



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

(11041872)

26 November 2019 (X-Paper)

09:00–12:00

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

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
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. Where applicable, answers must be in accordance with the SABS (SANS) Code of Practice SANS 10142-1:2003 for the Wiring of Premises.
 5. Sketches must be neat, labelled and large enough to show the required detail.
 6. Round off answers to TWO decimals.
 7. Write neatly and legibly.
-

QUESTION 1: CONDUCTORS AND CABLES

1.1 Give FIVE advantages of installing cables in ducts. (5)

1.2 Determine the maximum time that an XLPE-insulated aluminium cable can carry a fault current of 1 800 A. The cross-sectional area of the aluminium conductors is 30 mm².

NOTE: Use the table below to solve this problem.

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

(4)

1.3 Define the term *conductor*.

(2)

[11]

QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

2.1 Explain how to join the conductors inside a low-voltage resin joint. (5)

2.2 Choose an area of application from COLUMN B that matches a conductor-joining method in COLUMN A. Write only the letter (A–G) next to the question number (2.2.1–2.2.5) in the ANSWER BOOK.

COLUMN A	COLUMN B
2.2.1 Crimped ferrule or lug joints	A joining overhead lines – placed over the conductor and tightened with a spanner
2.2.2 Britannia joints	B terminating and joining conductors in electrical installations and equipment
2.2.3 Strip connectors	C joining hard-draw bate copper wires under a lot of tension when in use
2.2.4 Line taps	D connecting wiring among various equipment within an enclosure or among individually enclosed items
2.2.5 Married joints	E stranded conductors and where tensile stress is low.
	F soldered joints are recommended for flexible conductors and cables.
	G only suitable corrosion free flexes may be used when soldering joints

(5 × 1)

(5)

2.3 What is the main function of an insulator?

(2)
[12]



QUESTION 3: DC MOTORS AND STARTERS

3.1 Compare a series motor and a shunt motor in terms of no-load speed and full load speed in the table below by filling in the missing word(s) next to the question number (3.1.1 – 3.1.4) in the ANSWER BOOK.

Speed	Series motor	Shunt motor
No-load speed	3.1.1	3.1.2
Full-load speed	3.1.3	3.1.4

(4 × 1) (4)

3.2 Show, with the aid of a labelled diagram, how you would connect a face plate starter to a series motor.



(5)

3.3 Draw the load characteristics of a shunt motor.

(3)
[12]

QUESTION 4: AC MOTORS AND STARTERS

4.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (4.1.1–4.1.3) in the ANSWER BOOK.

4.1.1 The main function of a stator is to produce magnetic flux and, in case of an induction motor, to convert electrical energy input into magnetic energy which is transferred to the rotor.

4.1.2 Three-phase motors require less maintenance.



4.1.3 An insulation resistance of 1 MΩ between the windings of an induction motor is not acceptable.



(3 × 1) (3)

4.2 Briefly explain how a rotor resistance starter operates.

(2)

4.3 Explain what you understand by *direct on-line starting*.

(2)

4.4 Rearrange the following statements so that they effectively describe the sequence of events that makes the rotor turn. Write only the question number of each statement in the correct order in the ANSWER BOOK. DO NOT COPY the sentence.

4.4.1 The stator coils produce a rotating magnetic field which cuts the rotor windings.

4.4.2 Because the rotor windings are short – circuited, the EMF induced in these windings will cause current to flow in them.

4.4.3 The supply to the motor creates current flow in the stator coils.

4.4.4 The current in the rotor produces a magnetic field that reacts with the field from the stator coils.

(4 × 1) (4)

4.5 Before a motor is connected to a supply it must be tested.

Explain how an open circuit test can be performed under the following points.

4.5.1 What measuring instrument is used? (1)

4.5.2 How is the measuring instrument connected to the three stator coils? (2)

4.5.3 What is the expected value that the instrument will indicate if each coil is open-circuited? (1)

[15]

QUESTION 5: EARTHING

5.1 Explain the purpose of earthing. (3)

5.2 Explain what is meant by the following:

5.2.1 Earth electrode (2)

5.2.2 System earthing (3)

5.3 List FOUR requirements of earth continuity conductor as stipulated in the code of practice. (4)

[12]

QUESTION 6: PROTECTION

- 6.1 Name FOUR faults that can lead to phase imbalance in a three-phase system. (4)
- 6.2 Explain the effect of severe starting on protective devices. (2)
- 6.3 Complete the following sentences by filling in the missing word(s). Write only the missing word(s) next to the question number (6.3.1 – 6.3.3) in the ANSWER BOOK.
- 6.3.1 A fuse shall disconnect the circuit against ... and ... (2)
- 6.3.2 Electronic products such as television set, computers and fax machines can be protected against lightning and overvoltage using a protective device called (1)
- 6.3.3 The maximum leakage current needed to trip the earth leakage relay is (1)
- [10]**





QUESTION 7: MEASURING INSTRUMENTS

- 7.1 Name the measuring instrument used to determine each of the following:
- 7.1.1 The instantaneous electric power consumed.
- 7.1.2 The amount of electric power consumed in a month. (2 × 1) (2)
- 7.2 List FOUR strategies that industrial consumers can use to reduce maximum demand of electricity. (4)
- [6]**

QUESTION 8: TRANSFORMERS

- 8.1 Name FOUR three-phase transformer connections. (4)
- 8.2 A 100 k VA, 11 000 V / 500 V 50 Hz single-phase transformer has 60 turns on the secondary winding.
- Calculate the following:
- 8.2.1 The primary current
- 8.2.2 The secondary current
- 8.2.3 The number of primary turns (3 × 2) (6)
- 8.3 Explain what is meant by *inductance*. (2)
- [12]**

QUESTION 9: ELECTRONICS

- 9.1 What readings would you expect when testing a silicon diode using an ohmmeter under the following conditions:
- 9.1.1 Forward-bias condition
- 9.1.2 Reverse-bias condition 
- (2 × 1) (2)
- 9.2 In which region does a transistor operate as an amplifier? (1)
- 9.3 With reference to the diode, explain what is meant by *biasing*. (2)
- 9.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (9.4.1–9.4.5) in the ANSWER BOOK.
- 9.4.1 When a P-type material is joined by some process to an N-type material the result is known as a P-P junction.
- 9.4.2 Two electrons can combine and share their valency shell which is called a valency bond. 
- 9.4.3 When a PN-junction is formed some of the electrons in the N-layer move over to the P-layer and form a depletion layer.
- 9.4.4 A junction transistor consists of a thin layer of P-type semiconductor to form an NPN-transistor or a thin layer of N-type material between two P-type materials to form a PNP-transistor. 
- 9.4.5 A transistor is used as a switch. 
- (5 × 1) (5)
[10]
- TOTAL: 100**

(11041872)

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: $S = \sqrt{3} V_L I_L$

True power: $P = \sqrt{3} V_L I_L \cos \theta$

Reactive power: $Q = \sqrt{3} V_L I_L \sin \theta$

Fault current: $I_{fc} = \frac{CIF \times A}{\sqrt{t}}$