higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 2

(6040102)

22 November 2019 (Y-Paper)
13:00–16:00

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

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QUESTION 1

Study FIGURE 1 that depicts a directly controlled DC motor.

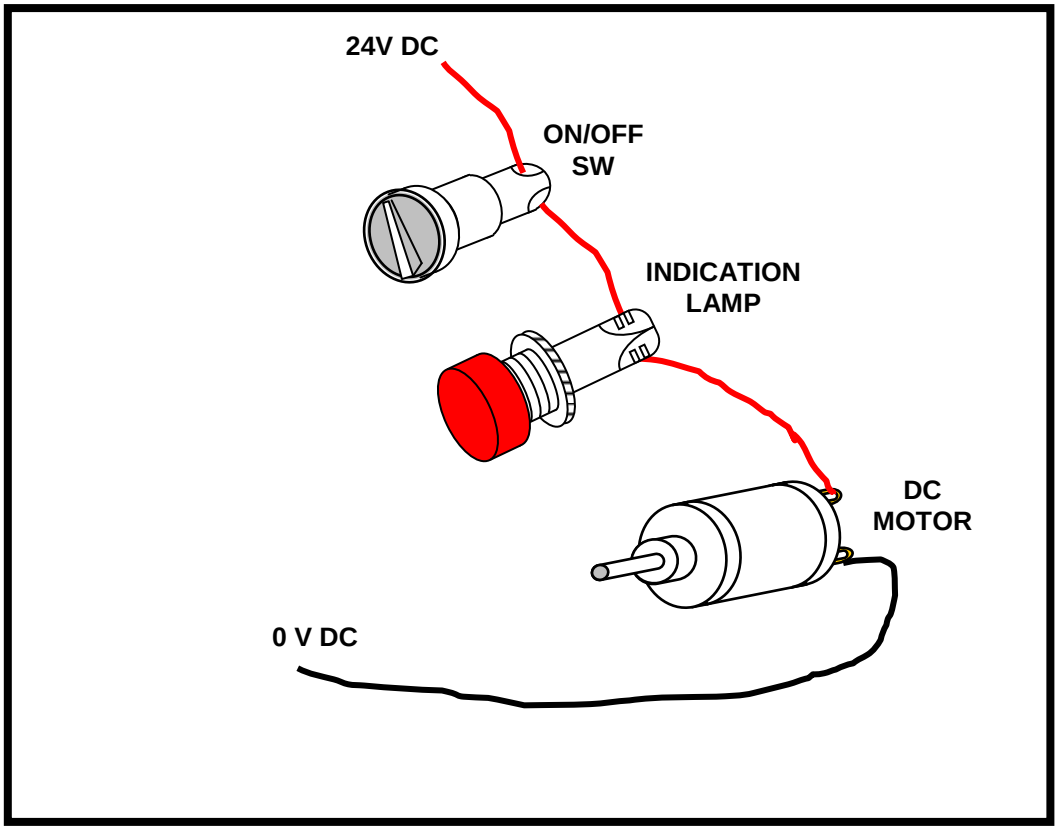


FIGURE 1

1.1 Explain energy conversion (NOT the definition). (2)

1.2 What is the function of the ON/OFF switch? (2)

1.3 What is the function of the indication lamp? (2)

1.4 Draw the simplified technical block diagram of the indication lamp, showing the energy conversion that takes place. (4)

1.5 Briefly explain how energy conversion takes place in the DC motor. (2)

1.6 Name TWO advantages of being able to analyse a technical system. (2)

1.7 Draw the systems diagram of the directly controlled DC motor, showing energy flow and information flow. (6)
[20]

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QUESTION 2

Study FIGURE 2 and answer the questions.

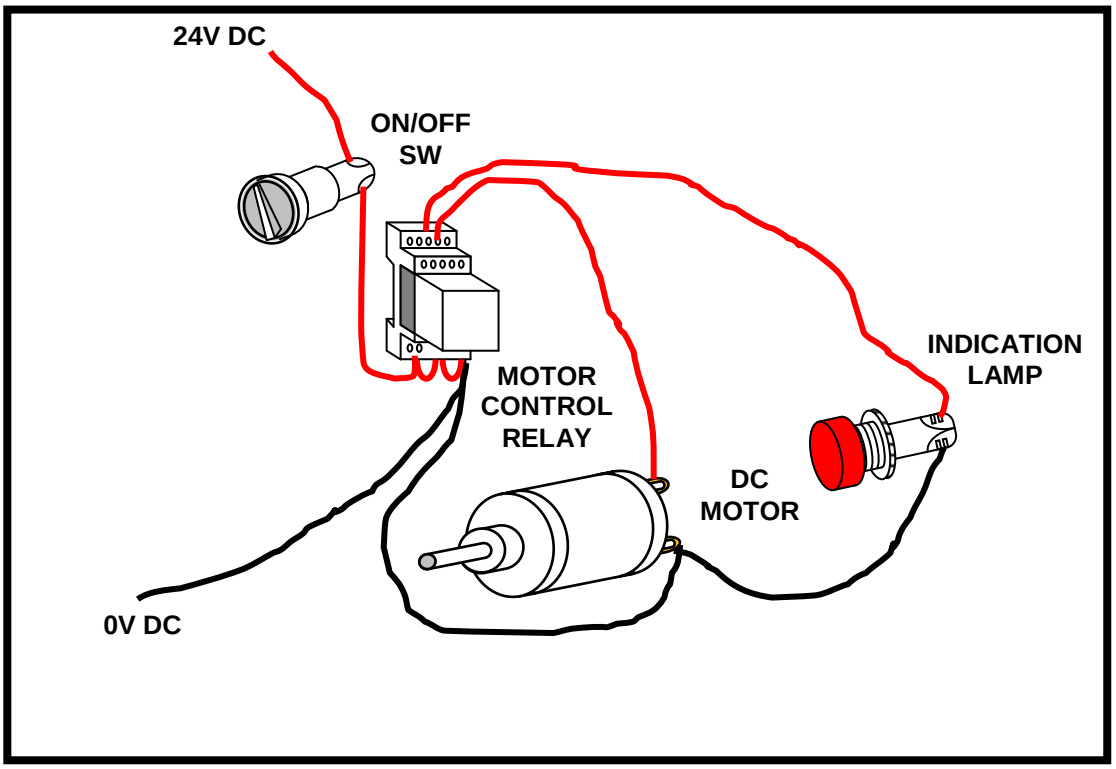


FIGURE 2

2.1 What type of control is being used in FIGURE 2? (1)

2.2 FIGURE 2 depicts components which are difficult to draw; therefore, symbols that represent the components are used.

Draw the fully labelled IEC symbols of the:

2.2.1 ON/OFF detent switch

2.2.2 Motor control relay

2.2.3 Indication lamp

2.2.4 DC motor

(4 × 1) (4)

2.3 Draw the fully labelled motor control circuit diagram in the relay ladder logic (RLL) IEC format that is represented by the pictorial drawing shown in FIGURE 2. (5)

2.4 List FOUR types of control used in mechatronic systems. (4)

2.5 Actuators are used to link the control circuit to the working circuit in relay ladder logic hardwired mechatronic applications.

2.5.1 Explain the operation of the actuator solenoid. (2)

2.5.2 Briefly explain the difference in action between *relay a*nd *solenoid valve*-type actuators. (2 × 2) (4)

[20]

QUESTION 3

3.1 Pneumatic systems use drives such as cylinders for linear motion and air motors for rotary motion.

List FOUR processes that use pneumatics. (4)

3.2 Draw the simplified technical systems block diagram that represents the pneumatic system. (4)

3.3 Name the TWO pneumatic distribution systems that one will encounter in the industry.

3.4 Explain how friction connectors are used when fitting and removing pneumatic pipes in a pneumatic application. (2 × 2) (4)

3.5 You are requested to construct a pneumatic application requiring a pneumatic piping diagram.

Explain how the basic piping rules will be applied in the design process. (6)

[20]

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QUESTION 4

Study the pictorial drawing in FIGURE 3 of a two-handed-controlled electro-pneumatic embossing machine.

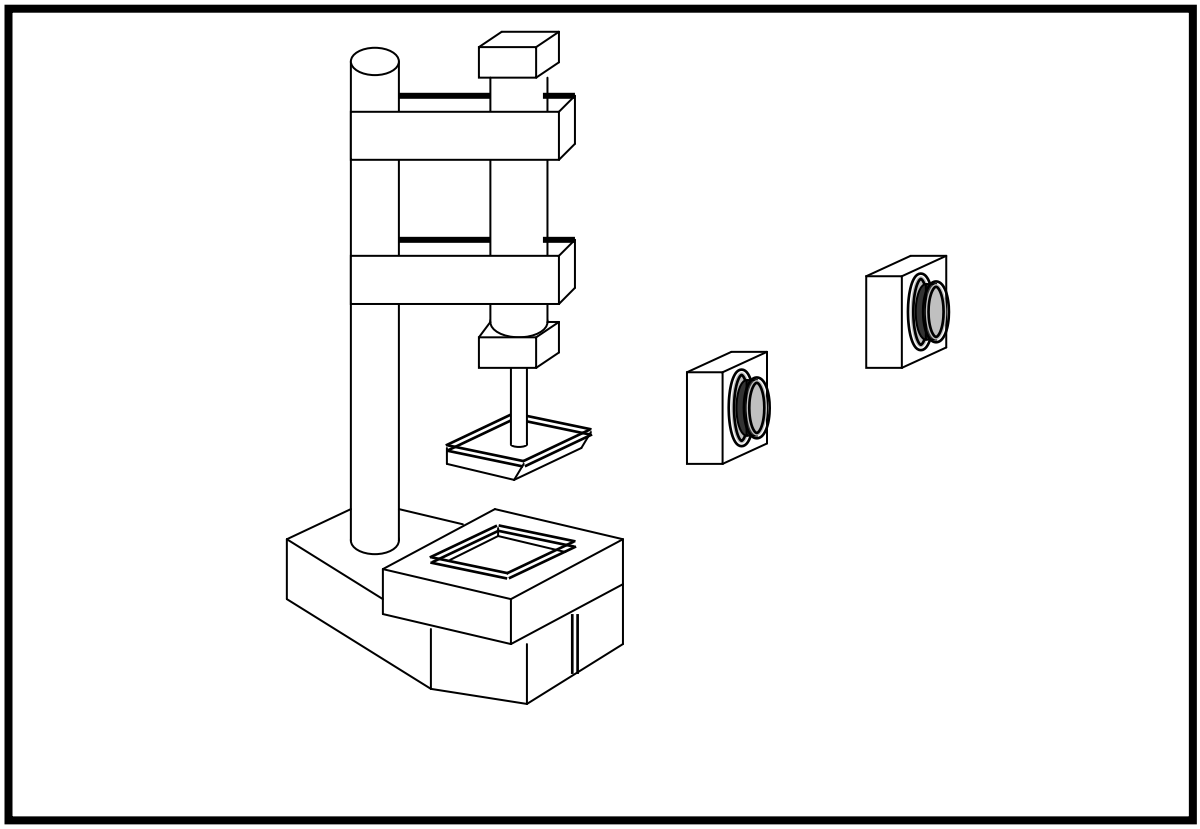


FIGURE 3

4.1 List FIVE related electro-pneumatic components that you would use to construct the embossing machine shown in FIGURE 3, using indirect control. (5)

4.2 Draw the 24-V two-handed-controlled DC circuit for the embossing machine shown in FIGURE 3 that will return automatically after the push buttons are released using indirect control. (5)

4.3 Draw the electro-pneumatic working circuit for the embossing machine shown in FIGURE 3 that will return automatically after the push buttons are released using indirect control. (4)

4.4 Briefly explain the operation of the embossing machine shown in FIGURE 3. (3)

4.5 Briefly explain how you would modify the two-handed-controlled circuit of the electro-pneumatic embossing machine to keep the cylinder energised and let it retract after a certain period has elapsed. (3)

[20]

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QUESTION 5

5.1 Explain what is meant by the term *troubleshooting.* (2)

5.2 One of the structured methods used when troubleshooting is the 'output-input-through-the-circuit' method.

Explain what must be done at each stage when using this troubleshooting method. (3 × 2) (6)

5.3 Explain the difference between *live* and *dead* circuit testing. (2 × 2) (4)

5.4 Explain how the 'output-input-through-the-circuit' method is applied for each of the scenarios given in the following questions (5.4.1–5.4.4) when troubleshooting using 'live' or 'dead' circuit testing on the electro-pneumatic embossing machine shown in FIGURE 3.

5.4.1 If the solenoid valve does not energise when the two-handed control is applied and the supply is present, how would this fault be cleared?

5.4.2 If the solenoid valve is in working order, but it does not energise when the two push buttons are operated at the same time, how would this fault be cleared?

5.4.3 If the solenoid valve is energised, but the cylinder does not extend, how would this fault be cleared?

5.4.4 If the solenoid valve is not energised, but the cylinder does not retract after the pre-set time has elapsed, how could this fault be fixed?

(4 × 2) (8)

[20]

TOTAL 100

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