higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 3

(6060463)

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09:00–12:00

This question paper consists of 9 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
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. Start each section on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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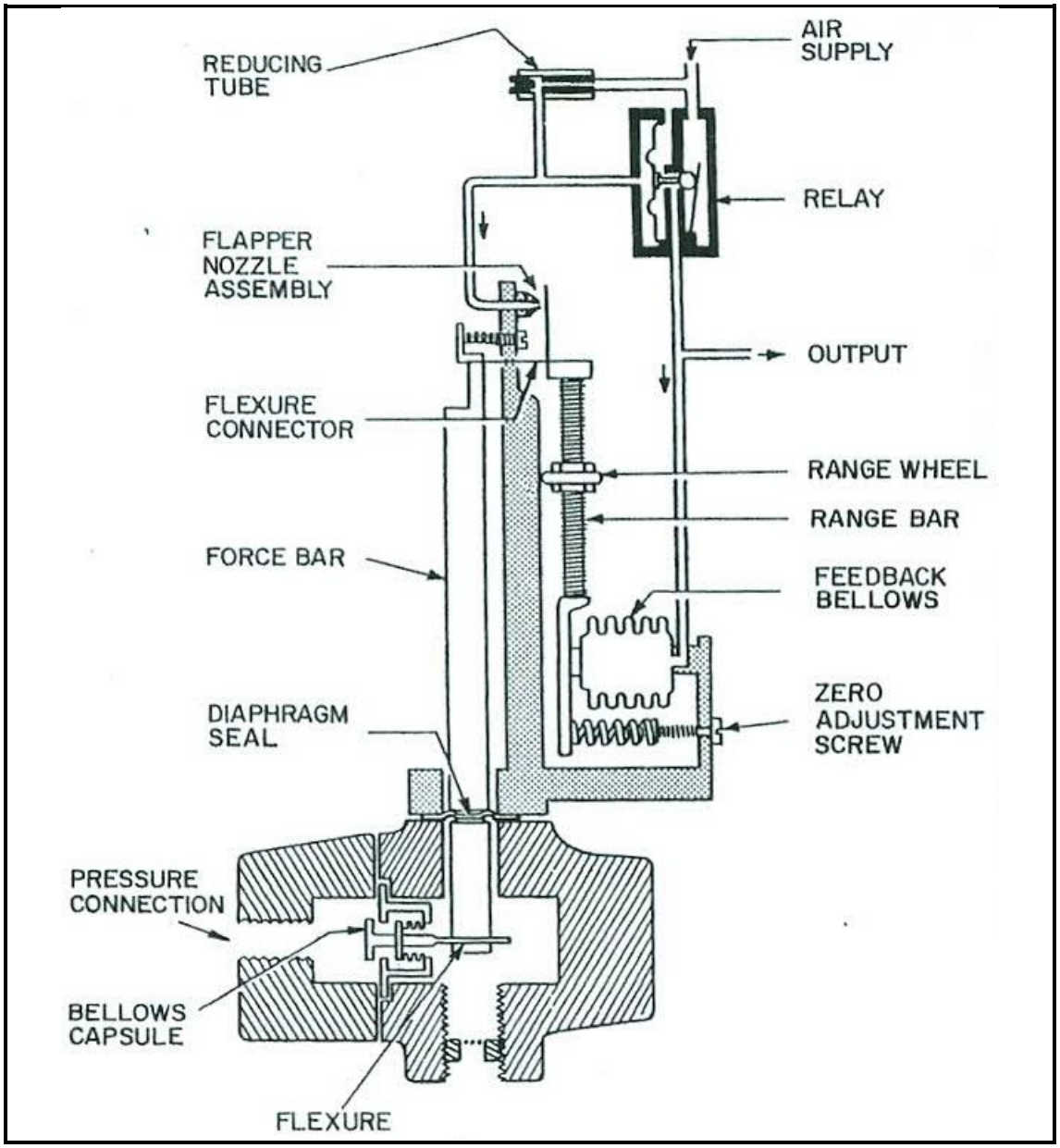
QUESTION 1

1.1 Look at the diagram below and answer the questions that follow.



[Source: *www.google/images.co.za*]

1.1.1 What is the instrument above used for? (2)

1.1.2 The instrument in the picture above helps to achieve two specific goals in any process operation.

List those goals. (4)

1.1.3 Give FIVE disadvantages of this instrument. (5)

1.1.4 After installation of the instrument above, explain how you will verify that it is working as expected. (3)

1.2 Choose a/an term/item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–L) next to the question number (1.2.1–1.2.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.2.1	It uses air pressure to send out its signals	A	converter
1.2.2	The lowest and highest readings that an instrument can measure	B	PPE
1.2.3	It is suitable as an intermediate element between pneumatic and electric control and measuring equipment	C	bellow chamber
1.2.4	A device that receives information in the form of one or more instrument signals	D	range
1.2.5	The standard requirement in all industrial work	E	relay
1.2.6	Checking, adjusting and ensuring that the range of an instrument is correct	F	inaccurate alignment
1.2.7	The point on the instrument where measurements starts	G	pneumatic transmitter
1.2.8	A standardised pressure measurement system consisting of three components	H	pressure transducer
1.2.9	The area where the air to be pumped comes from	I	zero point
1.2.10	This can cause excessive wear on bearings or other mechanical parts	J	diaphragm
		K	capillary tube
		L	calibration

(10 × 1) (10)
[24]

QUESTION 2

2.1 In your own words explain the discoveries made by the following scientists/professors.

2.1.1 Seebeck

2.1.2 Peltier

2.1.3 Thompson

(3 × 3) (9)

2.2 Expansion thermometers indicate temperature by means of the change in volume or pressure of the liquid or gas inside it.

2.2.1 Make a neat, labelled diagram of a gas expansion thermometer. (5)

2.2.2 Explain Charles's Law. (2)

2.2.3 Complete the following sentence or sentences/paragraph or paragraphs by writing only the missing word or words next to the question number (a–d) in the ANSWER BOOK.

The principle of operation for the expansion thermometers.

In the liquid filled thermometer the pressure is held (a) … and volume is allowed to (b) … .

In the gas filled thermometer the volume is held (c) … and the pressure is allowed to (d) … .

(4 × 1) (4)

2.2.4 Explain step by step the basic calibration procedure for the expansion thermometers. (6)

2.3 Give TWO reasons that will necessitate that the thermometer be recalibrated. (2)

2.4 Name FIVE disadvantages of thermistors. (5)

2.5 List THREE things that can be done as part of preventative maintenance on thermometers because they can be easily damaged and then give incorrect readings. (3)

[36]

QUESTION 3

3.1 Explain in your own words what you understand about the three types of flow channels.

3.1.1 Open Channel

3.1.2 Artificial Channel

3.1.3 Natural Channel

(3 × 2) (6)

3.2 Free surface flow refers to partially filled pipes.

Give THREE conditions that must be known when measuring flow rate in the partially filled pipes. (3)

3.3



VORTEX FLOWMETER

3.3.1 What is the vortex meter used for? (2)

3.3.2 Give FOUR different types of flow that this instrument can measure. (4)

3.3.3 What are the FOUR advantages of this instrument? (4)

3.4 Make a neat, labelled diagram to show the operating principle of an electromagnetic flow meter and in your own words explain the electromagnetic induction process. (10)

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3.5 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (3.5.1–3.5.10) in the ANSWER BOOK.

3.5.1 The exit stream is directly related to the water depth and has side slopes in the vertical to horizontal ratio of 4:1.

A Rectangular
B Triangular
C Trapezoidal
D Tracer

3.5.2 The most commonly used thin plate weir for larger flows.

A Rectangular
B Triangular
C Trapezoidal
D Tracer

3.5.3 The exit stream is directly related to the water depth above the bottom of the V.

A Rectangular
B Triangular
C Trapezoidal
D Tracer

3.5.4 Large obstruction in the flow.

A Weir
B Velocity
C Flume
D Tracer

3.5.5 It is a pipe like structure built in a specific shape and size to meet certain standards and requirements.

A Weir
B Velocity
C Flume
D Tracer

3.5.6 Thick liquid usually very dark in colour which does not mix easily with the fluid.

A Weir
B Velocity
C Flume
D Tracer

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3.5.7 The disadvantage of this instrument is that, if you want more accurate results, you have to be prepared to take many measurements and do calculations.

A Weir
B Velocity
C Palmer-Bowlus
D Parshall

3.5.8 Consist of an upstream section, throat and a diverging downstream section.

A Weir
B Velocity
C Palmer-Bowlus
D Parshall

3.5.9 Has a trapezoidal throat of uniform cross-section and a length about equal to the diameter of the pipe in which it is installed.

A Weir
B Velocity
C Palmer-Bowlus
D Parshall

3.5.10 $Q = 2/3\ b\sqrt{2gH^3}$ is a formula for:

A Weir
B Velocity
C Palmer-Bowlus
D Parshall

(10 × 1) (10)

3.6 Make the following calculations of a rectangular weir:

3.6.1 A rectangular weir with a channel base width of 2 meters is used in a small river. The head is 2.8 m.

Calculate the flow rate in m^3/s. (3)

3.6.2 What would the flow rate have been if the base width had been 1 meter rather than 2 meters? (3)

[45]

QUESTION 4

4.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (4.1.1–4.1.7) in the ANSWER BOOK.

4.1.1 Hydrostatic level measurement is done by using a differential pressure measuring unit.

4.1.2 Continuous level measurements are when a measurement can be taken at any time an exact value can be read.

4.1.3 To calculate the level of the tank, you must consider where the DP sensor is positioned in the tank.

4.1.4 Discrete level measurement is when a measurement can be taken at any time and an exact value can be read.

4.1.5 Level measurement is used to measure the volume of liquids and solids.

4.1.6 When liquid in a small tube creeps up making it difficult to read the level, this is called the error of parallax.

4.1.7 A conductive level measuring instrument is only used in conductive liquids.

(7 × 1) (7)

4.2 List FIVE different ways of measuring liquid. (5)

4.3 Make neat, labelled drawings of the following level measuring instruments and explain how they measure level.

4.3.1 Conductive level measuring instrument (12)

4.3.2 Capacitive level measuring instrument (12)

4.4 Do the following calculations about level measurements.

4.4.1 You want to measure the level of a tank. You know that the DP sensor is 0.6 m below the bottom of the tank. The sensor measured the water level of the tank at 2.2 m. What is the actual level of the tank? (3)

4.4.2 You have a level measurement of 2 meters. The maximum level that the tank can take is 4.4 meters.

What percentage of the tank is filled? (3)

4.5 Explain in your own words what zero suppression is. (3)

[45]

TOTAL: 150

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