higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 2

(6060452)

27 February 2018 (X-Paper)
09:00–12:00

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

NCV

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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. Write neatly and legibly.

NCV

QUESTION 1

1.1 Give FIVE advantages of using MIC system. (5)

1.2 Give FIVE industry fields in which MIC system is used. (5)

1.3 Various options are given as possible answers to the following questions. Choose the answer and write only (A–E) next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

1.3.1 These companies convert a number of natural resources, which include water, metals and gasses, into a wide variety of products like ceramic products, fragrances and flavor etc.

A Chemical industry
B Petrochemical industry
C Minerals processing industry
D Pulp and Paper industry
E Food and beverage industry

1.3.2 These companies are defined as companies that manufacture chemical products obtained from petroleum and other fossil fuels that contain the same chemical products:

A Chemical industry
B Petrochemical industry
C Minerals processing industry
D Pulp and Paper industry
E Food and beverage industry

1.3.3 Products of this company include a wide variety of building materials, cement, glass and ceramics:

A Chemical industry
B Petrochemical industry
C Minerals processing industry
D Pulp and Paper industry
E Food and beverage industry

1.3.4 This production requires many chemical and mechanical processes:

A Chemical industry
B Petrochemical industry
C Minerals processing industry
D Pulp and Paper industry
E Food and beverage industry

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1.3.5 This manufacturing industry requires a large number of processes to take place in process plant in order to make its product:

A Chemical industry
B Petrochemical industry
C Minerals processing industry
D Pulp and Paper industry
E Food and beverage industry

(5 × 1) (5)
[15]

QUESTION 2

2.1 Valves are divided into two types; *manual valves* and *control valves*.

2.1.1 What is the difference between the two valves? (4)

2.1.2 What is the purpose of the control valves? (3)

2.1.3 What are valves used for? (4)

2.1.4 Explain how the uses of valves you mentioned in QUESTION 2.1.3 are used. (12)

2.2 Limitation is something that does not allow something else to do its job correctly; a shortcomings.

What causes the limitation in control valves? (4)

2.3 Explain the following terms in control valves:

2.3.1 Pneumatic

2.3.2 Diaphragm

2.3.3 Functionality

2.3.4 Actuator stem

2.3.5 Actuator spring

(5 × 2) (10)

2.4 Give ONE control valve accessory that you know. (1)
[38]

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QUESTION 3

3.1 Pressure switches are used in a wide variety of monitoring and control application.

3.1.1 Explain how a pressure switch works. (6)

3.1.2 What is a pressure switch? (3)

3.2 A device that creates known pressure in order to calibrate instruments. It does this by using exact masses and pistons of an exact area.

3.2.1 Which instrument are they referring to in the above statement? (2)

3.2.2 Give the equation that governs the instrument above. (3)

3.2.3 Make a neat labeled diagram of this instrument. (8)

3.3 Complete the following sentences/paragraph(s) by filling the missing word(s). Write only the word(s) next to the question number (3.3.1–3.3.5) in the ANSWER BOOK.

Boyles Law investigated the relationship between the volume and the pressure gas. During his investigation, he realized that at a 3.3.1 …, the … 3.3.2 … of a given amount of gas will decrease if the 3.3.3 … increases. In other words, if the temperature stays the same, a certain amount of gas will have less 3.3.4 … and higher 3.3.5 … (5 × 1) (5)

3.4 Give formulae for Boyles Law. (3)
[30]

QUESTION 4

4.1 A thermocouple is an electrical device consisting of two dissimilar conductors forming electrical junctions at different temperatures.

4.1.1 Give FOUR applications of thermocouple. (4)

4.1.2 Give TWO limitations of thermocouples. (2)

4.1.3 Make a neat sketch for a thermocouple. (5)

4.1.4 Explain how you will maintain a thermocouple. (5)

4.2 Materials that are used to make resistance thermometer must have certain properties:

List FIVE of the properties that are important. (5)

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4.3 RTDs are very reliable, but like all instruments they can also encounter some problems.

Name TWO common problems associated with RTDs. (4)

4.4 List guidelines that you can follow when cleaning manometers. (5)
[30]

QUESTION 5

5.1 There are various ways to measure flow.

5.1.1 What is the purpose of measuring flow? (5)

5.1.2 Name THREE industries in which flow measurement is used. (3)

5.2 The pressure difference across a restriction in a pipe is 10 cm water at a flow rate of 150 m^3/h. What will the pressure difference be at the flow rate of 300 m^3/h. (6)

5.3 What instrument will you use to check the level of oil in the car tank? (2)

5.4 When the flow rate is 5 m^3/s and the fluid has flowed into the tank for 2 hours, what is the level of a tank that has a base area of 10 000 m^2 and a height of 5 m?

Find out how much of water will be in the tank after 0,5 h. (6)

5.5 Explain how you will calibrate an orifice plate flow meter? (3)

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5.6 Choose a/an item/word from COLUMN B that matches a/an description/word/item in COLUMN A. Write only the letter (A–G) next to the question number (5.6.1–5.6.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
5.6.1	The Reynolds number is anything from 1 to 2000	A	tapered
5.6.2	The Reynolds number is above 4 000	B	Impetus
5.6.3	When the tube is gradually narrowing at one end	C	turbulent
5.6.4	An artificial channel for conveying water, typically in the form of a bridge supported by tall columns across a valley	D	constitute
5.6.5	To express or measure the quantity of flow in a system	E	aqueduct
		F	laminar
		G	volumetric flow
		H	cubic meters/hour

(5 × 1) (5)

5.7 Explain how you will go about installing a turbine flow meter. (7)

[37]

TOTAL: 150

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INSTRUMENTATION TECHNOLOGY

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.

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

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

$t^o = 9/5\ t + 32^o F$

$t^o C = (t + 273{,}15)$ kelvin

$t^o F = 5/9\ (t - 32)\ °C$

$Q = K\sqrt{h}$

Tank Volume = Base Area × Height

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