



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N3

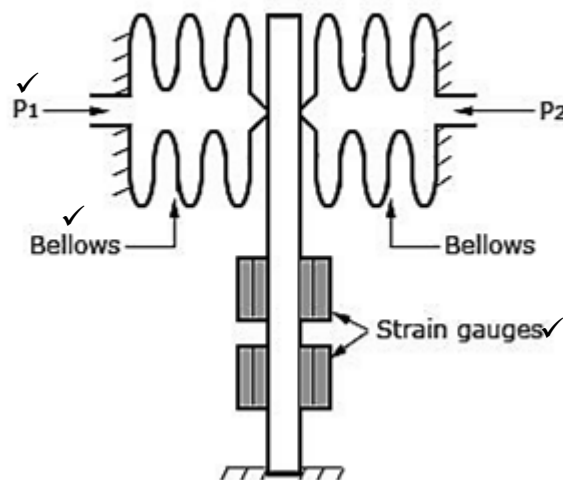
2 August 2021

This marking guideline consists of 6 pages.

QUESTION 1

- 1.1
- Inductance
 - Reluctance
- (2)
- 1.2
- Inductance type transducers operate on the principle of a change in inductance in an alternating-current circuit.
 - Reluctance type transducers operate on the principle of changing the air gap between the magnet and the core (reluctance).
- (2 + 2) (4)

1.3

Pressure Measurement With Strain Gauge on Bellows

- Strain gauges is cemented to a fixed cantilever ✓
- Differential pressure changes tension on the cantilever ✓
- Strain gages measures this tension in cantilever in effect measuring the differential pressure. ✓

(6)

- 1.4
- 1.4.1 Spiral-type bonded strain gauge or foil type strain gauge (1)
- 1.4.2 The wire is replaced with a thin foil✓ to obtain a bigger contact area.✓ (2)
- 1.4.3
- It follows the surface to which it is cemented very well.
 - It has a high gauge factor.
 - It is made waterproof easily.
 - Special patterns are easily produced.
 - It has relatively small creep and hysteresis effects.
 - Because of the big contact area foil gauges dissipate heat easily.
 - It can be prepared within a few minutes with the proper cement and equipment.
- (Any 5 × 1) (5)

- 1.5 The electrical resistance will change when tension or pressure is applied to it.✓✓ The change in length (as well as the change in cross-sectional area) of the wire will be proportional to the applied stress and the electrical resistance will be related to the length and cross-sectional area as shown in the equation.✓✓

$$\text{Formula: } R = \frac{\rho \times l}{A}$$

(5)
[25]

QUESTION 2

- 2.1 2.1.1 True
 2.1.2 True
 2.1.3 True
 2.1.4 True
 2.1.5 False

(5 × 1) (5)

- 2.2 2.2.1 • Thermistors
 • Thermocouples
 • Resistance temperature detectors

(3)

2.2.2

$$R_T = Ae^{\frac{B}{T}}$$

$$100 \times 10^3 = Ae^{\frac{3\,000}{300}}$$

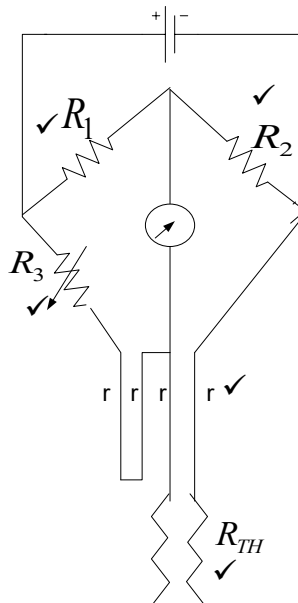
$$\Rightarrow A = 4,54$$

$$R_{900} = 4,54e^{\frac{3\,000}{900}}$$

$$= 127,26 \, \Omega$$

(4)

- 2.3 2.3.1



(2 marks for correct drawing) (5)

$$\begin{aligned}
 2.3.2 \quad R_t &= R_1 + R_2 \checkmark \\
 &= 15 + 15 \checkmark \\
 &= 30 \, \Omega \checkmark
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 2.3.3 \quad R_1/R_3 + L_1 + L_2 &= R_2/R_t + L_3 + L_4 \checkmark \\
 15/15 + 4 + 4 &= 15/R_t + 4 + 4 \\
 15(R_t + 8)/15 &= 15(15 + 8)/15 \checkmark \\
 R_t + 8 &= 15 + 8 \checkmark \\
 R_t &= 15 + 8 - 8 \\
 R_t &= 15 \, \Omega = R_3 \checkmark \checkmark
 \end{aligned}
 \tag{5}$$

[25]

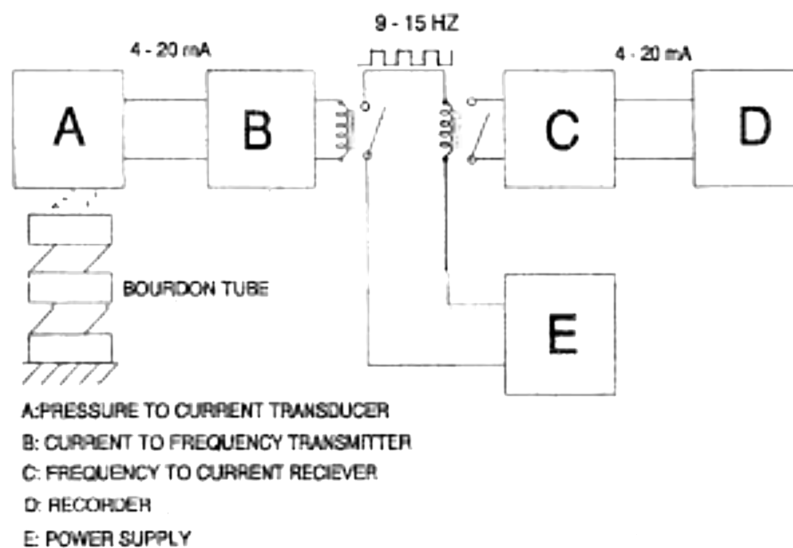
QUESTION 3

- 3.1 3.1.1 G
 3.1.2 F
 3.1.3 B
 3.1.4 A
 3.1.5 D
- (5 × 1) (5)

- 3.2 3.2.1 Telemetry is an automated communication process by which measurements and other data are collected at remote locations and transmitted to receive equipment for monitoring. (2)

- 3.2.2 • Remote pressure reading
 • Fuel-oil monitoring
 • Water-level monitoring
 • Remote speed reading
 • Remote meter reading (2)

3.2.3



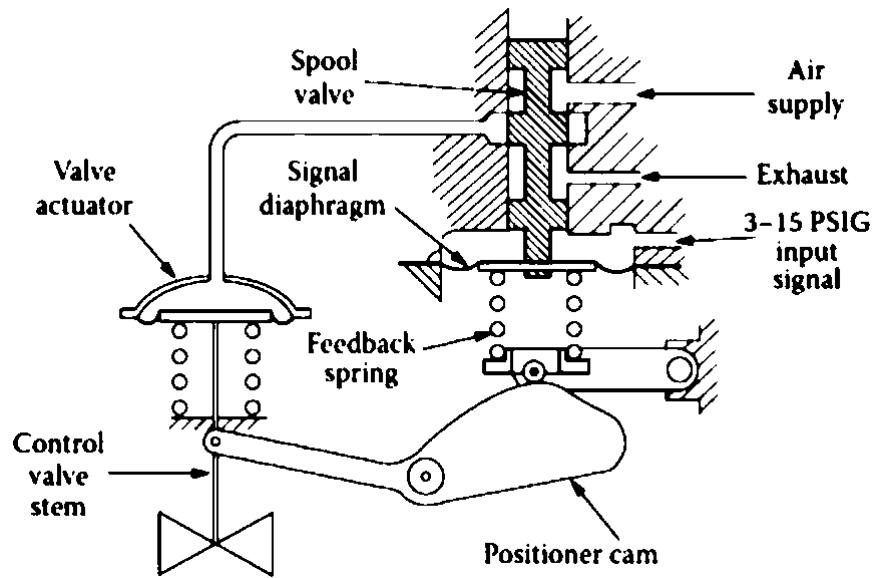
(3 for the correct drawing + 5 for labels) (8)

- | | | | |
|-------|--|-------------|-----|
| 3.2.4 | <ul style="list-style-type: none"> • No time lag • Not sensitive to vibration • Linear output • Unlimited range • Electrical signals over many kilometres • No pressure drop | (Any 5 × 1) | (5) |
| 3.2.5 | <ul style="list-style-type: none"> • Supply voltage variations • Load resistor • Lead wires | | (3) |

[25]**QUESTION 4**

- | | | | | |
|-----|-------|---|---------|-----|
| 4.1 | 4.1.1 | Control system in which the output has no influence or effect on the control action of the input signal | | |
| | 4.1.2 | Control system with feedback from the measuring element back to the correcting element | | |
| | 4.1.3 | Difference between the measured value and set point | | |
| | 4.1.4 | Movable part of a valve body assembly that provides a variable restriction of flow | | |
| | 4.1.5 | Signal that deviates from the desired value | (5 × 1) | (5) |
| 4.2 | 4.2.1 | A positioner moves the actuator stem in accordance with the value of the input signal.✓✓ It is operated from a separate air supply through a relay to drive the stem to the desired position.✓ | | (3) |
| | 4.2.2 | An increase in air pressure on the diaphragm will cause the valve to open and allow an increase of flow through the valve. | | (2) |
| | 4.2.3 | <ul style="list-style-type: none"> • The high gain helps to overcome stem friction. • The valve stroke is closely matched to the input signal. • The input signal is dead-ended in a small chamber thereby reducing time lag. • Split-ranging is easily obtained due to the amplification. • The positioner output is independent of the input signal permitting greater thrust. | | (5) |

4.2.4



(3 for correct drawing)

(10)

[25]**TOTAL:****100**