higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 3

(6060463)

6 December 2023 (X-paper)
09:00–12:00

This question paper consists of 7 pages and a formula sheet.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

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INSTRUMENTATION TECHNOLOGY
NQF LEVEL 3
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. Use only a black or blue pen.
5. Write neatly and legibly.

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QUESTION 1

1.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 Pressure can be defined as the amount of force on a unit area.

1.1.2 A pneumatic transmitter uses air pressure to send out signals.

1.1.3 Most convertors are calibrated in the laboratory to the range specified by the customer.

1.1.4 Electronic transmitters and convertors are used to measure temperature, pressure, flow and levels in processes and systems.

1.1.5 An electronic transmitter can be seen as a variable resistor where the resistance is changed by the process conditions.

(5 × 1) (5)

1.2 List FIVE components of a convertor. (5)

1.3 Give FIVE tips that need to be considered when installing a pneumatic transmitter and convertor. (5 × 2) (10)

1.4 Name TWO important types of maintenance that is required for pneumatic transmitters and convertors. (4)

[24]

QUESTION 2

2.1 Pyrometers:

2.1.1 Name FIVE advantages of pyrometers. (5)

2.1.2 List FIVE disadvantages of pyrometers. (5)

2.1.3 Name THREE areas where pyrometers can be used. (3)

2.2 Thermistors are used as temperature sensors.

Explain how you would go about installing a thermistor. (10)

2.3 Fever is one of the most typical clinical symptoms of Covid-19. Non-contact infrared thermometers are commonly used to screen for fever.

2.3.1 Draw any instrument that measures human temperature. (4)

2.3.2 Explain how the instrument drawn in QUESTION 2.3.1 works. (5)

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2.4 Explain the following terms:

2.4.1 Meniscus

2.4.2 Parallax error

(2 × 2) (4)

[36]

QUESTION 3

3.1 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (3.1.1–3.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1.1	Irrigation, drainage, sewer canals	A	electromagnetic induction
3.1.2	Large obstruction in flow	B	transmitter
3.1.3	Thick liquid, usually very dark in colour, that does not mix easily with a fluid	C	Doppler meter
3.1.4	The process of passing a conductor through a magnetic field created by electromagnetic coils in order to produce a voltage	D	weir type
3.1.5	Device that converts measurements from a sensor into a signal	E	Coriolis mass flow meter
3.1.6	Measures the flow of water, steam or gases in pipes	F	rectangular weir
3.1.7	Used where it is important to know the mass that flows through the system	G	artificial channels
3.1.8	This meter requires two sensors: one to send the wave and the other to receive the reflected wave	H	Parshall
3.1.9	The most commonly used thin weir plate for larger flows	I	tracer methods
3.1.10	This flume consists of an upstream section, a throat and a diverging downstream section	J	Palmer-Bouwlus
		K	non-contact open channel
		L	vortex

(10 × 1) (10)

3.2 In industry, the vortex is used in different processes.

3.2.1 List these processes. (6)

3.2.2 Explain how vortex flow meters work. (5)

3.2.3 Explain how you would go about calibrating the meter. (5)

3.2.4 What are the problems that can occur with this meter? (5)

3.3 With the aid of a neat, labelled drawing, show the operating principle of a typical electromagnetic flow meter.

Pay attention to highlighting the following components:

- Voltage meter
- Fluid flow
- Magnetic coils
- Electrodes (8)

3.4 Complete the table below for a weir-type flow meter. Write only the missing word or words next to the question number (3.4.1–3.4.3) in the ANSWER BOOK.

ADVANTAGES	DISADVANTAGES
Measurement accurate to within at least 4%	(3.4.1) …
(3.4.2) …	Vulnerable to blockages by debris
Fewer problems when installed correctly	(3.4.3) …

(3 × 1) (3)

3.5 Give THREE examples of open flow channels. (3)

[45]

QUESTION 4

Level measurement theory:

4.1 4.1.1 Explain the following:

(a) Continuous level measurement

(b) Discrete level measurement

(2 × 2) (4)

4.1.2 Name FIVE ways that can be used to measure the level of a liquid. (5)

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4.2 Use calculations to solve the following:

4.2.1 Calculate the level of water in a tank. The height between the two mercury levels in a U-tube manometer is 0,5 m. The zero level of the manometer is in line with the zero level of the tank. (6)

4.2.2 Calculate to what height the mercury in a U-tube manometer will rise above the zero mark. The level in the water tank is 7,5 m. The zero level of the manometer is in line with the zero level of the tank. (6)

4.3 Make a neat, labelled diagram of a conductive level measuring instrument and explain how you would go about installing its sensor. (12)

4.4 Explain how the following activities are performed:

4.4.1 Installing a conductive level measuring instrument

4.4.2 Installing a capacitive level measuring instrument

4.4.3 Calibrating a vibrating level measuring instrument

(3 × 3) (9)

4.5 Complete the following paragraph by writing only the missing word or words next to the question number (4.5.1–4.5.3) in the ANSWER BOOK.

(4.5.1) … measurement devices are used when you want to know the change in the level of fluid inside a tank or the pressure level. These devices are designed to be sensitive, because they must be able to measure the slightest change in the (4.5.2) … The limit of this device depends on the size of the (4.5.3) … .

(3 × 1) (3)

[45]

TOTAL: 150

FORMULA SHEET

1. $H_L = \left(\frac{\rho_m}{\rho_L} \times h\right) - h/2$

2. $\rho_L g H_L + \rho_L g\, h/2 = \rho_m g\, h$

3. $H_L = \left(\frac{\rho m}{\rho_L} \times h\right) - H_1 - h/2$

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