higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE (VOCATIONAL)

## STORED PROGRAMME SYSTEMS
### NQF LEVEL 3

(10040103)

**08 November 2022 (X-paper)**
**09:00–12:00**

**This question paper consists of 6 pages.**

175Q1N2208

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**TIME: 3 HOURS**
**MARKS: 100**

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**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 blue or black pen.
6. Use fully labelled IEC symbols.
7. All drawings must be neat and correctly labelled with designations and terminal numbering.
8. Write neatly and legibly.

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## QUESTION 1

1.1 List FOUR PLC input field devices. (4 × 1) (4)

1.2 Explain the difference between an *embedded controller* and a *software-driven controller.* (2 × 2) (4)

1.3 Draw a PLC systems block diagram of a mechatronic conveyor system showing the control panel and the operator panel. The energy, electrical and materials flow must be shown.

(7 × 1) (7)

**[15]**

## QUESTION 2

2.1 The FIVE senses of the human body are copied to produce industrial sensors used in automation.

List the FIVE senses of the human body. (5 × 1) (5)

2.2 Study FIGURE 1 showing four sensors used for various applications in a gas water heating furnace.

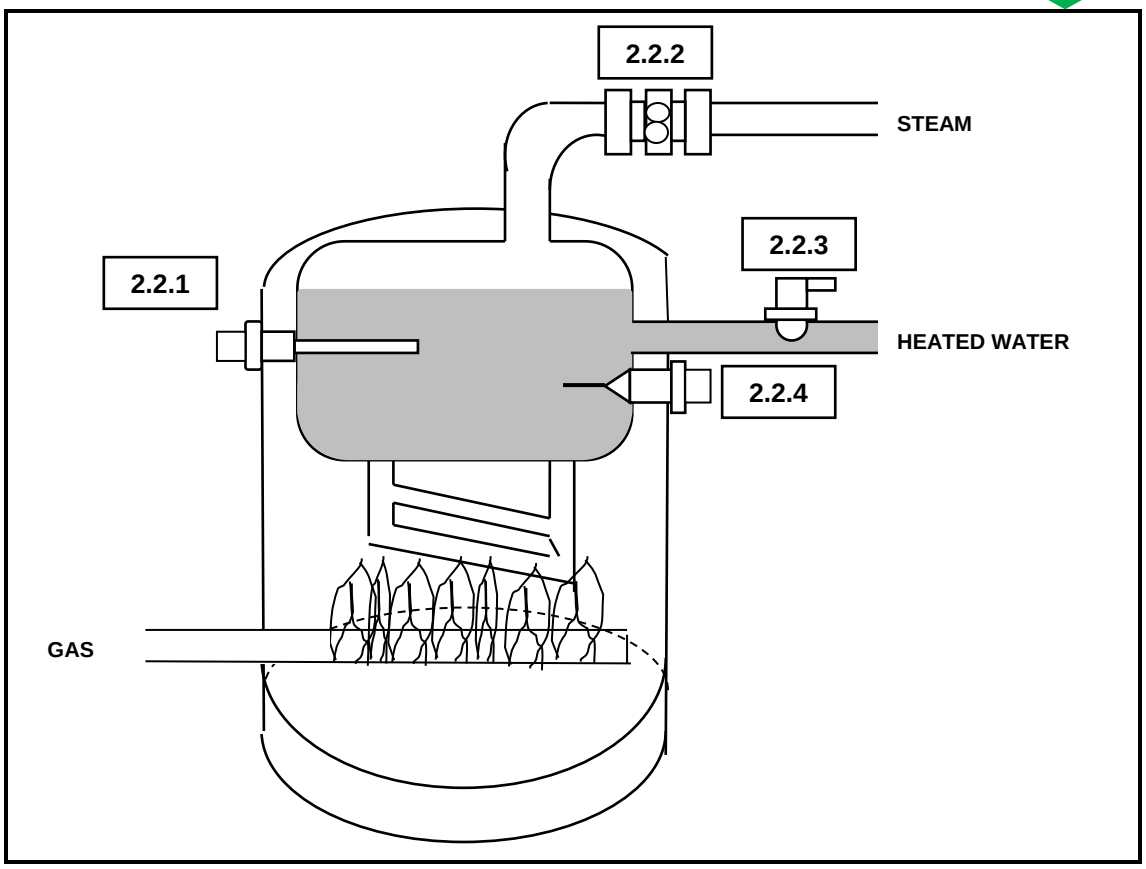



**FIGURE 1**

List the FOUR sensor applications (2.2.1–2.2.4) in the ANSWER BOOK.

(4 × 1) (4)

2.3 Are the sensors shown in FIGURE 1 discrete or analogue type sensors? (1 × 1) (1)

2.4 Show by means of a drawing the difference between a discrete and analogue sensor output signal. (2 × 2) (4)

2.5 Show by means of a perception drawing how you would place two mechanical cat's whisker sensors to detect work pieces of different sizes on a conveyor belt for pneumatic type ejection. (6 × 1) (6)

**[20]**

## QUESTION 3

3.1 A perception or pictorial drawing (FIGURE 2) assists a mechatronic person to design a material and i/o address allocation list of a PLC automated task.

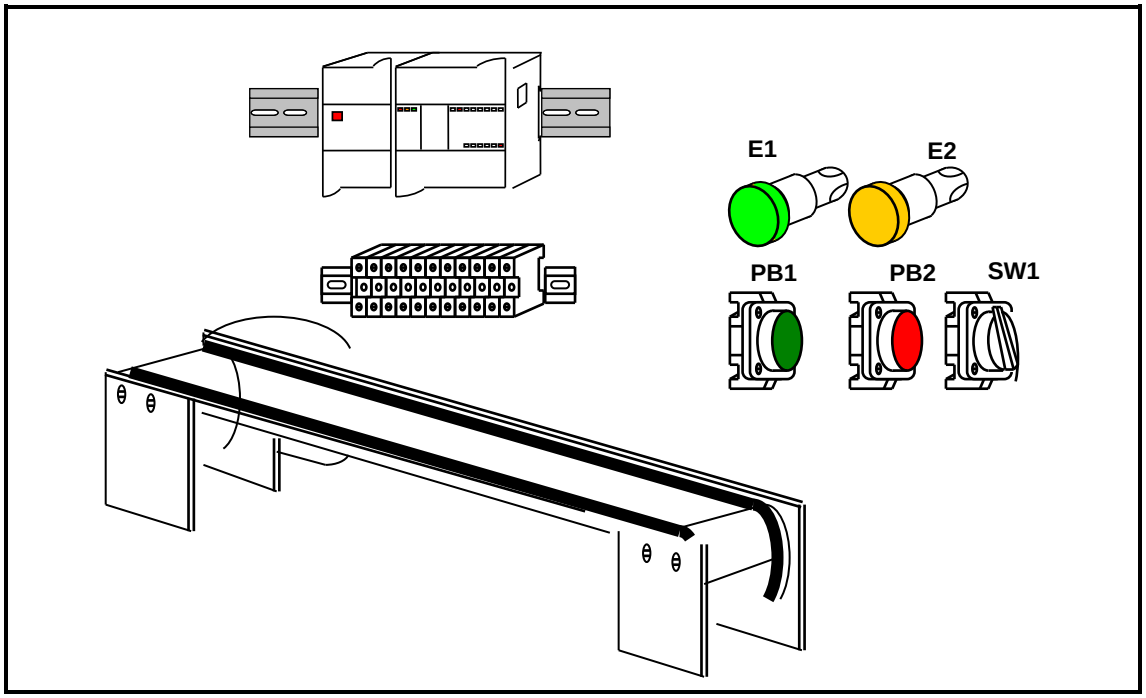



**FIGURE 2**

Answer the following related questions:

3.1.1 What type of switch is Sw1?

3.1.2 What is the function of Sw1?

3.1.3 What type of input device is Pb1?

3.1.4 What is the function of Pb1?

3.1.5 What is the PLC address of Pb1?

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3.1.6 What type of device is Pb2?

3.1.7 What is the function of Pb2?

3.1.8 What is the terminal numbering of Pb2?

3.1.9 What is the name of the output devices as indicated by the designations E1and E2?

3.1.10 What is the common DC safe voltages used for PLC?

(10 × 1) (10)

3.2 List THREE documents, besides the materials list, that can be derived from the pictorial or perception drawing. (3 × 1) (3)

3.3 Explain what can be determined from the instructions given in a perception or pictorial drawing. (1 × 2) (2)

3.4 Show by means of a drawing how the safety relay (SR) and related contacts (11&12) (21&24) must be connected to a PLC. (5 × 1) (5)

**[20]**

**QUESTION 4**

4.1 With reference to FIGURE 2, write a PLC source code in PLC ladder to meet the following outcomes:

When the system is turned on, the green standby lamp E1 is energized. Once the start push button Pb1 is activated, the green standby lamp E1 will de-energize and the amber run lamp E2 will energize. At the same time the 24 V DC motor will run.

The motor will stop after a count of ten work pieces detected by sensor S1 and will automatically restart when a period of 25 seconds has elapsed.
When the stop Pb2 is activated, the amber run lamp E2 will go out and the green standby lamp E1 will energize. The motor (M1) will stop. (15 × 1) (15)

4.2 List the THREE basic switching logic gates that form the backbone of PLC ladder programming. (3 × 1) (3)

4.3 List SIX of the NINE basic LADDER design rules. (6 × 1) (6)

4.4 Differentiate between a *graphical* and a *written application* PLC source code. (2 × 2) (4)

4.5 Name TWO graphical PLC programming languages commonly used for programming PLC applications. (2 × 1) (2)

**[30]**

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## QUESTION 5

5.1 List FOUR troubleshooting skills a mechatronic person needs to troubleshoot a PLC automated application. (4 × 1) (4)

5.2 Draw up a check list that a mechatronic person would use to check compliance against a PLC task instruction. (7 × 1) (7)

5.3 Explain the difference between *checking* and *testing* during a PLC automated installation process.

(2 × 2) (4)
**[15]**

**TOTAL: 100**

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