higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 2

(6060452)

10 November 2022 (Y-paper)
13:00–16:00

This question paper consists of 7 pages and 1 formula sheet.

237Q1N2210

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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 blue or black pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 Define the following terms concerning the optimal performance of measuring instruments:

1.1.1 Accuracy

1.1.2 Precision

(2 × 2) (4)

1.2 Explain what the terms *class, group* and *division* refer to in the classification of hazardous areas. (3 × 2) (6)

1.3 Name FIVE common signal methods to transfer information from a sensor to a control room display. (5)

[15]

QUESTION 2

2.1 Name and explain the FOUR main purposes of control valves. (4 × 2) (8)

2.2 An actuator is a device that provides the power and motion to manipulate the moving parts of a valve or damper controlling fluid flow through a final element.

2.2.1 What is the purpose of a throttle valve?

2.2.2 What does valve flow characteristic mean?

2.2.3 What is the purpose of a positioner?

(3 × 2) (6)

2.3 Name SIX common problems of control valves. (6)

2.4 Explain the terms *flashing* and *cavitation* regarding control valves. (2 × 3) (6)

2.5 Make a labelled free-hand drawing of a limit switch as a valve accessory. (8)

2.6 Give THREE limitations of limit switches. (3)

[37]

QUESTION 3

3.1 Define the following:

3.1.1 Vacuum pressure

3.1.2 Atmospheric pressure

3.1.3 Dead-weight tester

(3 × 2) (6)

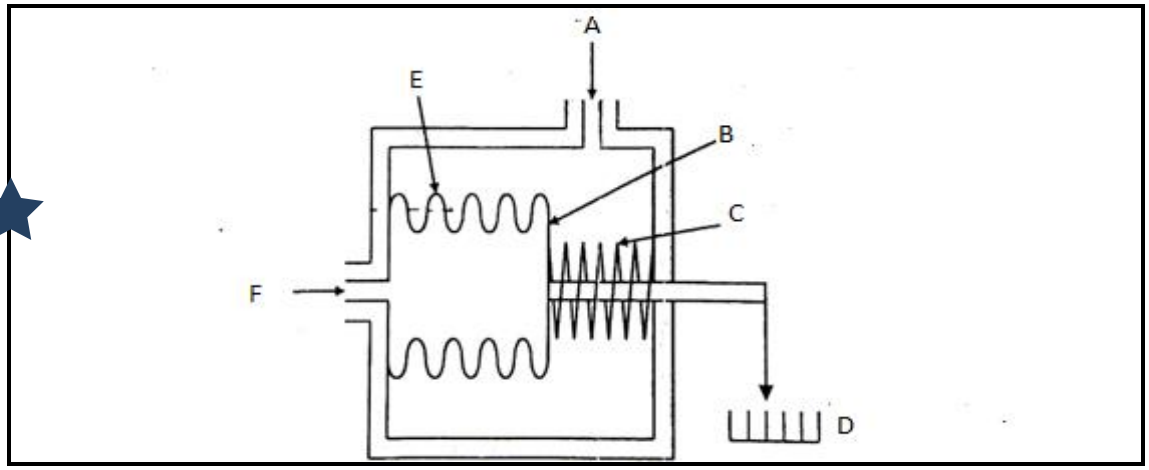
3.2 Manometers measure different types of pressure. The type of sealing liquid used in them depends on the magnitude of the required pressure difference.

3.2.1 Name four common types of manometers you have studied.

3.2.2 Name four types of sealing liquid commonly used in manometers.

(2 × 4) (8)

3.3 Study the diagram below and answer the following questions:



3.3.1 Identify the above diagram. (2)

3.3.2 Label the components marked A–F. (6)

3.3.3 What is the purpose of the component marked C? (1)

3.4 A Bourdon tube is the most used pressure-measuring device in the industry today.

3.4.1 Name THREE types of Bourdon tube. (3)

3.4.2 Name FOUR common problems associated with Bourdon tubes. (4)

[30]

QUESTION 4

4.1 Different materials act as the sensing element in resistance thermometers.

4.1.1 Give three reasons why platinum is the most common material used as the sensing element in RTDs. (3)

4.1.2 Name TWO types of platinum resistance thermometers. (2)

4.2 Name and explain the purposes of using thermo-wells in industrial process systems. (13)

4.3 Explain the operational principle of a resistance thermometer. (5)

4.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (4.4.1–4.4.7) in the ANSWER BOOK.

4.4.1 Although man has been well aware of the concepts of hot and cold since the dawn of time, there was no way to measure temperature.

4.4.2 Galileo Galilei (1564–1642) invented the thermometer around 1952.

4.4.3 Only in the 1600s were the first devices invented that could measure temperature.

4.4.4 In the 1800s many developments in temperature measurement occurred.

4.4.5 In the 1900s semiconductor equipment such as integrated circuit sensors, thermistors, and so on, were invented.

4.4.6 A thermometer is a thermoelectric device for measuring the temperature difference between two points.

4.4.7 Thermometry is the measurement of temperature.

(7 × 1) (7)

[30]

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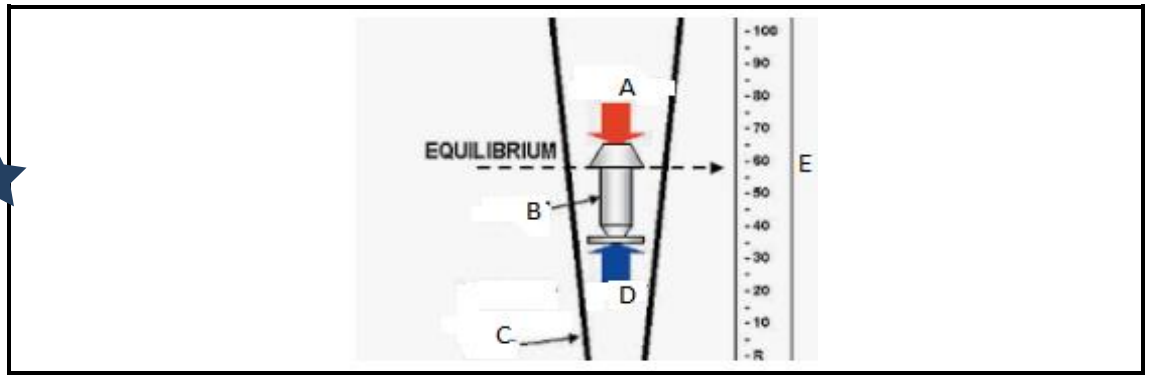
QUESTION 5

5.1 Positive displacement flow meters are mainly named after the inbuilt mechanical device in a meter unit. Various types of positive displacement flow meters are used in industry.

Make a neat and labelled sketch of an oscillating positive displacement flow meter. (8)

5.2 What is the flow rate of a tank when 15 000 litres of water flows out of it in one hour? (5)

5.3 Study the diagram below and answer the following questions.



5.3.1 Name the instrument indicated by the diagram. (2)

5.3.2 Provide the labels for parts A–E. (5)

5.3.3 Explain the operational principle of this instrument. (5)

5.3.4 Name THREE limitations of this type of flow meter. (3)

5.4 Various options are given as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (5.4.1–5.4.5) in the ANSWER BOOK.

5.4.1 A basic … flow meter consists of two temperature sensors with an electric heater between them.

A magnetic
B turbine
C thermal
D swirl

5.4.2 The working principle of a … flow meter is based on Bernoulli's equation.

A positive displacement
B mass flow detector
C differential pressure
D electromagnetic

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5.4.3 An irregular movement of fluid made up of many small currents swirling in all directions.

A Turbulent flow
B Laminar flow
C Ideal flow
D Transitional flow

5.4.4 … meters use containers of a known size, which are filled and emptied for a known number of times in a given time period to give the total flow volume.

A Rate-of-flow
B Positive displacement
C Thermal mass flow
D Inferential flow

5.4.5 The … is the relationship between the minimum and maximum flow rates for a measuring range that has to comply with a specific accuracy.

A flow rate
B turndown ratio
C specific ratio
D discharge coefficient

(5 × 1) (5)

5.5 Name FIVE types of differential flow measuring instrument. (5)

[38]

TOTAL: 150

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FORMULA SHEET

1. $V = 1{,}274\left[\frac{Q}{d^2}\right]$
2. $R_T = R_0[1 + \alpha T]$
3. $\Delta P = P_2 - P_1 = \rho g h$
4. $Q_1 v_1 = Q_2 v_2$
5. $P = \frac{Mg}{A}$
6. $K = \frac{5}{9}[°F + 459{,}67]]$
7. $℃ = \frac{5}{9}[°\mathrm{F} - 32]$
8. $K = °C + 273$

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