



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE INSTRUMENT TRADE THEORY N3

31 JULY 2018

This marking guideline consists of 7 pages.

QUESTION 1

- | | | |
|-----|-------|---|
| 1.1 | 1.1.1 | B |
| | 1.1.2 | A |
| | 1.1.3 | D |
| | 1.1.4 | B |
| | 1.1.5 | A |

(5 × 1) (5)

- | | | |
|-----|-------|-------|
| 1.2 | 1.2.1 | False |
| | 1.2.2 | True |
| | 1.2.3 | True |
| | 1.2.4 | False |
| | 1.2.5 | True |

(5 × 1) (5)
[10]

QUESTION 2

- | | |
|------|---|
| 2.1 | D |
| 2.2 | A |
| 2.3 | I |
| 2.4 | H |
| 2.5 | J |
| 2.6 | L |
| 2.7 | E |
| 2.8 | B |
| 2.9 | G |
| 2.10 | C |

(10 × 1) **[10]**

TOTAL SECTION A: 20

SECTION B**QUESTION 3**

- 3.1 3.1.1
- The electrical resistance of a wire changes proportionally when stress or pressure is applied to it. A change in pressure cause an change in length, resulting in change in resistance
 - The equation for the resistance of wire with realltion to its dimension is as follows:

$$R = \frac{\rho l}{A}$$

Where : R = resistance

L = length

A = area

ρ = resistivity

(5)

- 3.1.2 Nonbonded strain gauge
Strain gauges that are not cemented to a structure but consist of wire which is wound around cores and structures. ✓✓

Bonded strain gauge

It consists of length of very thin wire formed into a grid pattern and bonded (glued) to a backing material suitable to withstand the temperature and other conditions under which it is likely to operate. ✓✓

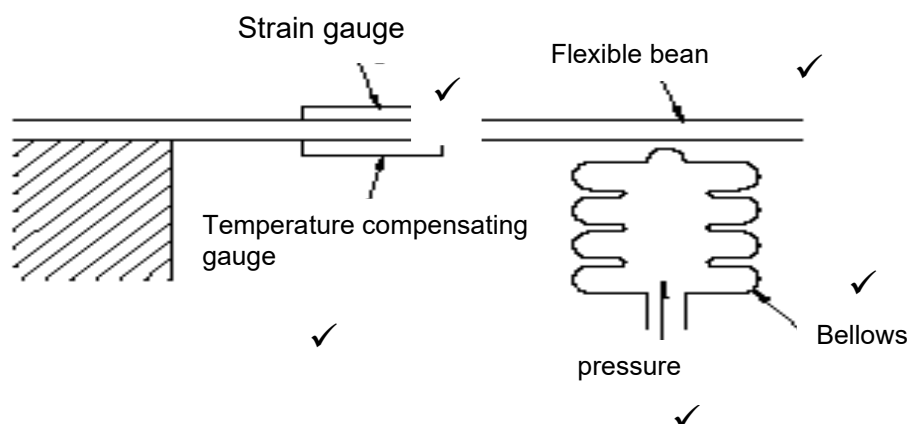
(4)

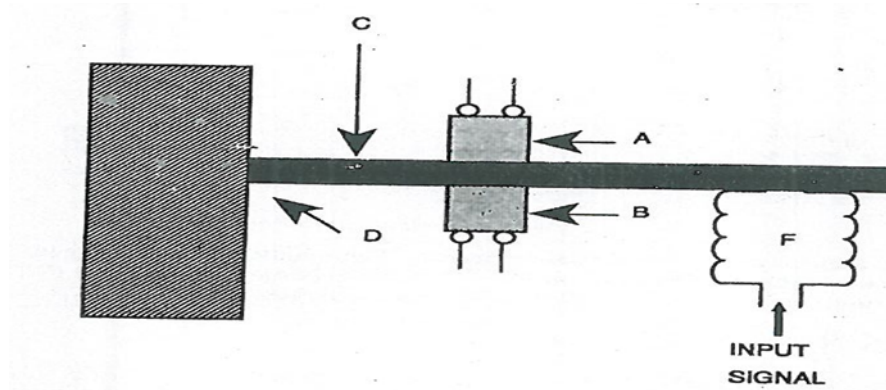
- 3.1.3 Is the ratio of relative change in electrical resistance, to the mechanical strain.

$$K = \frac{\Delta R/R}{\epsilon}$$

(1)

- 3.2 3.2.1

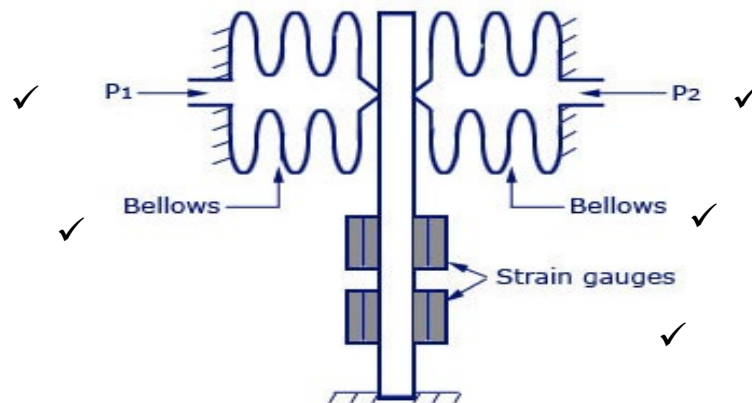
**OR**



A = Active strain gauge
 B = Compenstating gauge
 F = Bellow
 C = Flexible beam

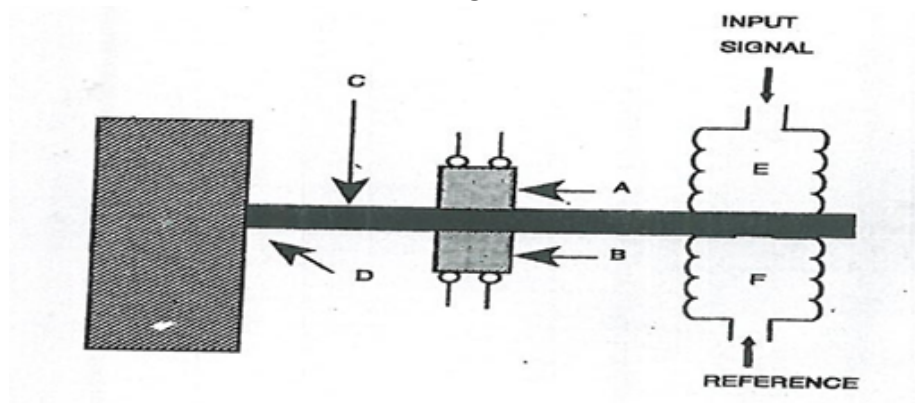
(5)

3.2.2



www.InstrumentationToday.com

OR



A = Active strain gauge
 B = Compenstating gauge
 F & E = Bellows
 C = Flexible beam

(5)
[20]

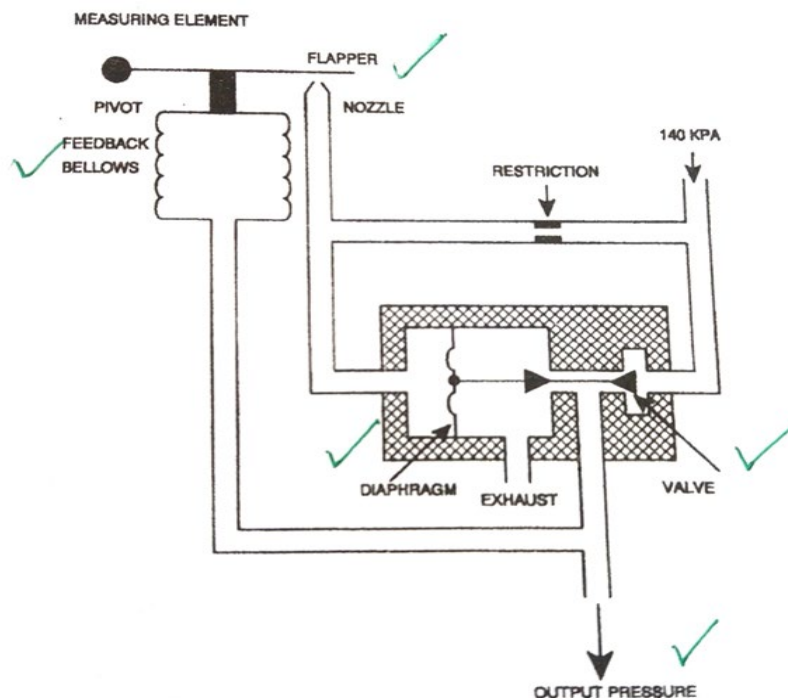
QUESTION 4

- 4.1 4.1.1 $R_t = R_o (1 + \alpha T + \beta T^2)$ ✓
 $R_t = 38 (1 + (3.92 \times 10^{-3} \times 500) + (-5.88 \times 10^{-7} \times 500^2))$ ✓
 $R_t = 38 (1 + 1.96 - 0.147)$
 $R_t = 106.894\Omega$ ✓ (3)
- 4.1.2 $R_t = R_o (1 + \alpha T)$ ✓
 $R_o = R_t / (1 + \alpha T)$
 $R_o = 150 / (1 + 0.00392 \times 25)$
 $R_o = 150 / 1.098$
 $R_o = 136.61\Omega$ ✓ (2)
- 4.2 4.2.1 Phenomenon in which a temperature difference between two dissimilar electrical conductors or semiconductors✓ produces a voltage difference between the two substances.✓ (2)
- 4.2.2 Effect whereby heat is given out or absorbed✓ when an electric current passes across a junction between two materials.✓ (2)
- 4.3 4.3.1
- Cold junction resistor✓
 - The emf produced by the temperature of the cold junction subtracts from the emf of the hot junction resulting in an error.✓
 - This must be accounted for by adding a voltage equal to the emf at the cold junction.✓
 - The value of this resistor must change with temperature since the room temperature changes all the time.✓ (4)
- 4.3.2
- The current flowing in the circuit when the battery runs dry
 - The current through the sensitivity resistor is adjusted until the galvanometer is balanced (2)
- 4.3.3
- The standard cell is periodically connected to the sensitivity resistance and the current through this resistor is adjusted by the variable resistor until the galvanometer is balanced.✓✓
 - The voltage applied to the potentiometer is then correct.✓ (3)
- 4.3.4 To shunt the slider wire resistance to the required value, thus allowing us to use the whole slider without damaging it. (2)

[20]

QUESTION 5

5.1 5.1.1



(5)

- 5.1.2
- When the flapper moves towards the nozzle, the nozzle back pressure increases.
 - This will cause the pressure acting in the diaphragm of the valve to increase, thus opening the valve more.
 - The feedback pressure and the output pressure will increase proportionally.
 - The feedback bellow will expand, thus repositioning the flapper.
 - The output pressure will decrease and stabilised.

(5)

- 5.1.3
- Output not linear
 - Large time lag
 - Variations in supply pressure
 - Sensitive to vibration
 - Nozzle may become blocked

(Any 4 × 1)

(4)

- 5.2
- Supply voltage variations✓
A regulator called a barretter lamp or cross coil instrument can be used.✓
 - Load resistor✓
To compensate for this, the load resistance is larger than the potentiometer resistance.✓
 - Lead wires✓
To compensate for this, the resistance value of the receiver is high.✓

(6)

[20]

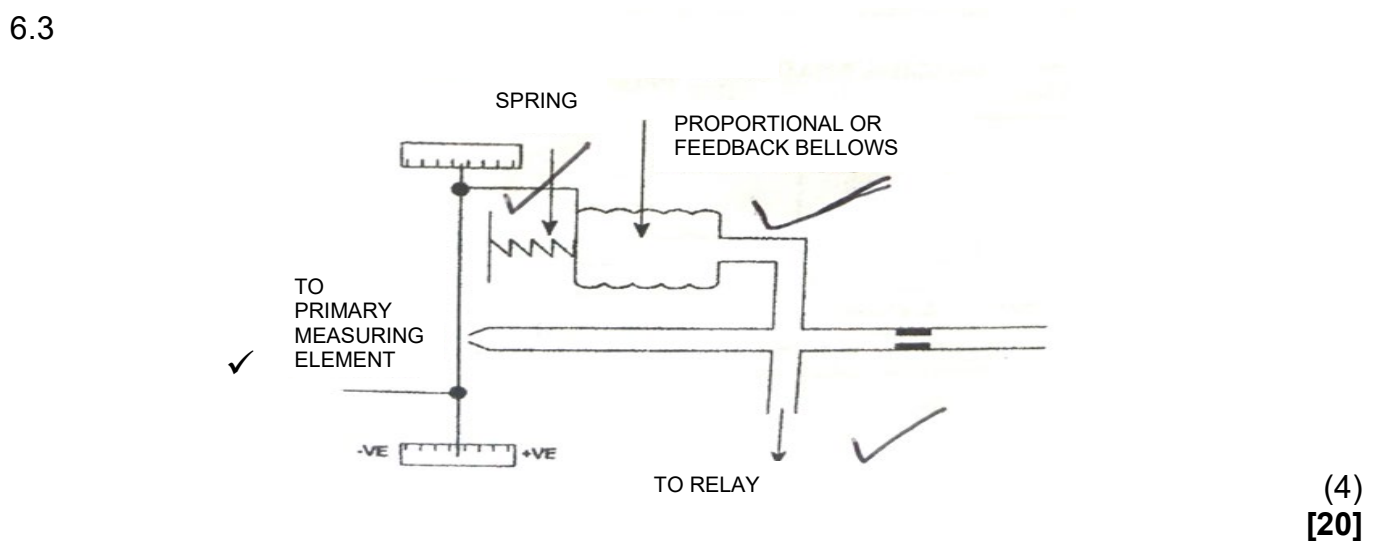
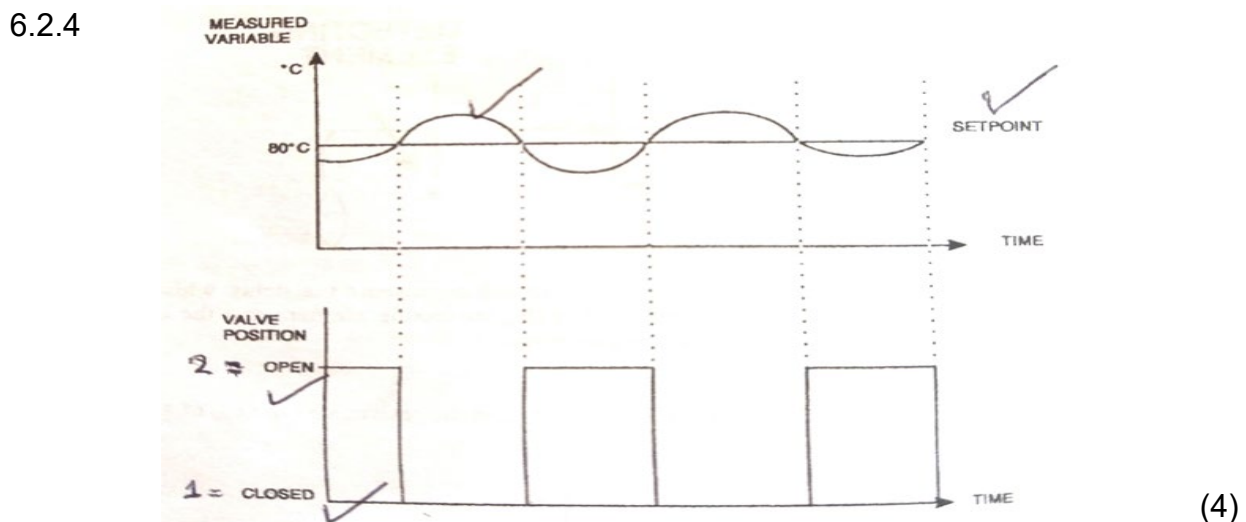
QUESTION 6

- 6.1 A Proportional
 B Integral
 C Derivative
 D Proportional and integral
 E Proportional and derivative
 F Proportional integral and derivative (6)

- 6.2 6.2.1 • Open-loop control system
 • Requires the operator to take corrective action. (2)

- 6.2.2 Two-step control action or ON–OFF control action (2)

- 6.2.3 A two-step control is when the controller controls between two extreme outputs, e.g. open or closed. (2)



TOTAL SECTION B: 80
GRAND TOTAL: 100