higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N3

7 April 2020

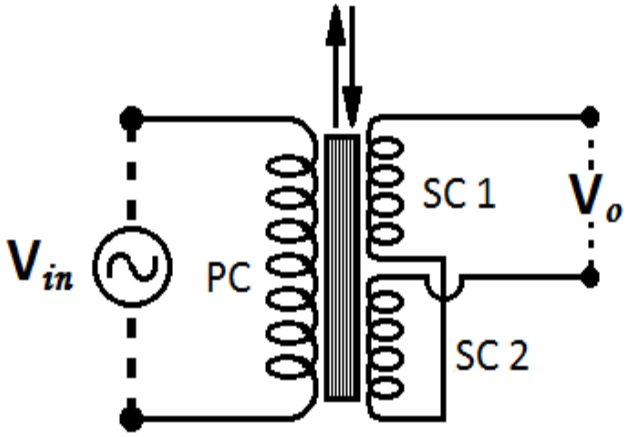
This marking guideline consists of 8 pages.

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QUESTION 1

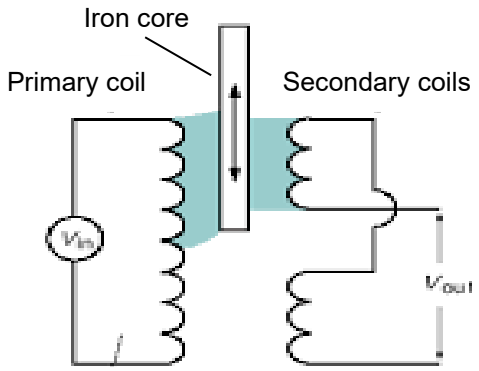
1.1 The electrical resistance of a conductor/wire will change when tension or pressure is applied to it. (2)

1.2 1.2.1



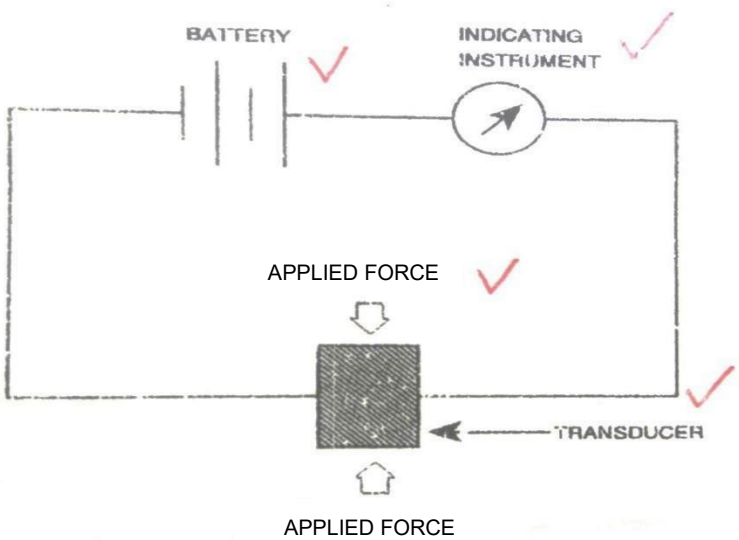
(2 marks for the correct positioning of the iron core) (2)
(1 mark for the correct drawing) (1)

1.2.2



(2 marks for the correct positioning of the iron core) (2)
(1 mark for the correct drawing) (1)

1.3 1.3.1



(4)

1.3.2
- It can withstand high pressures and overload.
- Temperature effects are very small.
- It has very good frequency response.
- High accuracy and repeatability.
- Negligible hysteresis effects. (5)

1.4 1.4.1 Piezoelectrical pressure transducer (1)

1.4.2
- When the pressure changes, the diaphragm is deflected✓ and pressure is applied on the crystal.✓
- The crystal generates an EMF✓ proportional to the pressure or force applied to it.✓ (4)

1.4.3
- High impedance output – a signal conditioning system is required
- Affected by temperature variations
- With long leads, error signals are generated (3)

[25]

QUESTION 2

2.1 2.1.1 A
2.1.2 A
2.1.3 A
2.1.4 A
2.1.5 A

(5 × 1) (5)

2.2 2.2.1 A – connecting leads
B – platinum sensing wire
C – protection tube (3)

2.2.2
- It helps to resist vibration
- and keeps the sensor from shorting. (2)

2.2.3
- An RTD is a thermoelectric device
- that has a positive temperature coefficient.
- The relationship between temperature and resistance is linear.
- This means that as the temperature increases, the resistance of the platinum wire increases
- and when the temperature decreases, the resistance decreases. (5)

2.3 Is = 2 mA (given)

Rcj = 3 Ω (given)✓

$R_s = \frac{V_{sc}}{I_s} = \frac{1,018}{0,002} = 509\ \Omega$✓

$R_z = \frac{V_{min}}{I_s} + R_{cj}$

$R_z = \frac{0}{0,002} + 3$✓

$= 3\ \Omega$✓

$R_t = \frac{V_{max} - V_{min}}{I_s}$

$R_t = \frac{24,9 \times 10^{-3} - 0}{0,002}$✓

$= 12,45\ \Omega$✓

$R_{sh} = \frac{R_{sw} \times R_t}{R_{sw} - R_t}$

$R_{sh} = \frac{25 \times 12,45}{25 - 12,45}$✓

$= \frac{311,25}{12,55}$

$= 24,9\ \Omega$✓

$R_u = \frac{V_{std\ cell} - V_{max}}{I_s}$

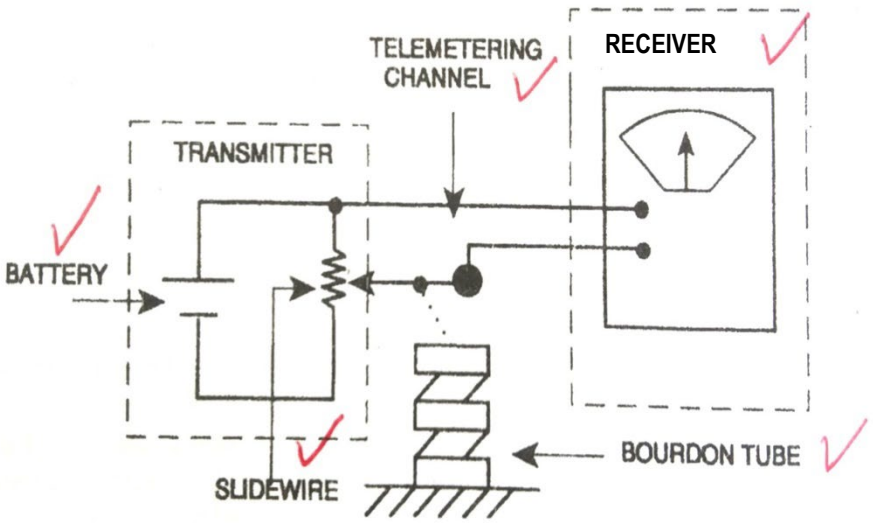
$R_u = \frac{1,018 - 24,9 \times 10^{-3}}{0,002}$ ✓

$= 496,55\ \Omega$✓ (10)

[25]

QUESTION 3

3.1 3.1.1

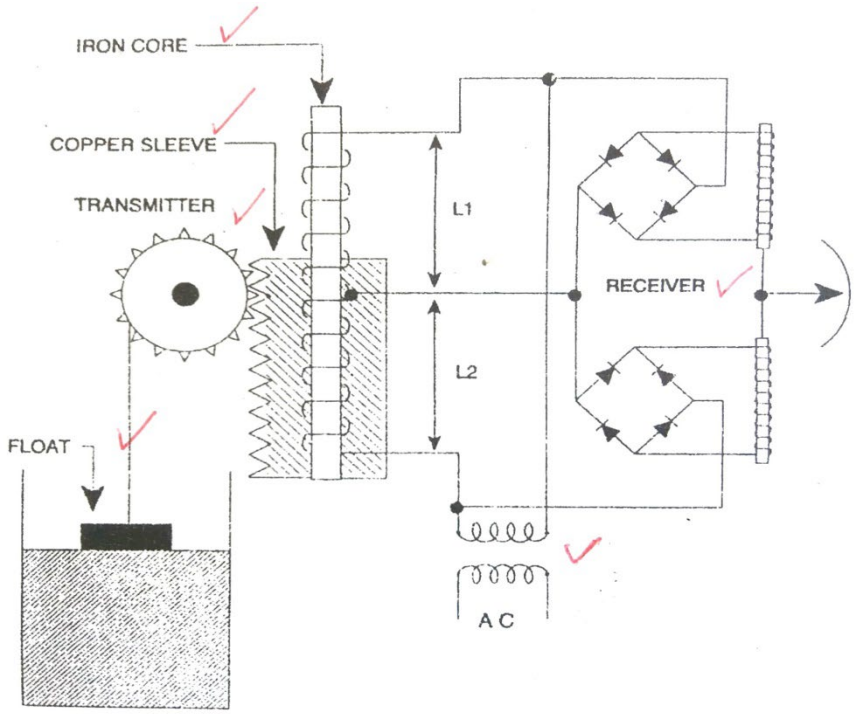


(5)

3.1.2

- With the change of pressure in the system, the Bourdon tube actuates the slider of the potentiometer,✓ thereby changing the voltage drop across the slider wire which is connected to the telemetering channel.✓
- The DC null-balance potentiometer measures the voltage✓ and positions a pointer on a scale graduated in terms of the pressure units.✓ (2 × 2) (4)

3.1.3



(6)

3.2	3.2.1	J
	3.2.2	D
	3.2.3	A
	3.2.4	H
	3.2.5	B
	3.2.6	I
	3.2.7	E
	3.2.8	F
	3.2.9	C
	3.2.10	G

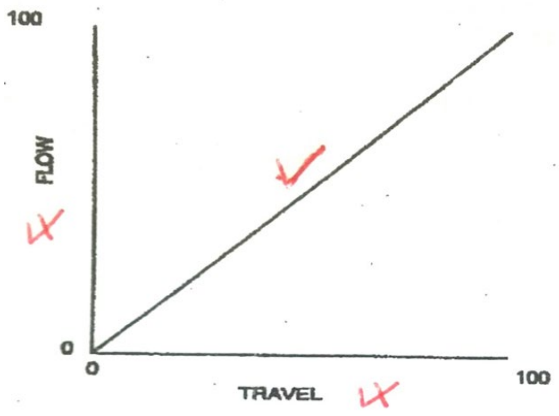
(10 × 1) (10)
[25]

QUESTION 4

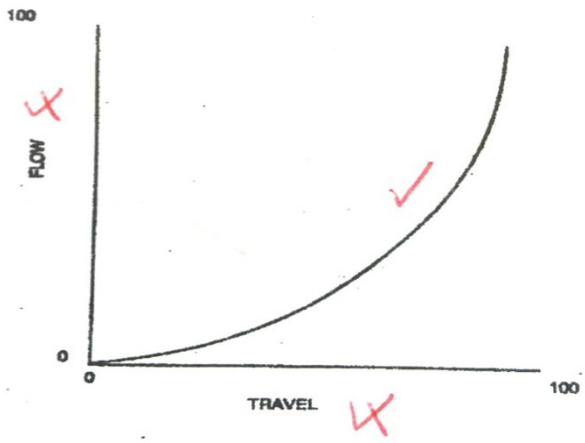
4.1	4.1.1	True
	4.1.2	True
	4.1.3	False
	4.1.4	False
	4.1.5	True

(5 × 1) (5)

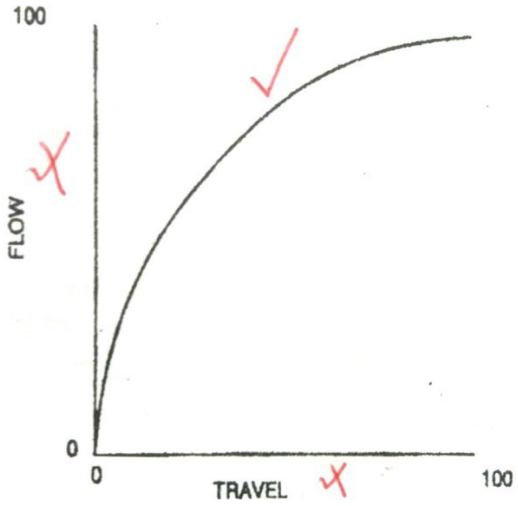
4.2 4.2.1



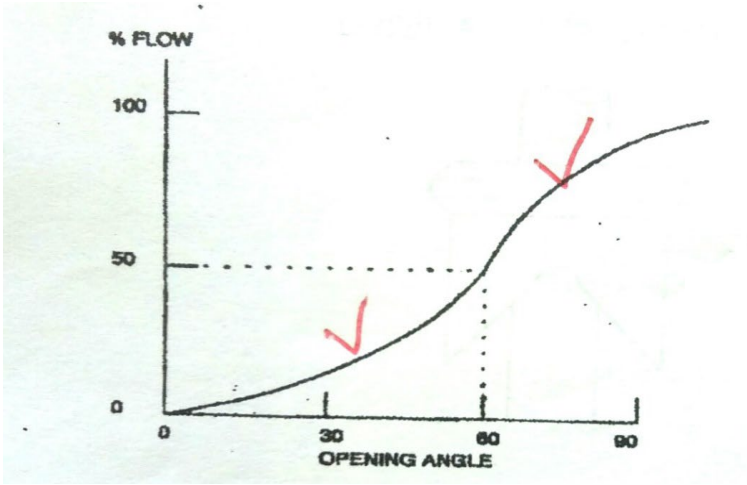
4.2.2



4.2.3

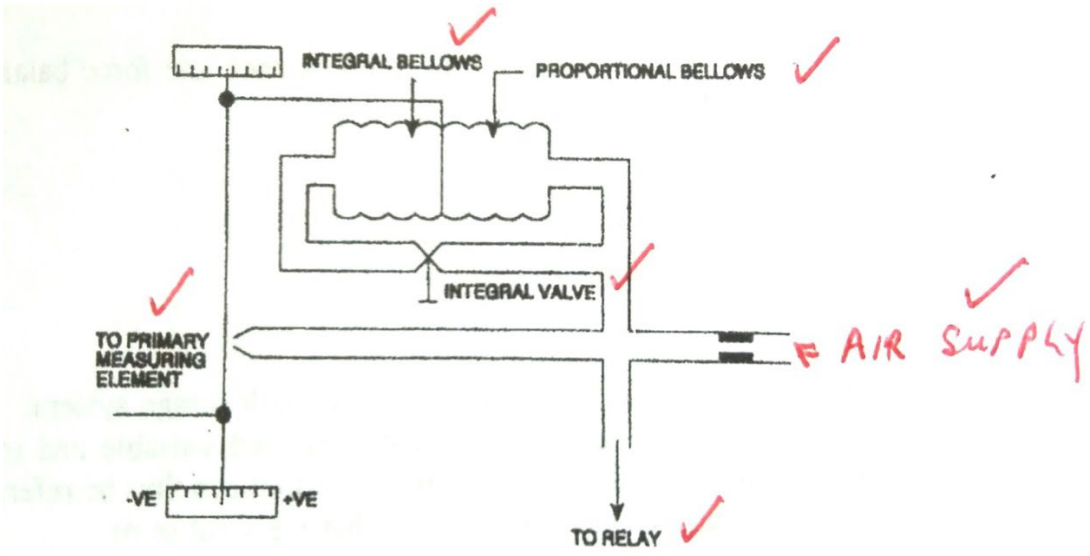


4.2.4



(4 × 2) (8)

4.3



(6)

- When the measured value begins to increase, it causes the flapper to move towards the nozzle.
- This will increase the nozzle back pressure
- resulting in a sharp increase in output pressure. The increasing pressure in the proportional bellows will expand the proportional bellows and re-position the flapper
- thus limiting the output pressure to a value which is proportional to the deviation (proportional action).
- With the integral valve partly open
- air will flow through to the integral bellows at the rate which depends upon the pressure drop across the valve and the size of the valve.
- Air flowing into the integral bellows will expand the bellows and tend to move the flapper towards the nozzle, increasing the output pressure (integral action). (Any 6 × 1) (6)

[25]

TOTAL: 100

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