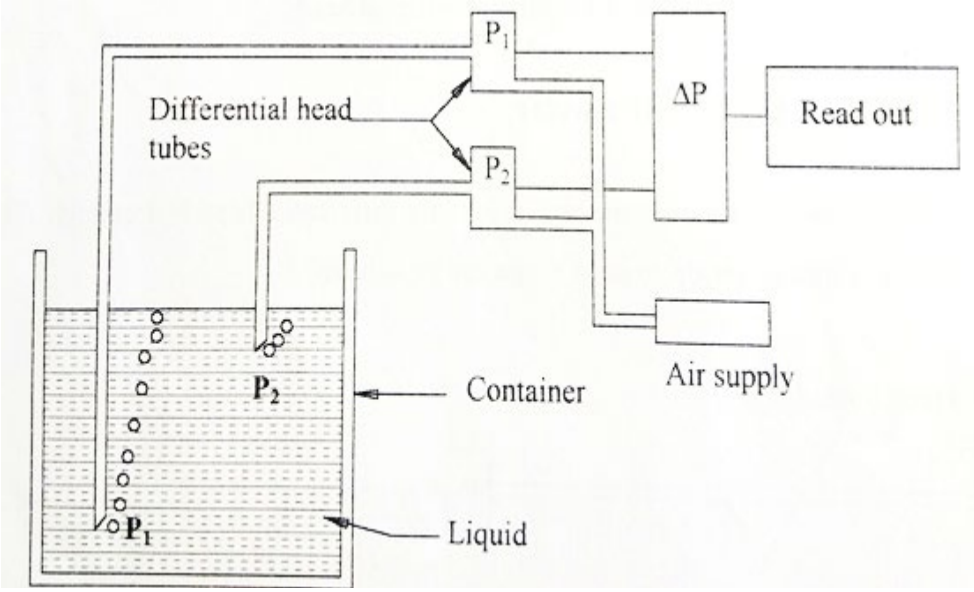
[14]

TOTAL SECTION A: 37

SECTION B: DENSITY, HUMIDITY AND VISCOSITY MEASUREMENT

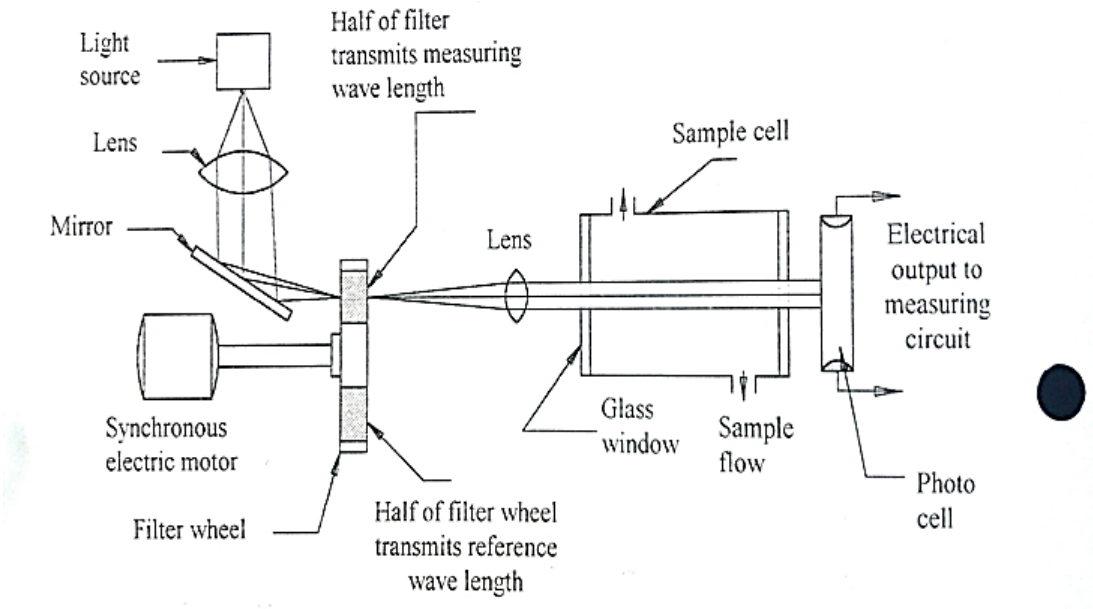
QUESTION 3

3.1



- The differential head type operates with two tubes placed at different levels inside a container in which air is passed through.✓
- A constant air supplied to both the tubes.✓
- The pressure at P_1 will be higher than the pressure at P_2 thus more pressure is needed at P_1 for bubbles to form than at P_2.✓
- When the bubbles become visible the pressure put forth at the end of the tube by the liquid will be almost equal to the applied air pressure.✓
- The difference in pressure will be directly proportional to the sum of a constant volume at each tube.✓
- This brings us back to the density equation, thus we can say that ΔP is directly proportional to the density.✓ (10)

3.2



(7)

3.3 3.3.1 Measure of a fluid's internal or inter molecular resistance to sheer force (2)

3.3.2
- Capillary-tube viscometer
- Falling ball/Falling piston viscometer
- Sliding-plate viscometer
- Rotational viscometer
- Vibrating-reed viscometer
- Ultrasonic viscometer
- Float viscometer
- Concentric viscometer (Any 4 × 1) (4)

3.3.3 Poise (1)
[24]

TOTAL SECTION B: 24

SECTION C: pH MEASUREMENT

QUESTION 4

4.1 4.1.1 True
4.1.2 False
4.1.3 True
(3 × 1) (3)

4.2
- Washing with water and wiping with cotton wool soaked in a diluted hydrochloric acid will suffice.
- In severe cases the electrodes may require soaking in solvents.
- Inorganic solvents are preferable for greasy and oily deposits.
- Organic solvents have a dehydrating effect on the membrane and therefore only brief immersion in a solvent followed by soaking in hydrochloric acid should be employed.
- A jet of solvent may be used periodically for frequent cleaning.
- An ultrasonic transducer attached to a thin plate may be employed. (6)

4.3
- Must have resistance to corrosion
- Strength against thermal shocks
- Strength against mechanical shocks
- Impermeability to water vapour for measurement at high temperatures (4)

4.4 To complete the electrical circuit with the glass membrane electrode.✓ It must provide a stable potential that is relatively invariable,✓ despite changes in either the chemical composition of physical properties of the process stream.✓ (3)
[16]

TOTAL SECTION C: 16

SECTION D: AUTOMATIC CONTROL

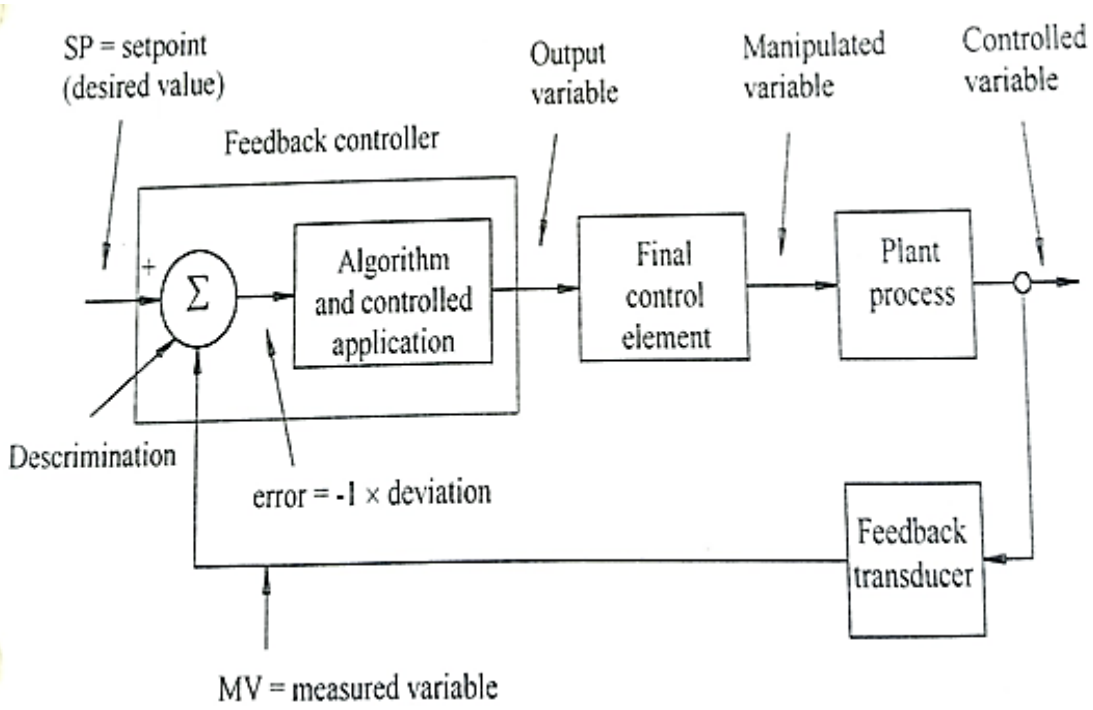
QUESTION 5

5.1

5.1.1	A
5.1.2	E
5.1.3	E
5.1.4	E
5.1.5	D
5.1.6	B
5.1.7	D

(7 × 2) (14)

5.2



(9)
[23]

TOTAL SECTION D: 23
GRAND TOTAL : 100

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