



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

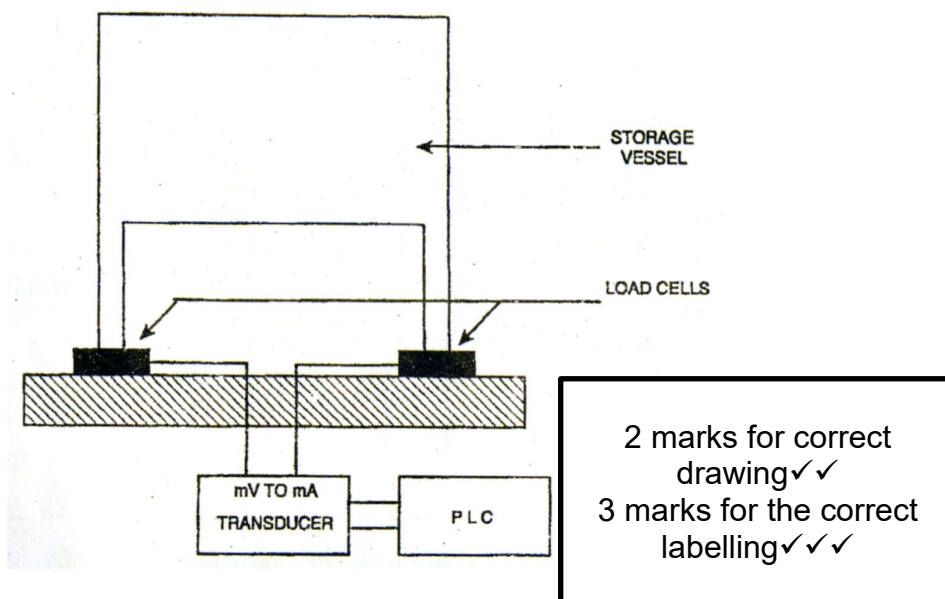
MARKING GUIDELINE
NATIONAL CERTIFICATE
INSTRUMENT TRADE THEORY N3

28 November 2023

This marking guideline consists of 7 pages.

QUESTION 1

- 1.1 1.1.1 Spiral/Foil type strain gauge. (1)
- 1.1.2 Bonded type strain gauge. (1)
- 1.1.3
- They follow the surface to which they are cemented very well.
 - They are easily made waterproof.
 - Special patterns are easily produced.
 - They can be prepared within a few minutes with the proper cement and equipment.
 - They have a relatively small creep and hysteresis effect.
 - They have a high gauge factor.
 - Foil gauges dissipate heat easily because of the high contact area.
- (7)
- 1.2 1.2.1 A load cell is essentially a force transducer or force sensor. (1)
- 1.2.2 Measuring mass or weight. (1)
- 1.2.3 Unbonded type strain gauge or non-bonded type strain gauge. (1)
- 1.2.4



- 1.3 1.3.1 True
- 1.3.2 True
- 1.3.3 True
- 1.3.4 True
- 1.3.5 False
- 1.3.6 False

(6 × 1) (6)

- 1.4
- The temperature measurement in a location.
 - The pressure produced by a cooling water pumping system.
 - The voltage maintained by a standby generator.
 - The flow in a pipeline.

(Any 2 × 1)

(Marker to use own discretion)

(2)

[25]**QUESTION 2**

- 2.1 2.1.1 The law of intermediate metals states that a third metal may be inserted into a thermocouple system without affecting the emf generated, ✓✓ if, and only if, the junctions with the third metal are kept at the same temperature. ✓

OR

A law stating that the use of a third metal in a thermocouple circuit does not affect the voltage, as long as the temperature of the three metals at the point of junction is the same.

- 2.1.2 The law of intermediate temperatures states that the sum of the emf developed by a thermocouple with its junctions at temperatures T1 and T2, ✓✓ and with its junctions at temperatures T2 and T3, will be the same as the emf developed if the thermocouple junctions are at temperatures T1 and T3. ✓

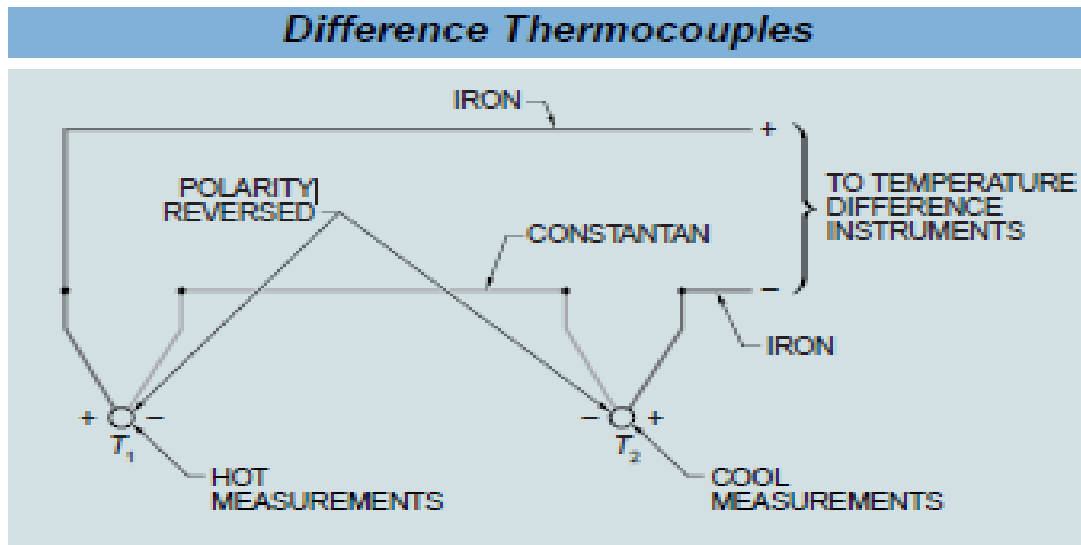
OR

A law stating that in a thermocouple circuit, if a voltage is developed between two temperatures T1 and T2, and another voltage is developed between temperatures T2 and T3, the thermocouple circuit generates a voltage that is the sum of those two voltages when operating between temperatures T1 and T3.

(3 × 2)

(6)

2.2



2 marks for the sketch
1 mark for the correct polarities
3 marks for labels

(6)

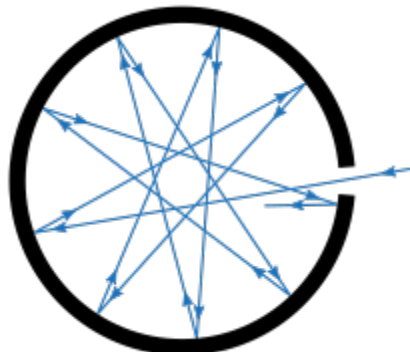
2.3

2.3.1

- The measurement of the total energy radiated from a heated body.
- The measurement of a spectral radiant intensity of the radiated energy from the heated body at a given wavelength.

(2)

2.3.2



(3)

2.4

$$I_s = 2 \text{ mA} \checkmark$$

$$R_s = \frac{V_{sc}}{I_s} = \frac{1,019}{0,002} = 509,5 \Omega \checkmark$$

$$R_{cj} = R_0 + \Delta R = 6,1 \Omega \text{ at } 35^\circ \text{C} \checkmark$$

$$R_z = \frac{V_{min}}{I_s} + R_{cj} = \frac{0,0081}{0,002} + 6,1 = 10,15 \Omega \checkmark$$

$$R_u = \frac{V_{sc} - V_{max}}{I_s} = \frac{1,019 - 0,0413}{0,002} = 489 \Omega \checkmark$$

$$R_t = \frac{V_{max} - V_{min}}{I_s} = \frac{0,0413 - 0,0081}{0,002} = 16,6 \Omega \checkmark$$

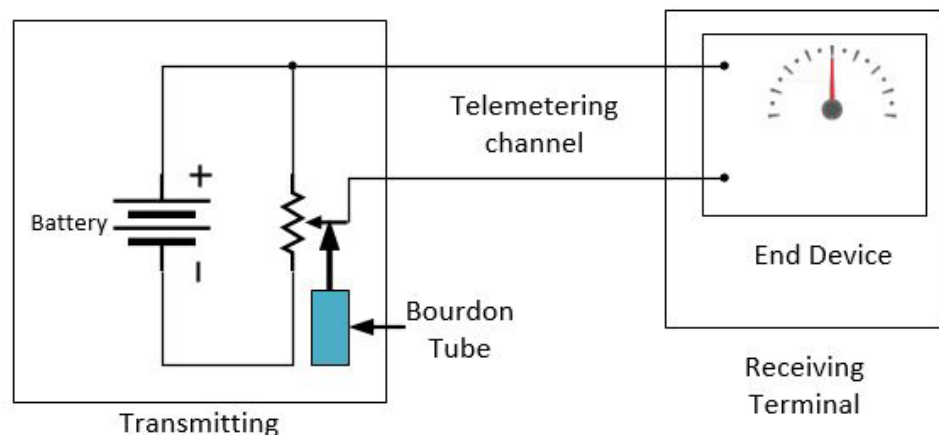
$$R_{sh} = \frac{R_{sw} \times R_t}{R_{sw} - R_t} = \frac{20 \times 16,6}{20 - 16,6} = 97,6 \Omega \checkmark$$

(8)

[25]

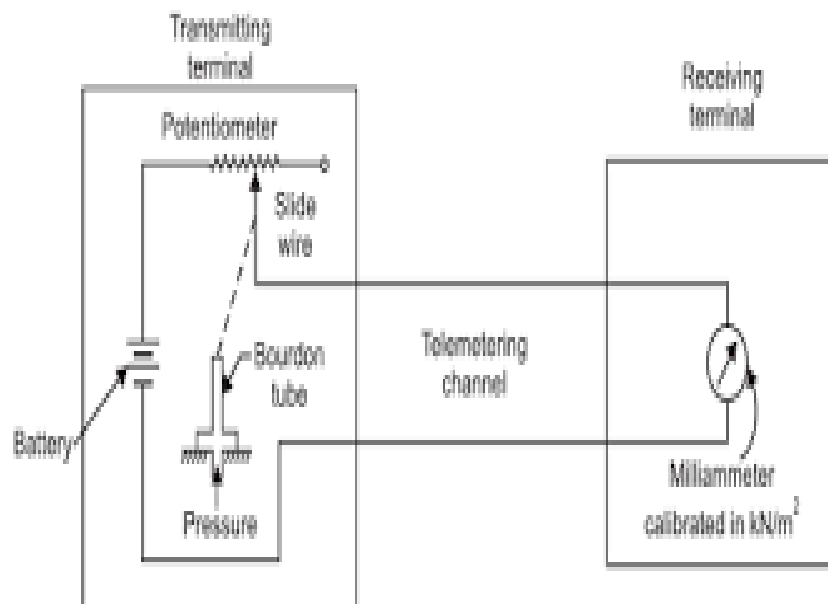
QUESTION 3

- 3.1 3.1.1
- Supply variations✓
The supply voltage must be stabilised because the readings will vary as the supply varies.✓
 - The load resistor✓
The value of the load resistance affects the linearity between the slider position and the voltage.✓
 - The lead wires✓
The lead wires between the transmitter and receiver are affected by the temperature changes and thus have an effect on the total resistance of the system.✓
(3 × 2) (6)
- 3.1.2
- A regulator, for example, a Barretter lamp is used.
 - Two voltage and two current coils are used.
 - A ratiometer instrument is used to compensate for the supply variations.
(Any 2 × 1) (2)
- 3.2 3.2.1 Voltage telemetering system



1 Mark for Bourdon tube✓
1 Mark for telemetering channel✓
4 Marks for the correct drawing✓✓✓✓

3.2.2



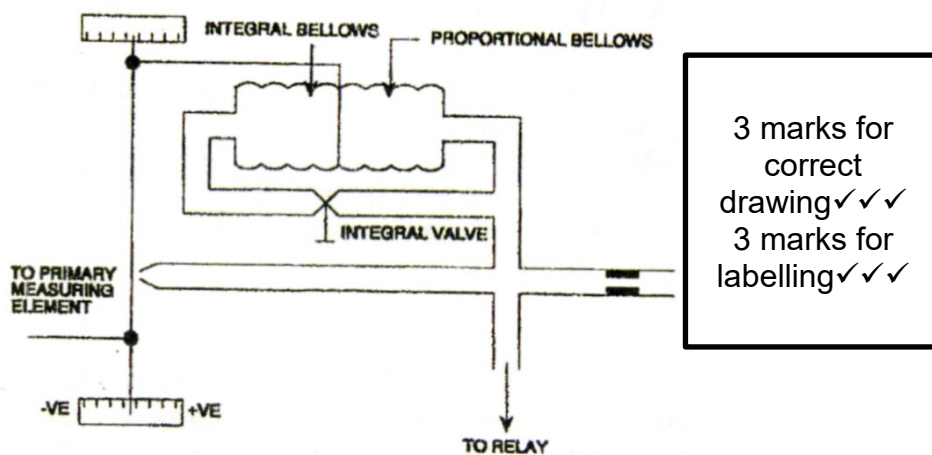
1 Mark for Bourdon tube✓
 1 Mark for telemetry channel✓
 4 Marks for the correct drawing✓✓✓✓
 (2 × 6) (12)

3.3	3.3.1	D
	3.3.2	G
	3.3.3	F
	3.3.4	E
	3.3.5	A

(5 × 1) (5)
[25]

QUESTION 4

4.1 4.1.1



(6)

4.1.2	• The controller consists of two bellows acting in opposite directions. Proportional bellows are fed directly from the flapper and the integral bellows are fed via the valve. • The midpoint of the bellows, couples to the flapper for negative feedback. • With the integral restrictor fully open, the system will act as a two-step controller. • With the restrictor fully closed, the system would operate as if it only had proportional action.	(4)
4.2	• Basic forces • Pressure load • Weight load • Inertia load • Friction load	(5)
4.3	4.3.1 It is the maintenance of a balanced condition within a process without human intervention.	(2)
	4.3.2 It is a simple control system that contains no feedback loop✓ and therefore the measured variable is not controlled or corrected.✓✓	(3)
4.4	4.4.1 • Distance-velocity lag • Transfer lag • Process lag	(3)
	4.4.2 The act of physically or chemically changing matter✓ including combining matter or converting energy.✓ (Marker to use own discretion)	(2)
		[25]
TOTAL:		100