higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 2

(6040102)

11 March 2020 (Y-paper)
13:00–16:00

This question paper consists of 5 pages.

499Q1S2011

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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 fully labelled IEC symbols.
6. Write neatly and legibly.

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QUESTION 1

1.1 FIGURE 1 shows a mechatronic system made up of a relay-controlled material transfer and a sorting conveyor that will eject metal workpieces.

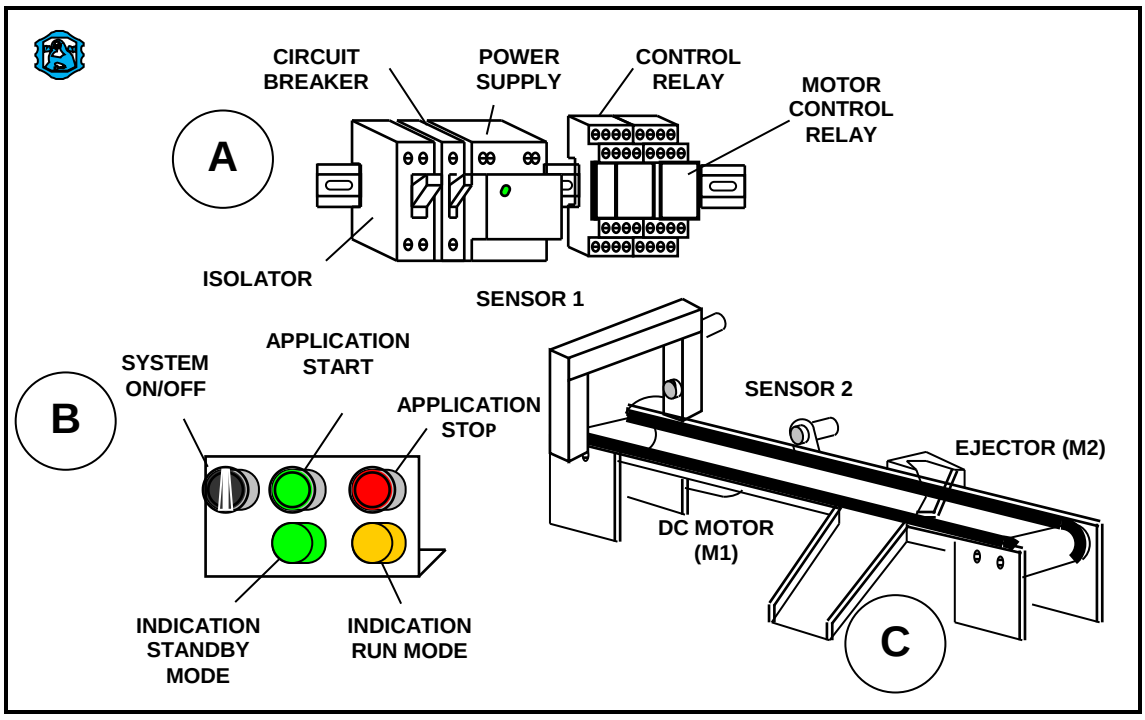


FIGURE 1

1.1.1 Name the subsystem A. (1)

1.1.2 Name the subsystem B. (1)

1.1.3 Name the subsystem C. (1)

1.2 Draw the systems diagram of the sorting-conveyor system shown in FIGURE 1. Show the technical subsystems, energy flow, information flow and materials flow. (10)

1.3

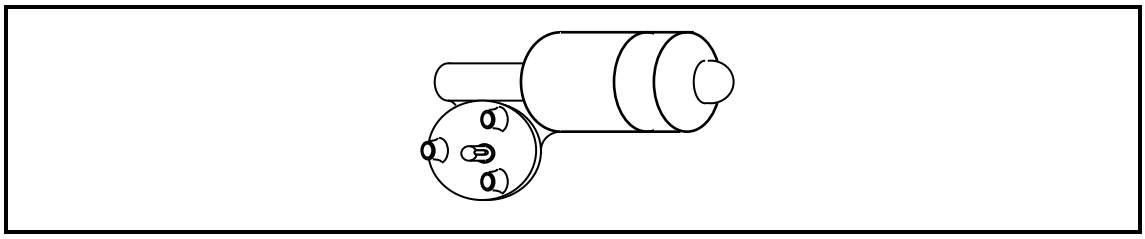


FIGURE 2

Draw the single technical block diagram of the DC-geared motor shown in FIGURE 2. Show the energy conversion that takes place. (4)

1.4 Explain why it is necessary for a mechatronic technician to have the ability to analyse a mechatronic system. (3)

[20]

QUESTION 2

2.1 Explain the function of photo-electric sensor 1 in the sorting conveyor shown in FIGURE 1. (2)

2.2 Explain the function of inductive sensor 2 in the sorting conveyor shown in FIGURE 1. (2)

2.3 Explain the operation of the solenoid ejector (M2) in FIGURE 1. (2)

2.4 Draw the relay ladder logic (hardwired) control circuit diagram used to automate the sorting-conveyor system shown in FIGURE 1 that meets the following operational procedure:

- SW1 will energise/de-energise the system.
- H1 will energise indicating standby mode.
- Pb1 will start the application where H1 will de-energise and H2 will energise indicating run mode.
- S1 will start the system.
- MCR will energise the conveyor motor.
- S2 when detecting a metal object will energise the hub (M2).

Ignore the ejector (M2) control section – only draw the system, application and conveyor control. (10)

2.5 Explain the term *time-based control*. (2)

2.6 Explain the term *remote control*. (2)

[20]

QUESTION 3

3.1 Explain the term *compressed air*. (2)

3.2 What is a *compressor*? (2)

3.3 List the THREE subsystems that make up a pneumatic system. (3)

3.4 Draw a systems diagram that will represent a compressor. (6)

3.5 Draw fully labelled symbols of each of the following pneumatic components:

3.5.1 Single-acting cylinder

3.5.2 Compressed air source

3.5.3 Flow-control valve

3.5.4 Shut-off valve

3.5.5 3/2-way spring return valve

(5 × 1) (5)

3.6 Explain the operation of a 3/2-way spring return valve. (2)

[20]

QUESTION 4

4.1 Explain why electricity is used to control electropneumatic systems. (2)

4.2 List FOUR applications for electro-pneumatic systems. (4)

4.3 Explain how the solenoid valve enables the link between the control circuit and the electropneumatic working circuit. (2 × 2) (4)

4.4 Draw a fully labelled electropneumatic circuit to demonstrate linkage between the control circuit and the pneumatic working circuit. (8)

4.5 Name TWO control voltages used in electropneumatic systems. (2)
[20]

QUESTION 5

5.1 What is *air contamination*? (2)

5.2 Name TWO forms of contamination. (2)

5.3 Name TWO problems due to contamination in an electropneumatic system. (2)

5.4 Draw a flow chart that will assist a mechatronic technician to apply the output-input-through the circuit in an electropneumatic application. (10)

5.5 Explain how the half-cut method is used in troubleshooting electropneumatic systems. (4)
[20]

TOTAL: 100

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