higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 2

XX February 2020

This marking guideline consists of 7 pages.

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QUESTION 1

1.1 1.1.1 Measures the amount of potential injury✓ that may occur if a safety system fails✓

1.1.2 Safety function✓ with a specified SIL assigned to it✓

1.1.3 Refers to an emergency or safety shutdown system✓ or safety interlock✓

(3 × 2) (6)

1.2 1.2.1 The instrument is used to test whether or not an installed instrument is functioning.✓ It is only used to test systems✓ and to determine whether a system failure or an instrument failure has occurred.✓

1.2.2 The instrument is used to measure very low electrical potential differences.✓ It is used again to generate very low electrical potential differences.✓✓

(2 × 3) (6)

1.3
- Pneumatic
- Electronic
- Wireless
- Field bus
- Fibre

(Any 3 × 1) (3)

[15]

QUESTION 2

2.1 2.1.1
- Low cost
- Available with fail-safe springs
- Small package and design
- Outstanding control
- High thrust when there are low air-supply pressures

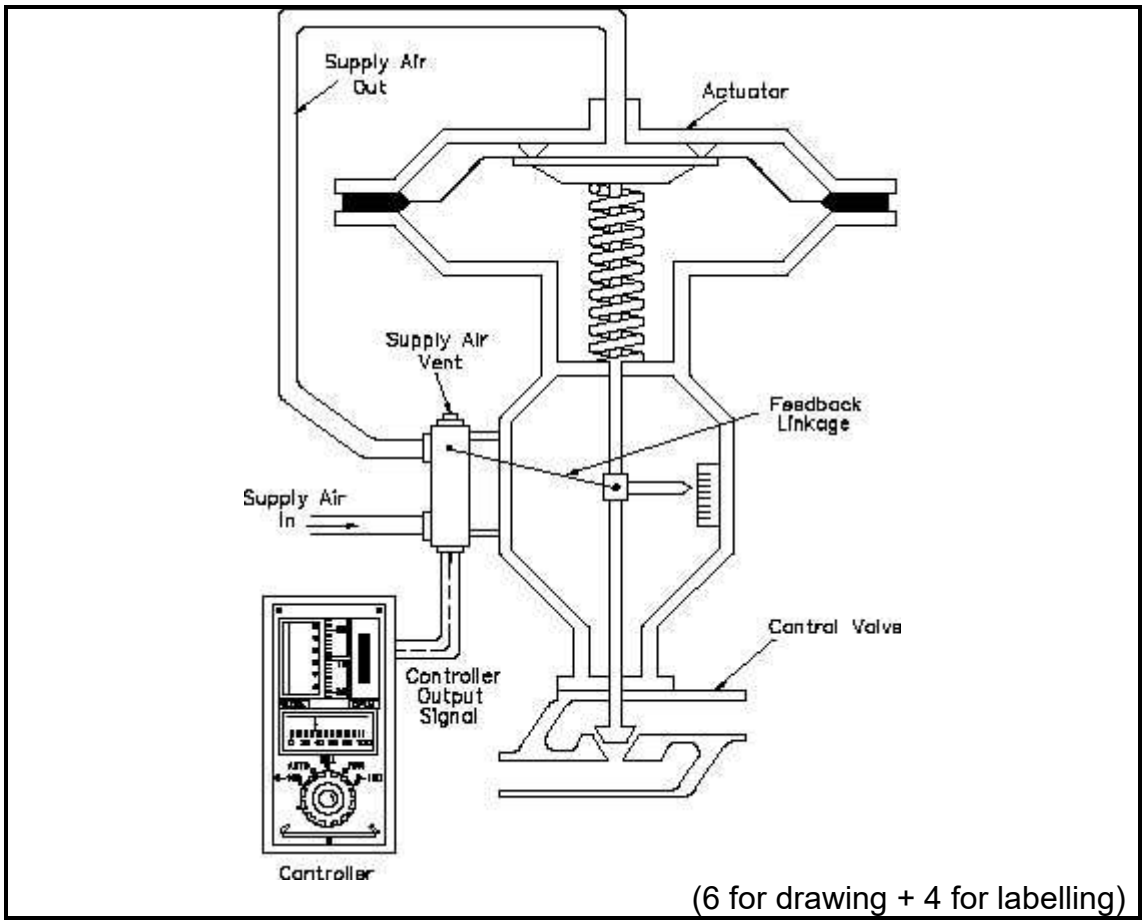
(Any THREE)

2.1.2
- Low cost
- Reasonable thrust
- Fast speed
- High torque capability
- Long stroke
- Small package and design
- Works at high temperatures (Any THREE)

2.1.3
- Simpler
- Costs less
- Maximum force in each direction
- More reliable than a spring-return actuator (Any THREE)

(3 × 3) (9)

2.2



(6 for drawing + 4 for labelling) (10)

2.3
- Conveyor system
- Radial drills
- Transfer machines
- Boring and milling machines
- High-speed production equipment (5)

2.4 2.4.1
- Faulty connections
- Incorrect or faulty power supply
- Incorrect current
- Circuit failure
- Air leaks
- Failure of the circuit board
- Obstructions
- Incorrect operating parameters
- Block output connection
- Incorrect air-supply pressure (Any 5 × 1) (5)

2.4.2 Check the following settings✓ at regular intervals:✓
- Air quality✓ – Poor-quality air can cause metal chips, dirt and oil to enter the system and restrict the nozzle.✓
- Blockages✓ – The exhaust port of the positioned is used to vent air into the atmosphere. Foreign objects stuck inside the opening can also cause problems.✓ (6)

2.5
- Incorrect design of the system
- Fault within the system (2)

[37]

QUESTION 3

3.1 3.1.1
- Pascal's law
- Charles' law
- Boyle's law (3)

3.1.2
- Pascal's law states that, because fluids are continuous media,✓ pressure imposed on a fluid at rest is transmitted undiminished to all other points in the fluid✓ and to the walls of the containing vessel.✓

- Charles' law states that, at constant pressure, the volume of a given amount of gas will increase if the temperature increases or the volume of a given amount of gas✓ is directly proportionate to its temperature✓ if the pressure does not change.✓

- Boyle's law states that, if the temperature stays the same,✓ a certain amount of gas will have less pressure✓ and a higher volume.✓ (3 × 3) (9)

3.1.3 Pascal's law
- $\Delta P = pg(\Delta h)$✓

Charles' law
- V∝T✓

Boyles' law
- P∝1/V✓ (3)

3.2 3.2.1 $F = m \times g$
$= 80 \times 9{,}81$✓
$= 784{,}8$ N✓ (2)

3.2.2 P = Force/Area✓
= 784,8/0,025✓
= 31,392 Pa✓ (3)

3.3	3.3.1	H		
	3.3.2	E		
	3.3.3	A		
	3.3.4	F		
	3.3.5	I		
	3.3.6	G		
	3.3.7	B		
	3.3.8	D		
	3.3.9	J		
	3.3.10	C		
			(10 × 1)	(10)
				[30]

QUESTION 4

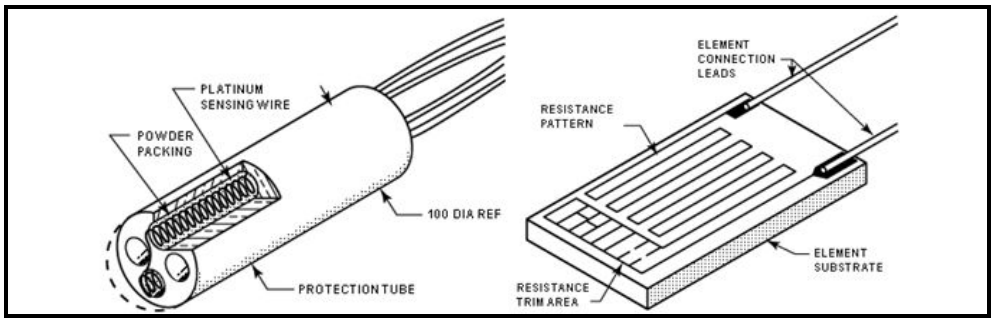
4.1	4.1.1	True		
	4.1.2	True		
	4.1.3	False		
	4.1.4	False		
	4.1.5	True		
			(5 × 1)	(5)

4.2 4.2.1
- Air-, gas- and liquid-temperature measurement
- Commercial and industrial applications
- Laboratories and other environments
- Air-conditioning and refrigeration servicing
- Food processing
- Stoves and grills
- Textile production
- Plastics processing
- Petrochemical processing
- Microelectronics
- Exhaust gas temperature measurement (Any 3 × 1) (3)

4.2.2
- RTDs must be powered to function.
- RTDs are seldom used for temperatures above 660 °C in industrial applications.
- Platinum RTDs are not as sensitive to low temperatures as thermistors. It also takes longer to respond than thermistors. (3)

4.2.3
- Nickel
- Copper
- Nickel iron (3)

4.2.4



(5)

4.2.5
- Insert the RTD into the process hole or opening.
- Tighten the RTD in place by turning it into the threaded connection.
- Connect the RTD to a gauge or dial according the manufacturer's specifications.
- RTDs should be installed away from lines to prevent electrical noise. (4 × 2) (8)

4.2.6 Install it in the appropriate place.✓ Give it a few moments to adjust to the temperature✓ and check to see whether it has a reading on the externally installed gauge.✓ (3)

[30]

QUESTION 5

5.1 5.1.1 ID = outside diameter – 2 × wall thickness✓
= 457 – 2 × 7,92✓
= 457 – 15,84
= 441,16 mm✓
= 0,441 m✓

$V = 1,274 (q/d^2)$✓
$= 1,274(3/0,441^2)$✓
= 19,652 m/s✓✓ (8)

5.1.2 ID = OD – 2 × wall thickness✓
= 73 – 2 × 5,16✓
= 62,68 mm or 0,06268 m✓✓

$V = 1,274 (q/d^2)$✓
$q = V \times d^2/1,274$
$= 3 \times 0,062268^2/1,274$✓
$= 0,00925\ m^3/s$✓✓ (8)

5.2 5.2.1 A: Nutating-disc flowmeter
B: Oscillating-piston flowmeter
C: Oval-gear flowmeter (Any 3 × 2) (6)

5.2.2 It is used to measure the quantities or volumes of liquid✓✓ that flow from place to place.✓✓ (4)

5.2.3
- It is frequently used for fluids with a high viscosity because it is insensitive to changes in viscosity.
- The rotating-piston meter measures small volumes well.
- Nutating-disc meters are used when a longer meter life is needed.
- Positive-displacement flowmeters are usually employed for applications with low volumes.
- These meters are also widely used in applications of custody transfers when duty must be paid on commodities like wines, spirits and petrol. (5)

5.2.4
- It cannot be used for low flow rates.
- It cannot be used with particles bigger than 100 µm, since it cannot tolerate suspension in flows very well.
- It is not recommended that these meters are used with liquids that contain a lot of gas bubbles.
- These meters should not be run at excessively high speeds, as it can suffer severe damage.
- It is not suited for measuring high volumes. (5)

5.2.5
- Chamber
- Reciprocating or rotating mechanical unit (2)

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TOTAL: 150

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