higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 3

(6060463)

26 February 2020 (X-paper)
09:00–12:00

This question paper consists of 6 pages.

057Q1S2026

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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 section 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 List FIVE common problems associated with the failure of electronic pressure-measuring instruments. (5)

1.2 Explain how the problems listed in QUESTION 1.1 affect the electronic pressure-measuring instruments. (5 × 2) (10)

1.3 Which steps must be taken when zero-checking pneumatic transmitters and converters? (8)

[23]

QUESTION 2

2.1 2.1.1 Name FIVE types of temperature-measurement devices commonly used in manufacturing. (5)

2.1.2 Explain why the temperature-measurement devices named in QUESTION 2.1.1 must be calibrated. (5)

2.1.3 How often should a device be calibrated? (3)

2.1.4 What should be considered when establishing calibration frequency? (3 × 2) (6)

2.1.5 Explain how to calibrate a temperature-measurement device. (3)

2.2 2.2.1 Draw a glass thermometer. (3)

2.2.2 Explain how this thermometer works. (3)

2.2.3 Give FIVE advantages and FOUR disadvantages of a thermistor. (5 + 4) (9)

[37]

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QUESTION 3

3.1 Explain in detail how to install a weir in a flow stream. (9 × 2) (18)

3.2 3.2.1 Make a labelled drawing of a vortex flowmeter. (10)

3.2.2 Explain the principle of operation of a vortex flowmeter. (5)

3.3 This meter has become one of the most versatile and reliable means to measure the flow of liquids or gasses in nearly any environment. Its strength is in the ability to measure multiple attributes over sustained periods with high repeatability and little maintenance.

Make a drawing that fits the given description. (7)

3.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.4.1–3.4.5) in the ANSWER BOOK.

3.4.1 Ultrasonic flowmeters can reliably measure liquids with entrained gasses.

3.4.2 Ultrasonic flowmeters are recommended for primary sludge, mixed liquor, aerobically digested sludge, dissolved air-flotation thickened sludge and its liquid phase.

3.4.3 Vortex meters require the use of straightening vanes or straight upstream piping to eliminate distorted flow patterns and swirl.

3.4.4 Coriolis meters work by measuring the mass flow rate and density of a fluid or gas as it flows through a vibrating tube.

3.4.5 Electromagnetic flowmeters use Faraday's law of electromagnetic induction to measure the process flow.

(5 × 1) (5)

[45]

QUESTION 4

4.1 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–J) next to the question number (4.1.1–4.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.1.1	Instrument technique designed to measure the height of a fluid or solid within a containing vessel	A	point measurement
4.1.2	Sensors that measure levels within a specified range and determine the exact amount of substance in a certain place	B	level measurement
4.1.3	Sensors that only indicate whether the substance is above or below the sensing point	C	continuous measurement
4.1.4	Switches that detect the height of a liquid or solid in a tank or another type of vessel	D	calibration
4.1.5	Two piezoelectric crystals present in the base of the probe	E	wet calibration
4.1.6	Ratio frequency applied to the probe and continuously observed to measure the change caused by the surroundings	F	dry calibration
4.1.7	Works either by absorption of acoustic energy as it travels from source to receiver or by the attenuation of a vibrating diaphragm surface	G	ultrasonic
4.1.8	Procedure to maintain accuracy of an instrument	H	vibrating point
4.1.9	Manometer calibrated with air	I	level switches
4.1.10	Manometer used to measure liquid flow calibrated to a higher differential pressure to compensate for the apparent density loss of the sealing fluid	J	capacitance

(10 × 1) (10)

4.2	4.2.1	To which height will the mercury rise when a differential pressure of 2 bar (200 kPa) is applied to a manometer under dry conditions?	(4)
	4.2.2	Calculate the height of the mercury when the same differential pressure of 200 kPa is applied when using the manometer to measure water flow (wet conditions).	(4)
4.3	4.3.1	Explain the ultrasonic operating principle.	(6)
	4.3.2	What must be considered when installing an ultrasonic transducer? (3 × 2)	(6)
	4.3.3	Name TWO conditions that will have an adverse effect on ultrasonic level measurement. (2 × 2)	(4)
4.4	4.4.1	Briefly explain the operating principle of a capacitance level probe.	(5)
	4.4.2	Draw a capacitive level meter.	(6)
			[45]

TOTAL: 150

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