higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS CONTROL
NQF LEVEL 3

15 November 2022

This marking guideline consists of 5 pages.

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QUESTION 1

1.1 True
1.2 True
1.3 False
1.4 True
1.5 True
1.6 True
1.7 True
1.8 False
1.9 False
1.10 True

(10 × 1) **[10]**

QUESTION 2

2.1 2.1.1

- Standard unit of measurement provides a reference point by which objects of weight, length or capacity can be described,✓ to ensure fairness and transparency.✓
- To reduce the incidence of retail fraud.✓
- As science progressed, a need arose to relate the measurement systems of different quantities, like length and weight and volume.✓
- To make our judgement more reliable and precise,✓ we need a common unit of measurement.
- It helps everyone to understand measurements in a set of unit systems.✓
- A standard measurement system is important because it allows scientists to compare data and communicate with each other about their results.✓ (7)

2.2 2.2.1 Pneumatic signals are produced by changing the air pressure in a signal pipe proportional to the measured change in a process variable.✓ The common industry standard pneumatic range is 3–15 psig.✓ The 3 psig corresponds to the lower range value✓ and the 15 psig corresponds to the upper range value.✓ (4)

2.2.2

- Electrical signal transfer methods are divided into two groups, namely analogue signals, and digital signals.✓
- Analogue signal is a continuous signal.✓
- The most common standard electrical signal is the 4–20 mA current signal,✓
- where 4 mA represents the lowest measurement, or zero and 20 mA represent the highest measurement.✓
- Digital signals are discrete levels or values,✓ with two bit '1' indicating HIGH and bit '0' indicating LOW.✓ (6)

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2.2.3 Radio signals are electromagnetic waves generated by time-varying electric currents,✓ consisting of electrons flowing through a metal conductor called an antenna.✓ (2)

2.3 2.3.1 °C= Kelvin – 273
= 400 - 273✓
= 127 °C✓ (2)

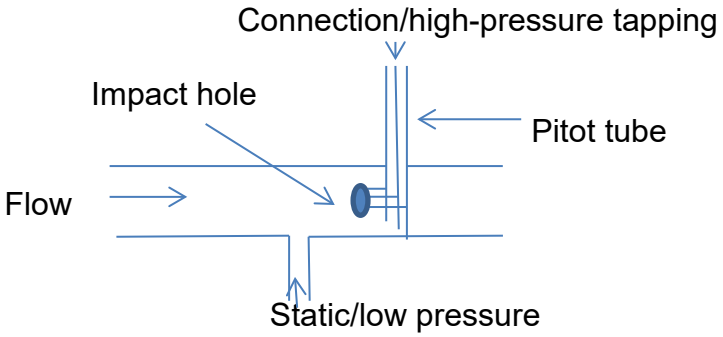
2.3.2 K = [(°F - 32) × 5/9] + 273✓
= [(35 - 32) × 5/9] + 273✓
= 275 K✓ (3)
[24]

QUESTION 3

3.1 Direct methods involve measuring the height of fluid directly,✓ e.g. With a dipstick, overflow pipe, float, or sight glass.✓ With indirect methods, another variable is measured that correlate to the liquid level,✓ e.g., pressure.✓ (4)

3.2 3.2.1
- Oscillation piston
- Oval gear
- Nutating disc.
- Rotating vane
- Reciprocating piston (Any 3 × 1) (3)

3.2.2 Diagram of the Pitot tube



1 mark for correct labelling (5)

3.3 3.3.1
1. *Seebeck effect.* It states that the voltage produced in a thermocouple✓ is proportional to the temperature between the two junctions.✓✓
2. *Peltier effect.* It states that if a current flows through a thermocouple✓ one junction is heated (puts out energy)✓ and the other junction is cooled (absorbs energy).✓ (6)

3.3.2 Bi-metal strips consist of two different metals welded together to form a cantilever.✓ When heated, both metals expand,✓ but the metal with the high expansion coefficient expands more than the metal with the lower expansion coefficient.✓ The result is that the one with a high coefficient of the strip becomes longer than the one with a lower coefficient,✓ causing the cantilever curls upwards or downwards.✓ (5)

[23]

QUESTION 4

4.1 4.1.1 A fail-safe system is one ensuring that in the event of an equipment failure✓ or in the event of any fault appearing, the system will always go to a safe status,✓ normally affecting availability.✓ (3)

4.1.2 A device designed to prevent damage to equipment and personnel by stopping or preventing the start of certain equipment if a preset condition has not been met.✓✓ (2)

4.2 4.2.1 Flow Control Element
4.2.2 Pressure Transmitter
4.2.3 Temperature Indicator Recorder
4.2.4 Pressure Indicator Controller
4.2.5 Level Indicator Controller
4.2.6 Temperature Transmitter

(6 × 1) (6)

4.3 4.3.1 Proper design, implementation, operation, and maintenance of plant alarm system.✓✓ (2)

4.3.2 (a) Flash when there is a hazards situation✓✓

(b) Make noise when there is a hazardous situation✓✓

(2 × 2) (4)

4.4
- Mechanical failure
- Malfunction
- Improper installation
- Unknown external forces
- Lack of maintenance

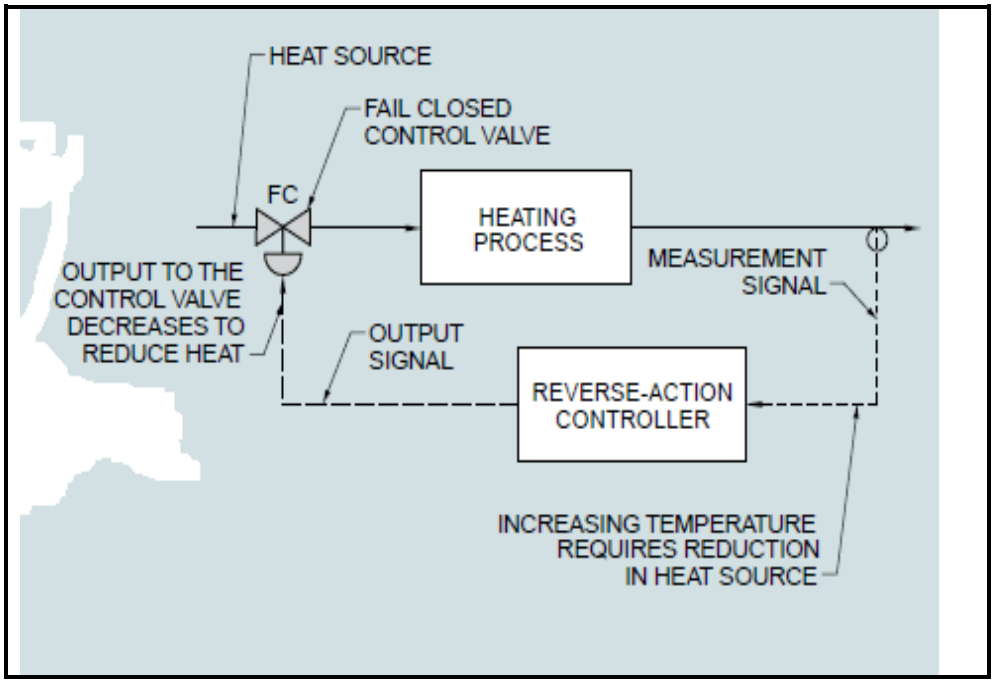
(Any 4 × 1) (4)

[21]

QUESTION 5

5.1 5.1.1 Closed-loop control or feedback control loop (2)

5.1.2



(6)

5.2 5.2.1 Only one process variable, namely drum level, is used as input to the control loop.✓ Drum level is measured and transmitted to a level controller,✓ which in turn manipulates the feedwater control valve✓ As the water level lowers, the valve opens✓ and as the water level rises the valve closes.✓ (5)

5.2.2 With a two-element system, both drum level and steam flows are used to regulate the feedwater flow into the drum.✓ With two-element control, the steam flow rate is measured and transmitted to a proportional positioning controller which compares the flow rate to the desired set point.✓ If any deviation exists, a control signal is transmitted to the feedwater controller to increase or decrease the feedwater flow.✓ A secondary signal is also sent to the feedwater controller from the drum level controller.✓ (4)

5.3
- Primary section for separation
- Secondary section (settling liquid)
- Mist extractor to remove any liquid from the gaseous part
- Gas outlet
- Liquid outlet (5)

[22]

TOTAL: 100

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