



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N2**

(11041872)

**15 April 2021 (X-paper)
09:00–12:00**

Nonprogrammable calculators and drawing instruments may be used.

This question paper consists of 7 pages and 1 formula sheet.

189Q1A2115

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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ELECTRICAL TRADE THEORY N2
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. Only use a blue or black pen.
 5. Write neatly and legibly.
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QUESTION 1: CONDUCTORS AND CABLES

- 1.1 Determine, using the table below, the maximum time that a paper insulated cable can carry a fault current of 8,67 kA. The cable has aluminium conductor with a cross-sectional area of 35 mm².



TYPE OF INSULATION	TYPE OF CONDUCTOR	CIF
PVC	Copper	96
PVC	Aluminium	62
XPLE	Copper	143
XPLE	Aluminium	92
Paper	Copper	116
Paper	Aluminium	78

(3)

- 1.2 The declared voltage between phases at the supply point of an installation is 380 V.

Determine the minimum allowable voltage at the point of consumption of a single-phase outlet.



(3)

- 1.3 What does the code of practice stipulate with regards to the maximum permissible voltage drop?

(2)

- 1.4 Indicate whether the statements are TRUE or FALSE by writing 'True' or 'False' next to the question number (1.4.1–1.4.3) in the ANSWER BOOK.

1.4.1 If the ground is not rocky, the best way to hide unsightly cables is to bury them.

1.4.2 The best way to prevent cables from being struck by lightning is to run the cables in ducts.





1.4.3 Cables working at their maximum current rating need to be well-ventilated to allow for adequate heat dissipation.

(3 × 1)


(3)

[11]


QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

- 2.1 Give ONE reason why power stations are located far away from the major load centres.  (2)
- 2.2 How will you identify which circuit breaker in the distribution board is protecting the geyser subcircuit? (1)
- 2.3 A mini-substation in a residential area in South Africa supplies both 380 V and 220 V.
- 2.3.1 Is the secondary winding of the substation's transformer connected in star or delta? (1)
- 2.3.2 Between which conductors will these voltages be measured? (2)
- 2.4 Name THREE design measures taken by manufacturers to protect circuit breakers against the harmful effects of an arc.  (3)
- 2.5 State the difference between a disconnecter and a switch disconnecter. (3)
- [12]**


QUESTION 3: DC MOTORS AND STARTERS

- 3.1 What is the main disadvantage of a shunt motor? (1)
- 3.2 What is the main disadvantage of a series motor? (1)
- 3.3 Complete the sentence by writing the missing word or words next to the question number (3.3.1–3.3.4) in the ANSWER BOOK.
- The overload relay (OLR) is a/an (3.3.1) ... sensitive (3.3.2) ... which has a set of (3.3.3) ... and (3.3.4) ... contacts.  (4)
- 3.4 Draw neat, labelled circuit diagrams to show TWO methods of how the direction of rotation of a compound-wound motor may be reversed. (6)
- [12]**

QUESTION 4: AC MOTORS AND STARTERS

- 4.1 Name TWO parts of the stator of an induction motor. (2)
- 4.2 Induction motors can be either of the single-phase or three-phase type.
- 4.2.1 State THREE advantages that single-phase motors have when compared to three-phase motors. 
- 4.2.2 State THREE disadvantages that single-phase motors have when compared to three-phase motors. (2 × 3) (6)
- 4.3 Name TWO methods used to reduce the voltage across the stator windings of a three-phase induction motor during starting. (2)
- 4.4 Explain how a single-phase motor is connected to produce a rotating magnetic field. (3)
- 4.5 Name the TWO main parts of a three-phase induction motors. (2)
- [15]

**QUESTION 5: EARTHING**

- 5.1 Earthing means electrically connecting an object to the general mass of the earth.
- 5.1.1 What do you understand by equipment earthing? (3)
- 5.1.2 What is another name for equipment earthing? (1)
- 5.2 Define *consumer's earth terminal*. (2)
- 5.3 The metal frame of a stove has an earth terminal.
- Explain how this terminal is eventually connected to the suppliers' protective earth.  (4)
- 5.4 Explain the importance of earthing. (2)
- [12]

QUESTION 6: PROTECTION

6.1 State the purpose of:

6.1.1 Earth-leakage relays

6.1.2 Fuses 

6.1.3 Surge protection device

(3 × 2) (6)

6.2 Name the FOUR main components of a bimetal-type overload relay.

(4)
[10]


QUESTION 7: MEASURING INSTRUMENT

7.1 Name ONE instrument that you would use to determine:

7.1.1 Whether the current rating of the supply cable is being exceeded

7.1.2 Whether the earthing in a domestic installation is continuous and within acceptable limits as stipulated in the code of practice

7.1.3 Whether the voltage at a point is within the permissible 5% volt drop

7.1.4 Whether an AC-operated alarm clock is losing time, or an electric grinder seems to be turning slower 

7.1.5 The ratio of the true power to the apparent power

7.1.6 An industrial consumers' apparent power

(6 × 1) **[6]**

QUESTION 8: TRANSFORMERS

8.1 A single-phase step-down transformer is rated at 100 kVA and has a turns ratio of 10:1.

Ignoring losses, calculate:

8.1.1 The secondary voltage if the primary voltage is 2 600 V

8.1.2  The secondary current if the primary current is 30 A

(2 × 2) (4)

8.2 In a balanced three-phase delta circuit the phase voltage is 250 V, and the phase current is 12 A. The phase angle is 25° lagging.

Calculate:

8.2.1 The true power of the circuit in kW



8.2.2 The reactive power of the circuit in kvar

(2 × 2)

(4)

8.3 A three-phase transformer has a star-connected primary and a star-connected secondary. The transformer supplies a line current of 100 A to a certain load. The primary line voltage is 2 200 V, and the secondary line voltage is 380 V.

Determine:

8.3.1 The primary phase voltage

(1)

8.3.2 The secondary phase voltage

(1)

8.3.3 The transformer ratio



(2)

[12]

QUESTION 9: ELECTRONICS

9.1 State TWO functions of an SCR.

9.2 Diodes can be tested using an ohmmeter.

Name TWO possible faults that can occur in a diode.

9.3 Explain the function of a diode.

9.4 What is the function of a rectifier circuit?

9.5 State TWO function of a transistor.



(5 × 2)

[10]

TOTAL:

100

FORMULA SHEET

Any applicable formula may also be used.

STAR $V_L = \sqrt{3} V_{PH}$

$$I_L = I_{PH}$$

DELTA $V_L = V_{PH}$

$$I_L = \sqrt{3} I_{PH}$$

TRANSFORMER $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1} = \frac{E_1}{E_2}$

SINGLE-PHASE

APPARENT POWER $S = VI$

TRUE POWER $P = VI \cos\theta$

REACTIVE POWER $Q = VI \sin\theta$

THREE-PHASE

APPARENT POWER $S = \sqrt{3} V_L I_L$ $S = 3 V_{PH} I_{PH}$

TRUE POWER $P = \sqrt{3} V_L I_L \cos\theta$ $P = 3 V_{PH} I_{PH} \cos\theta$

REACTIVE POWER $Q = \sqrt{3} V_L I_L \sin\theta$ $Q = 3 V_{PH} I_{PH} \sin\theta$

FAULT CURRENT $I_{fc} = \frac{CIF \times A}{\sqrt{t}}$