higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 2

(6040102)

12 March 2018 (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. All drawings are to be neat and correctly labelled.
5. All symbols are to be of IEC standard.
6. All terminal numbers are to be labelled.
7. Write neatly and legibly.

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QUESTION 1

1.1 Study FIGURE 1 below showing an electric hand-held drilling machine.

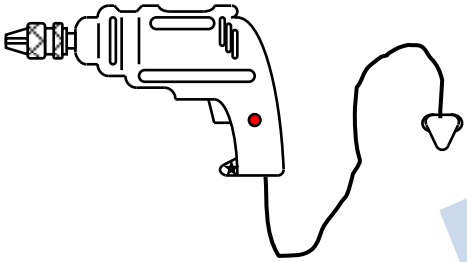


FIGURE 1

Answer the following related questions:

1.1.1 What is the energy conversion that takes place in the electric hand-held drilling machine? (1)

1.1.2 Draw the technical system block diagram of the electric hand-held drilling machine showing energy flow, data flow and material flow. (6 × 1) (6)

1.1.3 Explain how the electric motor speed is reduced in the electric hand-held drilling machine? (1)

1.1.4 Explain the operation of the electric hand-held drilling machine. (2)

1.2 What motion is generated by the each of the following hand-held machine tools shown in FIGURE 2 to FIGURE 5 below? Write only the answer next to the question number (1.2.1–1.2.4) in the ANSWER BOOK.

1.2.1

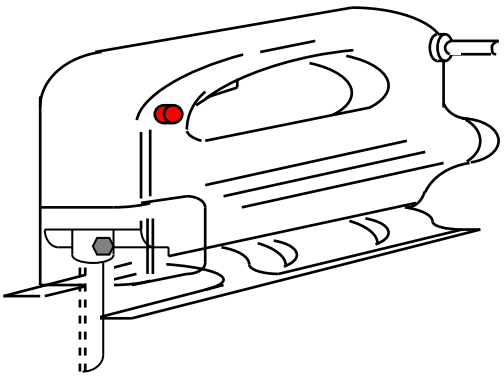


FIGURE 2

1.2.2

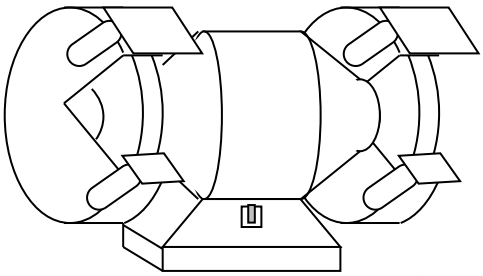


FIGURE 3

1.2.3

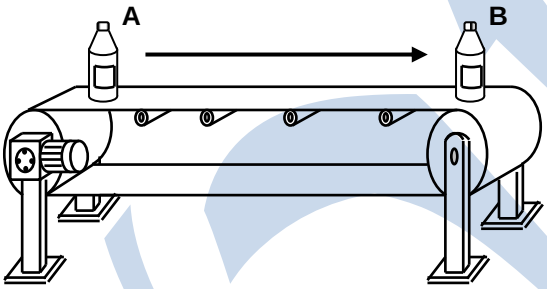


FIGURE 4

1.2.4

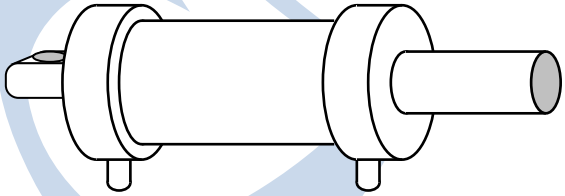


FIGURE 5

(4 × 1) (4)

1.3 A complete engineering system can be represented by a single block diagram; however, it does not provide enough information, so a systems diagram is used to show the various subsections that make up the engineering system.

Draw a systems diagram showing the various subsections that make up the conveyor system represented by FIGURE 4 in QUESTION 1.2.3. (6 × 1) (6)

[20]

QUESTION 2

FIGURE 6 shows a pictorial drawing of a compressor where the air pump is driven by a single-phase electric motor.

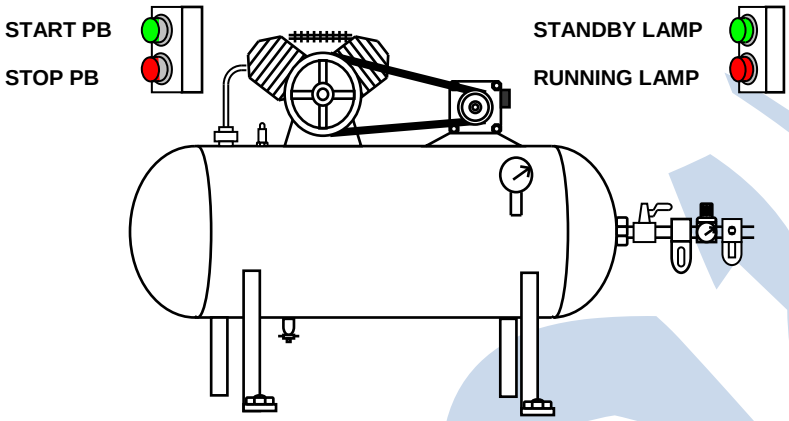


FIGURE 6

Answer the following related questions:

2.1 Two types of controls are used in mechatronics, namely *closed loop control* and *open loop control.*

Explain these TWO types of control. (2 × 2) (4)

2.2 Control circuits may either be combined or separately connected.

Explain, using simple circuit diagrams, the difference between *combined control* and *separate control*. (2 × 3) (6)

2.3 Draw a relay logic ladder (RLL) diagram showing how combined control is used for the control of the compressor shown in FIGURE 6 above. (10 × 1) (10)

[20]

QUESTION 3

3.1 List the THREE subsections that make up a pneumatic system. (3 × 1) (3)

3.2 Explain the function of each of the three subsections listed in QUESTION 3.1. (3 × 2) (6)

3.3 Draw the basic systems diagram that represents a pneumatic system. (6 × 1) (6)

3.4 Explain why an air distribution system must be built having a slope (fall) of 1 : 100. (2)

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3.5 Name the TWO types of air distribution systems used in industry. (2)

3.6 When would one use a pneumatic application? (1)
[20]

QUESTION 4

4.1 Study the perception drawing shown in FIGURE 7 below.

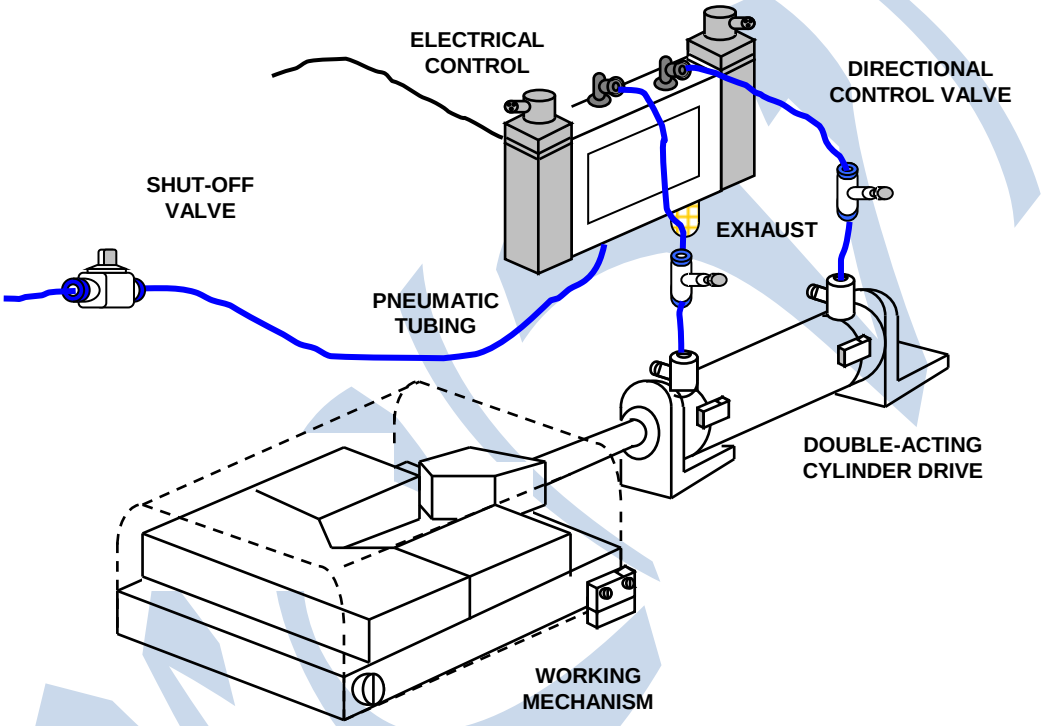


FIGURE 7

Draw the labelled electro-pneumatic working circuit diagram using IEC symbols. (8 × 1) (8)

4.2 Study FIGURE 8 below representing an electro-pneumatic gravity feeder (A1) and a pneumatic ejector (A2).

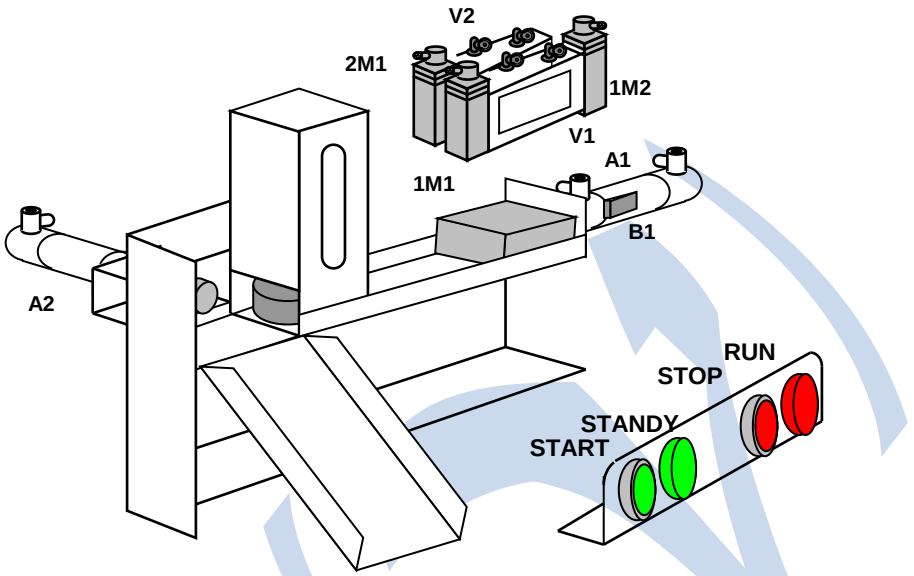


FIGURE 8

Draw the status step diagram that represents the operation of the TWO electromagnetic pneumatic cylinders (A1+)(A2+)(A1,A2-). (8 × 1) (8)

4.3 Explain the operation of the electro-pneumatic system represented by FIGURE 8 above. (4 × 1) (4)
[20]

QUESTION 5

5.1 What is the purpose of troubleshooting an electro-pneumatic application? (1 × 2) (2)

5.2 What is meant by the *commissioning process* of an electro-pneumatic application? (1 × 2) (2)

5.3 Explain, using a drawing, how you would troubleshoot the pneumatic subsystem of an electro-pneumatic application using the *output-input-through-the-system* approach. (4 + 4) (8)

5.4 Explain, using a drawing, how you would locate a fault in the electrical control system of an electro-pneumatic application using the *half-cut method*. (4 + 4) (8)
[20]

TOTAL: 100

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