higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTROTECHNOLOGY
NQF LEVEL 3

(12040423)

18 February 2025 (X-paper)
09:00–12:00

This question paper consists of 6 pages.

051Q1S2518

Copyright reserved

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
ELECTROTECHNOLOGY
NQF LEVEL 3
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. Use only a black or blue pen.
5. Write neatly and legibly.

Copyright reserved

QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 Which ONE of the following is not a component used to build a starter?

A Overload circuit breaker
B Spring balance
C Contactor
D Push button

1.1.2 Nameplate ratings:

A Max current, voltage, insulation
B Voltage, insulation, velocity
C Velocity, speed, max current
D Insulation, velocity, max current

1.1.3 Standard voltages that can be used for a control circuit:

A 24 V DC, 110 V DC, 110 V AC and 220 V AC
B 18 V DC, 10 V DC and 12 V DC
C 90 V, 80 V, 15 V and 30 V
D 5 V, 8 V, 13 V and 25 V

1.1.4 Reason why a nameplate is very important in a motor:

A It tells the size of the motor.
B It gives more specs and the rating of the motor.
C It does not give any information.
D It gives nothing that helps to fix the motor.

1.1.5 Formula for efficiency:

A $\eta = \frac{P_o}{P_i} \times 100\%$

B $\eta = (P_o - P_i) \times 100\%$

C $\eta = (Pi - P_o) \times 100\%$

D $\eta = P_o \times 100\%$

(5 × 1) (5)

1.2 Make a neat, fully labelled sketch of an electromagnet (solenoid) showing the magnetic lines and their relative directions. (6)

1.3 State THREE ways in which the magnetic flux of a solenoid can be strengthened. (3)

1.4 Which material is used to make generator brushes? (1)

1.5 A 30 kW DC motor draws 100 A from 250 V.

HINT: P = V × I

Calculate:

1.5.1 The output power in kW (2)

1.5.2 The total losses in the motor (1)

1.5.3 The efficiency of the motor (2)

[20]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 The functions of motor control include starting the motor, turning the motor off, jogging the motor, inching the motor and speed controlling the motor.

2.1.2 Direct contact refers to a person coming into contact with a conductor that is live in normal circumstances.

2.1.3 It is necessary to open enclosures or remove covers before carrying out a virtual inspection of an installation.

2.1.4 Guarding can be achieved by fixed guards and moveable guards.

2.1.5 The metal enclosure and all metal removable covers or doors must be bonded to the protective earth conductor of the installation.

(5 × 1) (5)

2.2 What is the purpose of *earthing*? (2)

2.3 Briefly explain how the windings of an electric motor can be tested. (2)

2.4 Name and explain THREE types of motor control. (3 × 3) (9)

2.5 What is the size of the cable that can be used to wire the control circuit? (2)

[20]

Copyright reserved

QUESTION 3

3.1 Choose a description from COLUMN B that matches a term in COLUMN A. Write only the letter (A–G) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1.1	Electrical interlock	A	can move forward and reverse
3.1.2	Overload	B	can run from an AC supply or a DC supply
3.1.3	Series motor	C	very useful information about the motor
3.1.4	Universal motor	D	very high starting torque
3.1.5	Nameplate	E	prevents the motor from running in both directions at the same time
		F	prevents overcurrent in motor
		G	low voltage

(5 × 1) (5)

3.2 Essentially lockout is the process of isolating the energy source to a machine, system or electrical installation with a malfunction and locking it out with a padlock.

3.2.1 Explain, with the aid of diagrams, TWO basic requirements to perform the lockout procedure. (2 + 2) (4)

3.2.2 What is a *lockout tag*? (3)

3.3 Briefly differentiate between a *circuit diagram* and a *wiring diagram*. (4 + 4) (8)

3.4 Draw the IEC symbol for an isolator. (3)

3.5 Name SEVEN tools needed to install an electric drive. (7)

[30]

QUESTION 4

4.1 Give ONE term for each of the following descriptions by writing it next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

4.1.1 Program loaded into the programmable logic controller that defines the operation to be performed by the PLC

4.1.2 Two vertical lines, labelled L1 and L2, connecting the rungs of a relay ladder diagram (horizontally for the IEC format)

4.1.3 Horizontal lines in a relay logic diagram that has input devices and an output device

4.1.4 Device that, when energised, opens normally closed contacts and closes normally open contacts

4.1.5 Mechanical assembly that opens and closes corresponding to the state of its associated relay coil; a normally open contact is closed when its relay coil is energised and a normally closed contact is opened when its relay coil is energised

(5 × 1) (5)

4.2 Design the forward/reverse control circuit of a motor. The motor must be reversing a manual control circuit that can be adapted for automated control of DC motors and single-phase AC motors. The latching and electrical interlocks must be shown on the circuit. Use two relays. (12)

4.3 What is a *relay logic diagram*? (3)
[20]

QUESTION 5

5.1 Explain why it is necessary to calibrate testing equipment before commissioning an installation. (3)

5.2 Explain the consequences of not planning for an installation. (3)

5.3 Briefly explain the purpose of maintenance on equipment and machines. (4)
[10]

TOTAL: 100

Copyright reserved