higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 3

(6060463)

7 December 2020 (X-paper)
09:00–12:00

This question paper consists of 6 pages and 1 formula sheet.

359Q1N2007

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TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Start each question on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	Device using air pressure to send out its signals	A	electronic signals
1.1.2	Device changing the range, frequency or shape of air- or gas-pressure signals	B	electronic transmitter
1.1.3	Preferred in large process plants	C	isolating diaphragm
1.1.4	Variable resistor where resistance is changed by process conditions	D	converter
1.1.5	Device protecting the electronic measuring components from high pressures and converts high pressures to lower pressures before it reaches the pressure sensor	E	pneumatic transmitter
		F	pressure sensor
		G	capillary tubing

(5 × 1) (5)

1.2 List EIGHT main components of a convertor. (8)

1.3 1.3.1 What are pneumatic transmitters commonly used for? (5)

1.3.2 Give TWO applications of pneumatic transmitters. (2)

1.3.3 Give FIVE disadvantages of pneumatic transmitters. (5)

[25]

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QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 The law of intermediate materials states that the sum of the thermo-electromotive forces in a circuit composed of any number of dissimilar materials is zero when the entire circuit is at the same temperature.

2.1.2 The law of intermediate temperature states that if two standardised but dissimilar metals produce a thermal emf of V1 when the junctions are at temperatures T1 and T2, and a thermal emf of V2 when the junctions are at T2 and T3, the emf generated when the junctions are at T1 and T3 will be V1 + V2.

2.1.3 A bimetallic thermometer obtains its temperature by measuring the change in length of the strip material in the form of expansion or contraction.

2.1.4 A thermistor is a special type of capacitor.

2.1.5 The first thing that must be done when dismantling an old thermistor is to open the case of the circuit.

(5 × 1) (5)

2.2 2.2.1 List FOUR types of pyrometers. (4)

2.2.2 Draw and label the FOUR pyrometers listed in QUESTION 2.2.1.

(4 × 5) (20)

2.3 When must a thermometer be recalibrated? (4)

2.4 Give TWO applications of a thermistor. (2)

[35]

QUESTION 3

3.1	3.1.1	What does *open channel* mean?	(2)
	3.1.2	Explain the purpose of open-channel flow measurement.	(4)
	3.1.3	Explain the disadvantages of open-channel flow measurement.	(3)
3.2		Which FOUR important facts should be kept in mind when setting flume in concrete? (4 × 2)	(8)
		Give FIVE tips to keep in mind before installing an electromagnetic flowmeter. (5 × 2)	(10)
3.4		How is calibration done in an electromagnetic flowmeter?	(6)
3.5	3.5.1	Name the TWO types of ultrasonic flowmeters.	(2)
	3.5.2	Make a neat freehand drawing of each of the TWO meters named in QUESTION 3.5.1. (4 + 4)	(8)
	3.5.3	Give the mathematical formulae for each meter named in QUESTION 3.5.1.	(2)
			[45]

QUESTION 4

4.1 Explain the term *level measurement*. (2)

4.2 4.2.1 Name the TWO categorise of level measurement. (2)

4.2.2 Differentiate between the TWO categories named in QUESTION 4.2.1. (2 + 2) (4)

4.3



4.3.1 Name the measuring instrument shown above. (1)

4.3.2 Give FIVE uses of this measuring instrument. (5)

4.3.3 Explain the basic working principle of this measuring instrument. (10)

4.3.4 Name the TWO common problems associated with this measuring instrument. (2 + 2) (4)

4.4 4.4.1 Draw a labelled diagram of a vibrating level-measuring instrument. (7)

4.4.2 Give FIVE tips for installing a vibrating level-measuring instrument. (5)

4.4.3 Give FIVE challenges inherent to using a vibrating level-measuring instrument. (5)

[45]

TOTAL: 150

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FORMULA SHEET

$P_G = P_{abs} - Pa$

$P_1 - P_2 = h\rho g$

$P_1 - P_2 = d\rho g\left(\frac{A1}{A2} + 1\right)$ **OR** $P_1 - P_2 = d\rho g\left(\frac{A2}{A1} + 1\right)$

$P = \frac{Mg}{A}$

$\frac{Q1}{Q2} = \frac{k\sqrt{h1}}{k\sqrt{h2}}$

Dry calibration $= \frac{P1-P2}{\rho g}$

Wet calibration $= \frac{P1-P2}{(\rho 2 - \rho 1)g}$

W.C. $= \left(\frac{P1-P2}{(\rho 2 - \rho 1)}\right) \times$ D.C.

D.C. $= \left(\frac{P1-P2}{\rho 2}\right) \times$ W.C.

$H = \frac{\Delta P}{\rho g}$

$H = h\frac{\rho 2}{\rho 1}$

$t° = 9/5\ t + 32\ °F$

$t\ °C = (t + 273{,}15)$ kelvin

$t\ °F = 5/9\ (t - 32)\ °C$

$V = IR$

$€ = \Delta L/L$

$K = \Delta R/R \div \Delta L/L$

$C = K\ A\ E/d$

$R_t = R_o\ (1 + \acute{\alpha}T + ɞT^2)$

Vmeter = Voltage drop AB – Voltage drop AD

Balance: Potential at A = Potential at B

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