higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N2

6 August 2021

This marking guideline consists of 6 pages.

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SECTION A

QUESTION 1

1.1 A
1.2 C
1.3 B
1.4 A
1.5 A

(5 × 1) **[5]**

QUESTION 2

2.1 True
2.2 True
2.3 True
2.4 True
2.5 True

(5 × 1) **[5]**

QUESTION 3

3.1 Discharge coefficient
3.2 Thermocouple or thermocouple thermometer
3.3 Ultrasonic flow meter
3.4 Annubar
3.5 Peltier effect

(5 × 2) **[10]**

TOTAL SECTION A: 20

SECTION B

QUESTION 4: PRESSURE MEASUREMENT

4.1.1 Force ✓per unit area✓

4.1.2 The mass ✓of a unit volume✓ of a substance

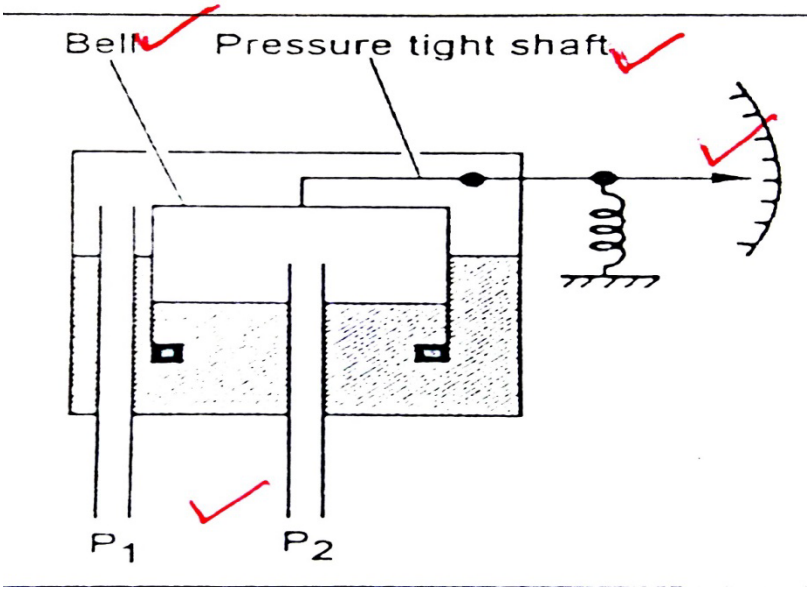
(2 × 2) (4)

4.2 $\Delta P = \rho g L \left[\sin\theta + \frac{A_2}{A_1}\right]$

$\Delta P = 13600 \times 10 \times 0{,}2 \left[\frac{0{,}00002}{0{,}03} + \sin 40^0\right]$✓✓

$\Delta P = 17500$ Pa or 17,5 kPa✓✓ (4)

4.3



(4)

4.4 4.4.1

- The pressure of a given amount of gas is inversely proportional to the volume
- if the temperature is kept constant. (2 × 1) (2)

4.4.2

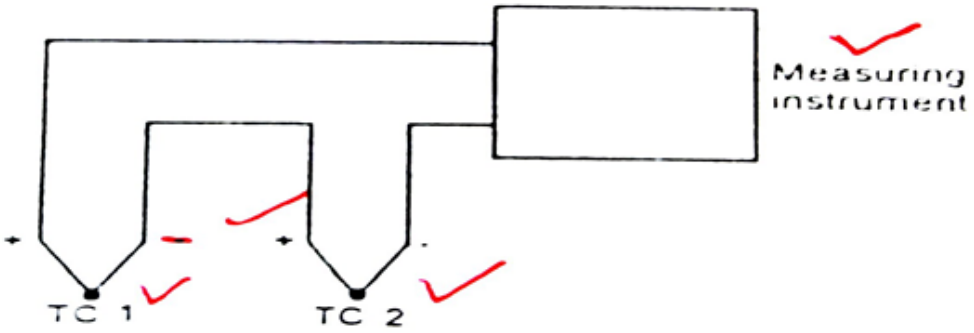
- Gas from the pressure that must be measured forces itself into the gauge at the process connection
- and fills the entire apparatus.
- The movable container filled with mercury is then slowly lifted.
- Mercury now rises in the tube and seals a fixed volume of gas, which is then compressed.
- The mercury rises higher in the capillary tube until it is brought to standstill on the zero-scale level.
- The compressed volume is read off as a measure of the original absolute pressure. (6)

[20]

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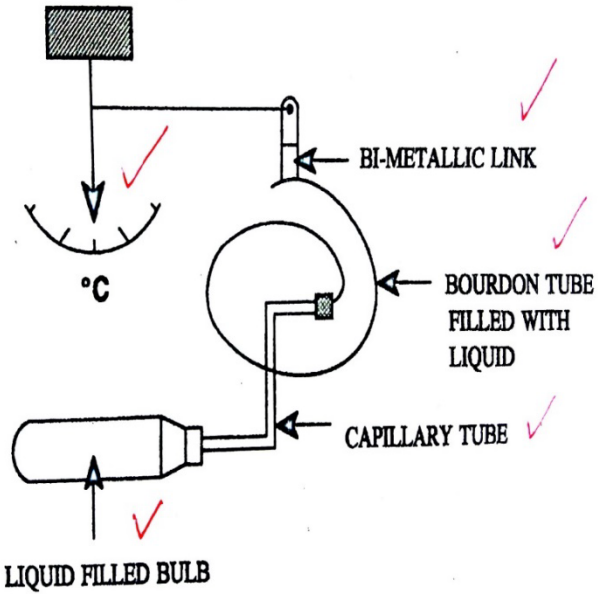
QUESTION 5: TEMPERATURE MEASUREMENT

5.1



(4)

5.2



ONE mark for sketch = ✓ (6)

5.3

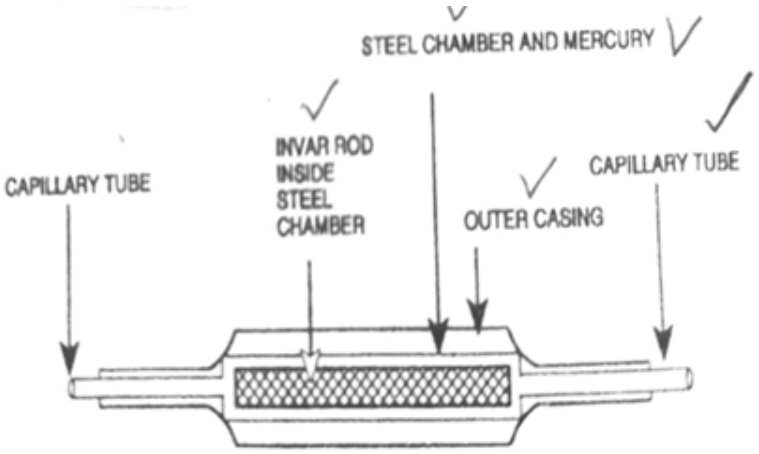
$$t^0C = \frac{5}{9}[t - 32]^0C$$

$$t^0C = \frac{5}{9}[320 - 32]^0C\checkmark$$

- $t = \frac{5}{9} \times 288^0C\checkmark$
- $t = 160^0C\checkmark$
- $K = t^0C + 273{,}15\checkmark$
  $= [160 + 273{,}15]K = 433K\checkmark$

(5)

5.4

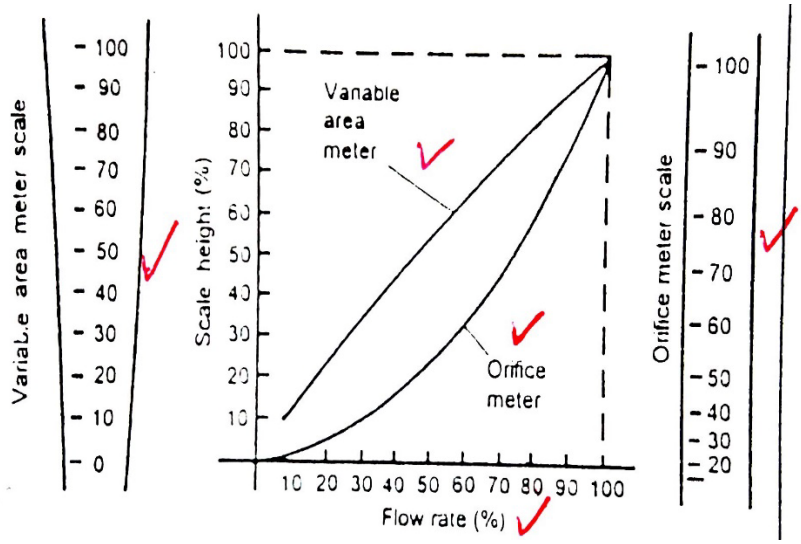


(5)
[20]

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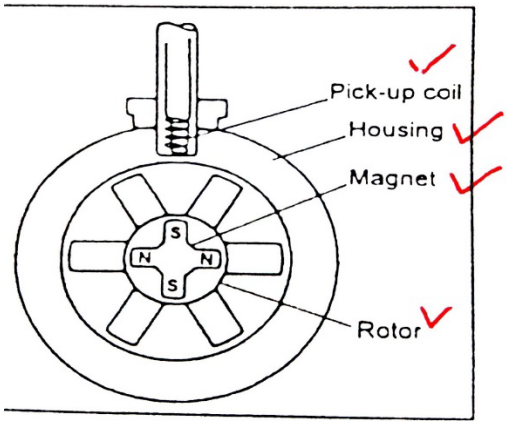
QUESTION 6: FLOW MEASUREMENT

6.1



(5)

6.2 6.2.1



(4)

6.2.2
- Flow velocity turns the rotor proportionally to the flow rate.
- The rotating rotor magnet set up a rotating field
- which generates alternating current pulses in the pick-up coils.
- The frequency of the pulse is proportional to the speed of the rotor and the number of poles on the magnet. (4)

6.3 6.3.1 To provide flow rate indications for liquids, gasses and steam (2)

6.3.2
- They are not well-suited for low flow rates.
- They can only be mounted vertically because they work with gravity.
- There may be no solids in the fluid measured, it must be clean. (3)

6.3.3
- Low cost.
- Direct read-out.
- Small pressure drop
- Easily maintained
- Flow rate directly proportional to the area of orifice.

(Any 2 × 1) (2)

[20]

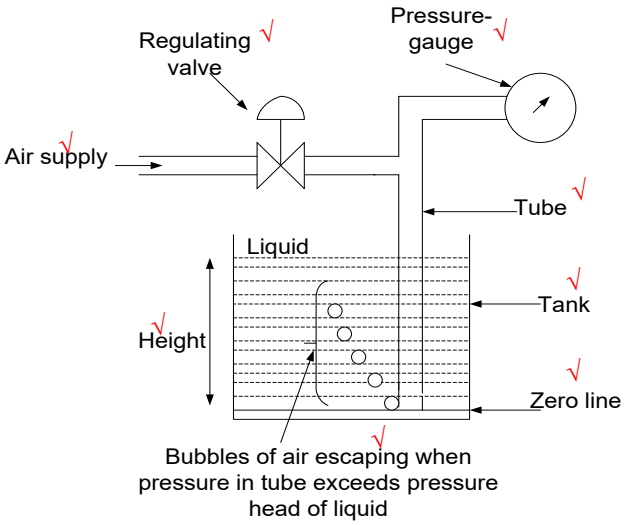
QUESTION 7: LEVEL MEASUREMENT

7.1

$$\frac{h}{2} = 0{,}5\ m$$
$$h = 0{,}5 \times 2 = 1\ m\checkmark$$
$$H_L = \left[\frac{\rho_m}{\rho_L}\right] \times h - \frac{h}{2}\checkmark$$
$$= \left[\frac{13600}{1000}\right] \times 1 - \frac{1}{2}\checkmark$$
$$= 13{,}1\ m\checkmark$$

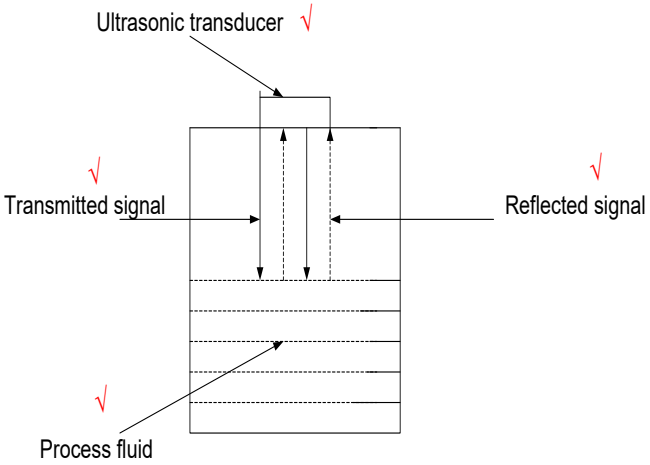
(4)

7.2



(8)

7.3



(4)

7.4

- The level sensor sends out sound waves in the form of bursts in downward direction to the fluid in the tank under level measurement.
- As soon as the directed sound waves hits the surface of the fluid, sound echoes get reflected and return to the sensor.
- The time taken by the sound wave to return is directly proportional to the distance between the piezo electric sensor and the material in the tank.
- This time duration is measured by the sensor, which is then further used to calculate the level of liquid in the tank.

(4)
[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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