higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 3

(6040213)

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

This question paper consists of 6 pages.

397Q1N2216

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TIME: 3 HOURS
MARKS: 100

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 Analogue-to-digital and digital-to-analogue converters are used extensively in industry today.

1.1.1 List FIVE applications of analogue-to-digital converters. (5)

1.1.2 Briefly explain why we use A/D and D/A converters in mechatronic systems. (3)

1.2 A thermistor is a resistance thermometer, or a resistor, whose resistance is dependent on temperature.

List SIX advantages of thermistors. (6)

1.3 Explain the difference between *half-wave* and *full-wave* phase control. (4)

1.4 Explain the function of a capacitor in your own words. (2)

[20]

QUESTION 2

2.1 Electro-magnets are one of the fundamental building blocks of AC and DC machines.

2.1.1 Explain the difference between a *permanent magnet* and an *electro-magnet*. (5)

2.1.2 Draw a neat, labelled diagram of an electro-magnet. (7)

2.1.3 Explain how switching the supply polarities will affect the current and magnetic fields in an electro-magnet. (2)

2.2 Explain the difference between a *stepper motor* and a *DC motor*. (4 × 2) (8)

[22]

QUESTION 3

3.1 Explain the purpose of a hydraulic filter. (2)

3.2 Hydraulic filters are located at different parts of the hydraulic system, each serving a different purpose.

Explain each of the following filters:

3.2.1 Air filter

3.2.2 Suction filter

3.2.3 Pressure filter

3.2.4 Return filter

3.2.5 Off-line filter

(5 × 2) (10)

3.3 What does P and T represent in hydraulic valves? (2)

3.4 FIGURE 1 below shows two incorrectly connected studs. Use the unconnected studs to show how you would connect them correctly.

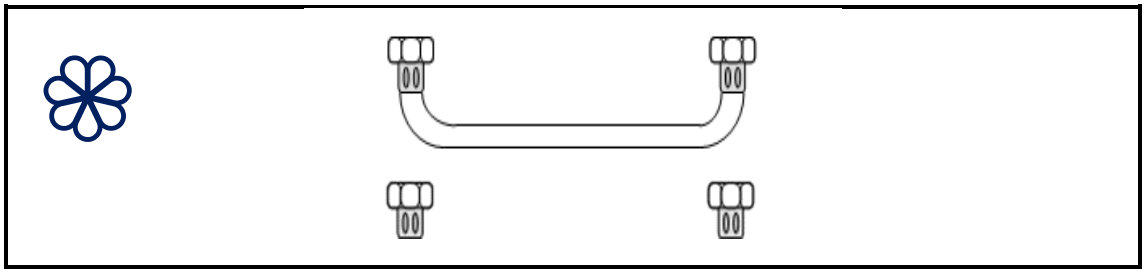

FIGURE 1 (2)

3.5 Explain the effects of contaminated fluid in a hydraulic application. (2)

[18]

QUESTION 4

4.1 FIGURE 2 below shows a safety control switching circuit.

Analyse the circuit and explain what happens in each line step-by-step when the main switch is activated. In your explanation, mention every component used in the circuit in accordance with the diagram's labelling.

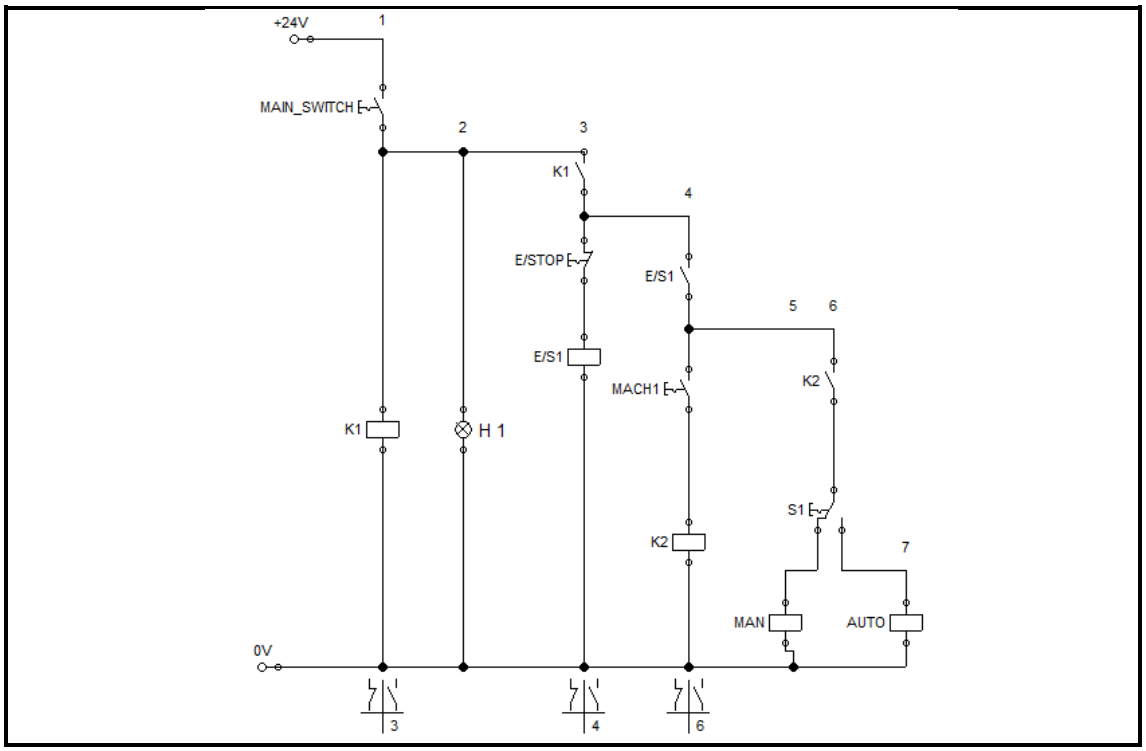

FIGURE 2 (12)

4.2 Briefly explain what occurs inside a single solenoid 4/2-way valve when a spool is moved by a solenoid from its normal position to its activated position. (4)

4.3 Describe the characteristics of the electro-hydraulic servo valve. (4)

[20]

QUESTION 5

5.1 Explain the procedure that should be followed when undertaking a logical fault diagnosis of a hydraulic system. (3)

5.2 State FIVE precautions that should be taken before restarting a hydraulic system after carrying out work on it. (5)

5.3 A hydraulic pump is operating in a mechatronic system. After a period of operation, the pump becomes increasingly noisy and starts to vibrate excessively.

Identify FIVE possible causes of these faults. (5)

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5.4 Explain what is meant by the term *continuous monitoring* in relation to a hydraulic system. (3)

5.5 Hydraulic-based mechatronic sub-systems perform valuable functions in industry.

If the system fails to operate, list FOUR things that you would check first to determine the cause. (4)

[20]

TOTAL: 100

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