higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 3

(6040213)

21 November 2019 (X-Paper)
09:00–12:00

This question paper consists of 7 pages.

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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. Drawings must be neatly drawn and fully labelled.
6. Draw the symbols in accordance with IEC standards.
7. Write neatly and legibly.

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QUESTION 1

1.1 List the THREE basic types of control used in a mechatronic system. (3)

1.2 Explain what *motion control* is. (2)

1.3 Explain the difference between *process control* and *automation control*.(2 × 2) (4)

1.4 Draw the mechatronic system block diagram indicating the information flow used for control in a mechatronic application. (8)

1.5 Explain what you understand under the black box approach used in mechatronic system troubleshooting. (3)

[20]

QUESTION 2

2.1 Mechatronic systems require precise coordination between subsystems to ensure that the correct output will be met.

List FIVE aspects where precise coordination is required. (5 × 1) (5)

2.2 Draw a simplified, labelled drawing indicating how rotary motion is transposed into linear motion using a screw and nut method. (5)

2.3 Indicate by means of a labelled characteristic curve representing discrete on/off control in relation to the motion of a DC motor reacting from starting from the idle position to standstill after switch off. (6)

2.4 Differentiate between a *single axis* and *multiple axes* control application. (2 × 2) (4)

[20]

QUESTION 3

3.1 List THREE applications that require high pressure to operate. (3 × 1) (3)

3.2 Determine the resultant force of a 10 N positive force and a 5 N force acting in an opposite direction. (3)

3.3 List THREE classifications of fluid flow. (3 × 1) (3)

3.4 Write down the *hydrostatic law*. (1 × 2) (2)

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3.5 Hydraulic energy is lost due to friction of the pipe wall causing loss of pressure due to the heat generated.

Draw a diagram to demonstrate the heat generated due to resistance in a pipe. (4)

3.6 Study FIGURE 1 of the hydraulic power pack.

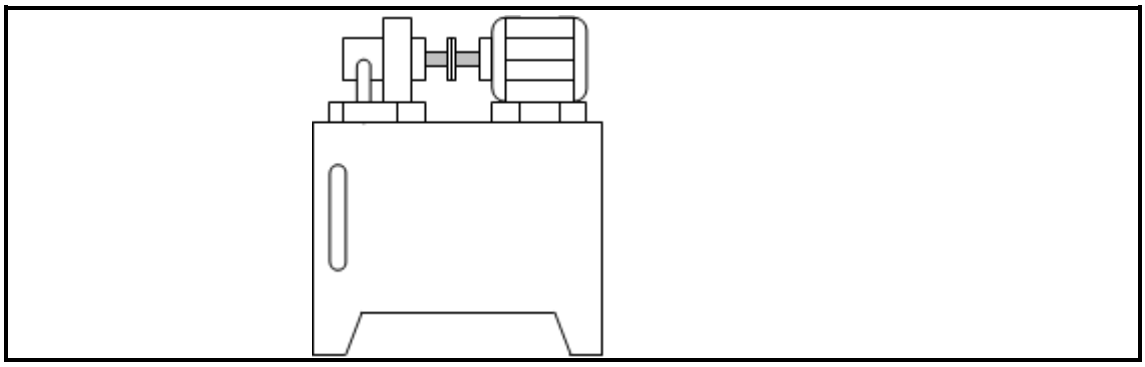

FIGURE 1

Draw the power pack block diagram indicating energy flow. (5)
[20]

QUESTION 4

4.1 Draw a fully labelled electronic controlled electro-hydraulic forming machine using a two-handed control and a light safety curtain as shown in FIGURE 2.

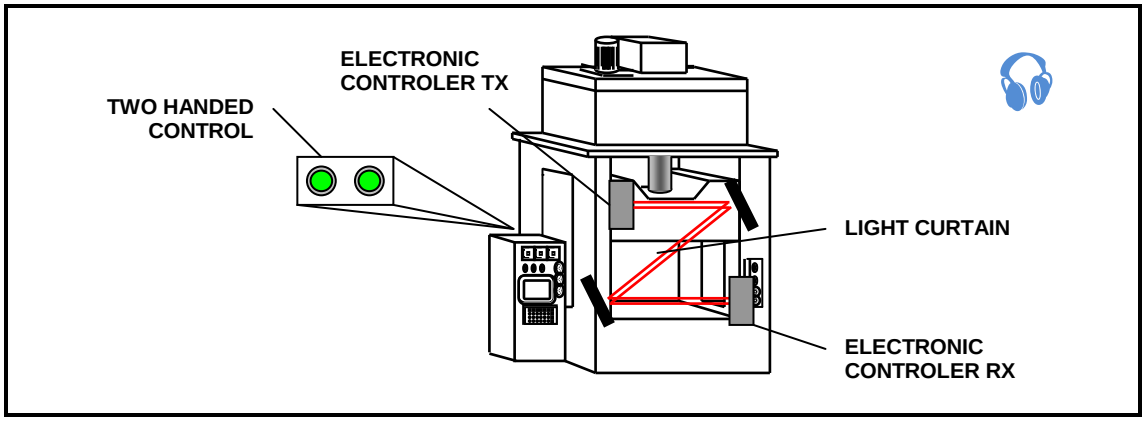

FIGURE 2

(10 × 1) (10)

4.2 Give THREE advantages of an electro-hydraulic application. (3)

4.3 Differentiate between *closed loop control* and *open loop control*. (2 × 2) (4)

4.4 Give THREE disadvantages of an electro-hydraulic application. (3)
[20]

QUESTION 5

5.1 A mechatronic technician must be able to determine possible causes of a given problem and then decide what action should be taken.

When a problem occurs and a pump fails to deliver oil:

5.1.1 Identify THREE possible causes. (3)

5.1.2 Explain what should be done to resolve the problem of a hydraulic pump rotating in the wrong direction. (2)

5.1.3 Explain what should be done to resolve the problem of not having voltage on the drive. (2 × 1) (2)

5.1.4 Explain what could be done to check for oil in the hydraulic power pack. (2)

5.2 Study FIGURE 3 of an electrical motor control-wiring diagram of the hydraulic power pack and answer the questions.

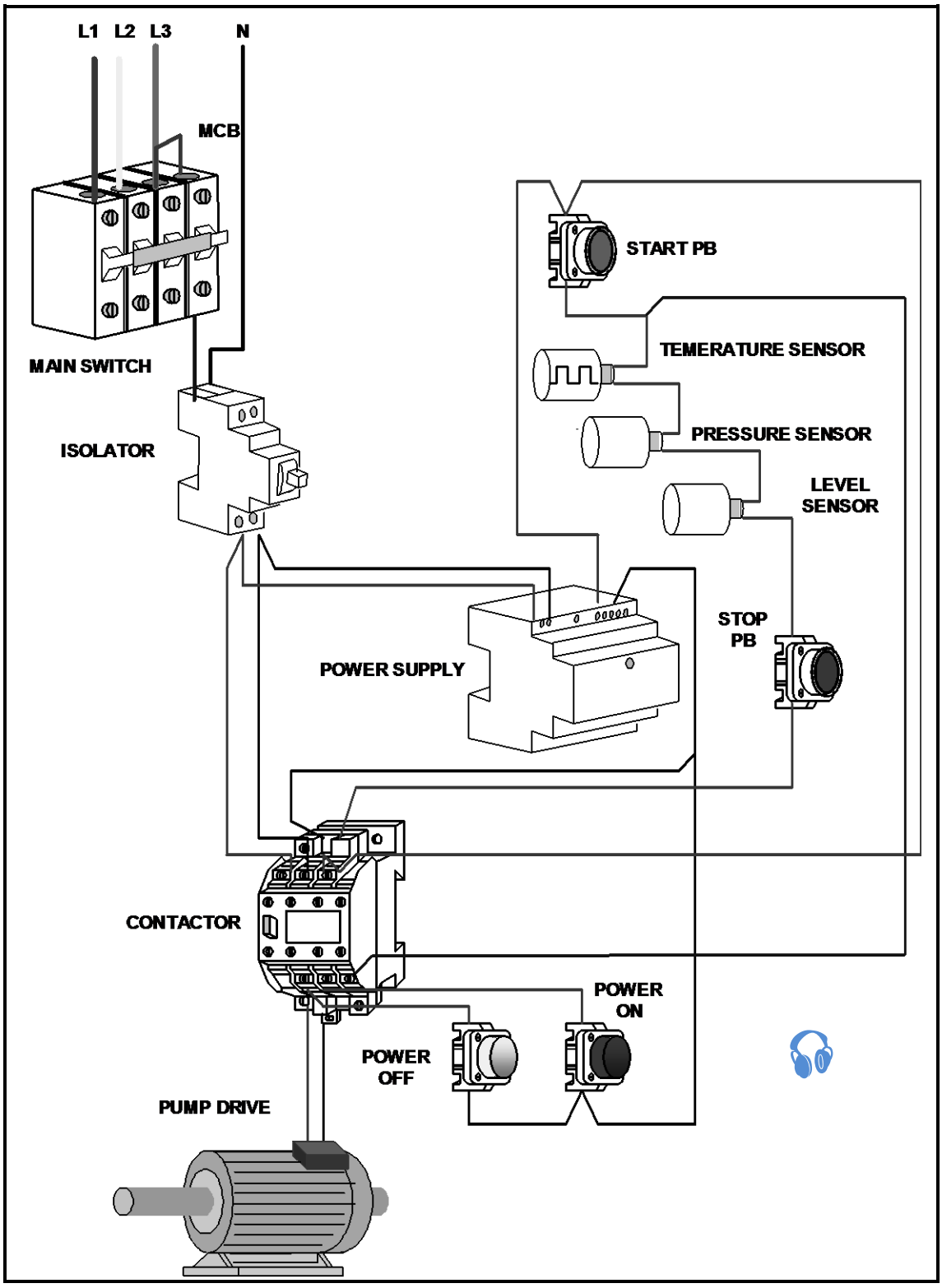

FIGURE 3

5.2.1 The MCB keeps on tripping.

Explain what possible fault condition could exist. (2)

5.2.2 What possible fault could exist if the green pilot light does not illuminate when the system is stopped? (2 × 1) (2)

5.2.3 All the wiring and components are operational on the main and control installation. However, the system switches off and does not restart.

Identify THREE possible conditions that could exist due to system safety failure. (3 × 1) (3)

5.3 The system has a fault condition and it was determined by means of voltage measurement that the voltage is present up to the terminals of the pump drive.

Explain what the possible fault could be. (2)

5.4 Name TWO possible cable errors that could occur during the installation of a VSD in a motion control application. (2 × 1) (2)

[20]

TOTAL: 100

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