higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

INSTRUMENTATION TECHNOLOGY
NQF LEVEL 2

(6060452)

2 December 2020 (X-paper)
09:00–12:00

This question paper consists of 6 pages and 1 formula sheet.

207Q1N2002

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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 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	Factory that uses materials to make finished goods	A	advantages of an MIC system
1.1.2	In a refrigerator, this part helps to keep the temperature within a certain range	B	excavation
		C	fossil fuels
1.1.3	Improves system efficiency	D	control loop
1.1.4	Process of digging out materials from the ground	E	process plant
		F	modem
1.1.5	Formed in a geological past from the remains of living organism	G	field bus

(5 × 1) (5)

1.2 Define the term *petrochemical industry.* (3)

1.3 Petrochemicals can be classified as olefins, aromatics or synthesis gas. Give TWO examples of each of the following:

1.3.1 Olefins

1.3.2 Aromatics

1.3.3 Synthesis gas

(3 × 2) (6)

1.4 Name ONE source of raw materials for the petrochemical industry. (1)

[15]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 The purpose of a control valve is to manipulate the flow of fluids, gas, steam, water or chemical compounds to keep the regulated process variable as close to the desired set-point as possible.

2.1.2 Control valves only have limitations if they are incorrectly chosen.

2.1.3 A plug valve is a rotational motion valve used to stop or start the fluid from flowing.

2.1.4 The largest part of a valve is called the valve stem and fluid flows through this section.

2.1.5 The purpose of limit switches is to adjust the actuator.

(5 × 1) (5)

2.2 Different kinds of valves have different applications.

Give ONE application for each of the following valves:

2.2.1 Ball and cage valve

2.2.2 Butterfly valve

2.2.3 Plug valve

2.2.4 Three-way valve

(4 × 2) (8)

2.3 Fail-safe system

2.3.1 Name THREE positions in which a fail-safe system fails. (3)

2.3.2 What is the purpose of a fail-safe system? (2)

2.3.3 Explain the limitations of a fail-safe system. (5)

2.4 Discuss the following general actuator problems:

2.4.1 Pneumatic actuator problem

2.4.2 Hydraulic actuator problem

2.4.3 Electric actuator problem

(3 × 3) (9)

2.5 Make a neat drawing of a positioner employed as a signal amplifier. (6)

[38]

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QUESTION 3

3.1 Explain how to re-assemble a bellows gauge. (5)

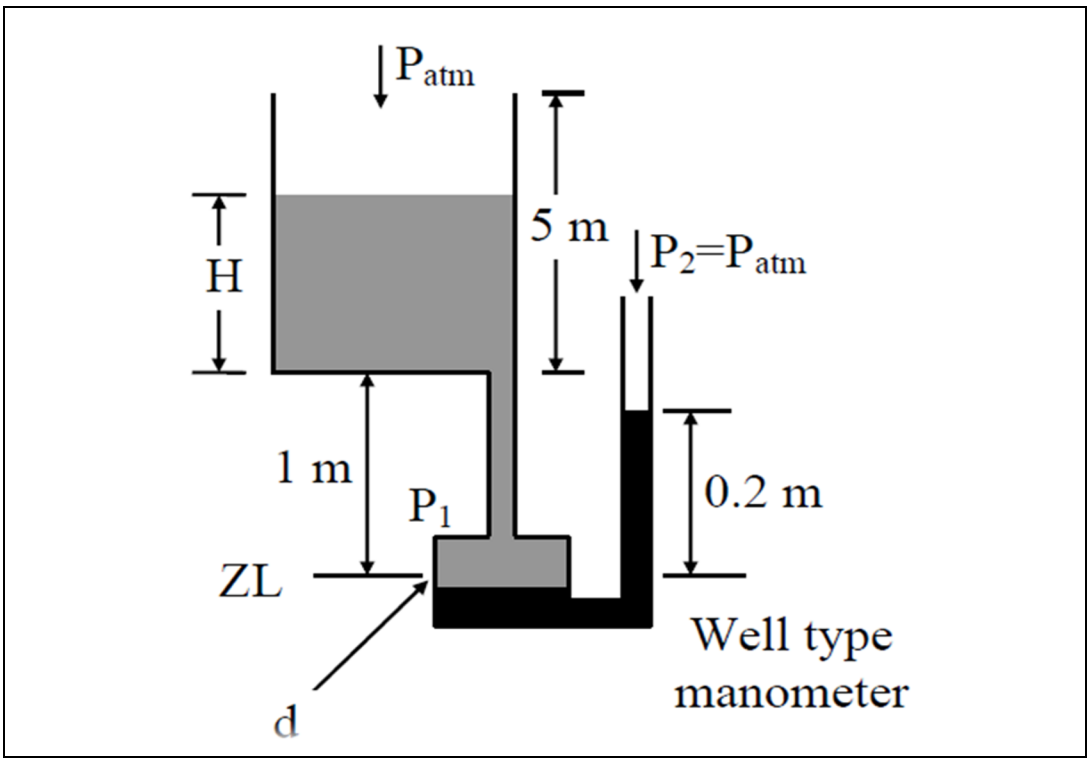
3.2 A typical Bourdon-tube gauge consists of a curved tube, an indicating needle and a Bourdon tube.

3.2.1 Explain what zero-checking of a Bourdon tube implies. (3)

3.2.2 Outline the procedure for zero-checking a Bourdon tube. (6)

3.2.3 Make a neat labelled drawing of a helical shaped Bourdon tube. (6)

3.3 A mercury (density 13 600 kg/m^3) well type manometer with A2/A1 = 0,01, is used to measure the level of a liquid (density 1 000 kg/m^3) in a 5-meter-high container, with the zero level of the manometer, 1 meter below the bottom of the tank. Calculate the level in the tank if the manometer reading is 200 mm (0,2 m).



(10)
[30]

QUESTION 4

4.1 Thermo wells

4.1.1 Explain what thermo wells are used for. (5)

4.1.2 Explain how thermo wells are used. (4)

4.2 Temperature

4.2.1 Briefly describe the development of temperature measurement during the 1800s. (5)

4.2.2 Explain why temperature is measured. (3)

4.3 Draw a graph that shows the resistance-temperature relationship for platinum, nickel and copper RTD's. (6)

4.4 What properties should materials for a resistance thermometer have? (5)

4.5 Fill in the missing words:

When matter changes its state, it is clear that there is a difference between … and … (2)
[30]

QUESTION 5

5.1 Make drawings of the following flow measurement instruments.

5.1.1 Pitot tube

5.1.2 Rotameter

5.1.3 Oscillating piston flowmeter

5.1.4 Venturi type flowmeter

5.1.5 Dall tube flowmeter

(5 × 5) (25)

5.2 Square root problem

5.2.1 Explain what the square root problem entails. (3)

5.2.2 Name FOUR methods that can be used to solve this problem. (4)

5.3 List FIVE factors that one will consider when choosing an orifice plate. (5)
[37]

TOTAL: 150

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INSTRUMENTATION TECHNOLOGY L2

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 $P_1 - P_2 = d\rho g \left(\frac{A2}{A1} + 1\right)$

$P_1 - P_2 = h\rho g \left(\frac{A1}{A2} + 1\right)$ or $P_1 - P_2 = h\rho g \left(\frac{A2}{A1} + 1\right)$

$P = \frac{Mg}{A}$

$\frac{Q1}{Q2} = \frac{k\sqrt{h1}}{k\sqrt{h2}}$

Dry calibration = $\frac{P1-P2}{\rho g}$

Wet calibration = $\frac{P1-P2}{(\rho 2 - \rho 1)g}$

W.C. = $\left(\frac{P1-P2}{(\rho 2 - \rho 1)}\right)$ X D.C

D.C. = $\left(\frac{P1-P2}{\rho 2}\right)$ X 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

$t^o\ F = 5/9\ (t - 32)^o\ C$

$V = IR$

$€ = \Delta L/L$

$K = \Delta R/R \div \Delta L/L$

$C = K\ A\ E/d$

$R_t = R_o\ (1 + \acute{\alpha}T + \text{ɞ}T^2)$

Vmeter = Voltage drop AB – Voltage drop AD

Balance: Potential at A = Potential at B

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