



# higher education & training

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

T510(E)(A1)T

**NATIONAL CERTIFICATE**

**ELECTRICAL TRADE THEORY N2**

(11041872)

**1 August 2018 (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

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**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. Leave at least THREE lines after each question.
  6. Sketches must be neat, labelled and large enough to show the required detail.
  7. A FORMULA SHEET with the formulae used in Electrical Trade Theory N2 is attached to the question paper.
  8. Answers must be given correct to THREE decimal places.
  9. Write neatly and legibly.
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## QUESTION 1: CONDUCTORS AND CABLES

- 1.1 State THREE general methods of installing armoured cables. (3)
- 1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write 'true' or 'false' next to the question number (1.2.1–1.2.2) in the ANSWER BOOK.
- 1.2.1 In a purely resistive circuit the current and the power will be in phase with each other.
- 1.2.2 In a purely capacitive circuit the current would lead the voltage by 180°. (2 × 1) (2)
- 1.3 Determine the required current-carrying capacity of a cable that is to supply a single-phase inductive load of 15 kW at a power factor of 0,9. (2)
- 1.4 Give a possible explanation for permissible volt drop between the supply point and any outlet point. (2)
- 1.5 The declared voltage at the point of supply to a block of flats is 220 volts.  
Determine the minimum permissible voltage at any point in the block of flats. (2)
- [11]

## QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

- 2.1 One of the most common jointing methods is the resin joint (Scotch-cast joint).  
State SIX steps of a resin joint in a low-voltage PVC wire-armoured cable when making the joint. (6)
- 2.2 Compare the operation and function of *disconnectors*, *relays* and *contactors* and present your answer in table format by copying and completing the following table in the ANSWER BOOK:

	COMPARISON	DISCONNECTORS	RELAYS	CONTACTORS
2.2.1	Operation			
2.2.2	Function			

(3)

(3)

[12]

**QUESTION 3: DC MOTORS AND STARTERS**

- 3.1 Draw a neat, labelled diagram, of a face-plate starter related to a shunt motor. (6)
- 3.2 Draw a neat, labelled diagram to show how the reversal of direction of rotation for a shunt motor is achieved. (3)
- 3.3 What is the difference between a cumulatively compounded motor and a differentially compounded motor? (2)
- 3.4 What is the main disadvantage of a shunt motor? (1)

**[12]****QUESTION 4: AC MOTORS AND STARTERS**

- 4.1 Draw a neat, labelled circuit diagram of a capacitor star induction-run motor. (4)
- 4.2 Name TWO types of rotors found in induction motors. (2)
- 4.3 What is a squirrel-cage rotor? (2)
- 4.4 Draw a load characteristic of a universal motor and label both axes. (3)
- 4.5 The overcurrent protection devices used for motors must meet certain requirements.

Discuss these requirements under the following headings.

4.5.1 Time delay

4.5.2 Tripping value

(2 × 2) (4)

**[15]**

**QUESTION 5: EARTHING**

- 5.1 What is the meaning of the term *earthed*? (3)
- 5.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and only write 'true' or 'false' next to the question number (5.2.1– 5.2.4) in the ANSWER BOOK.
- 5.2.1 The earthing of electricity-associated equipment means connecting the current-carrying exposed conductive parts of appliances to earth so as to ensure that the potential difference between the appliance and earth is not zero.
- 5.2.2 When making a joint in a wire-armoured cable it is important to join some or even all of the wire-armouring strands in order to maintain earthing continuity.
- 5.2.3 All noncurrent-carrying metalwork of an electrical installation can be bonded by means of an earth-continuity conductor and connected to the live lead intended to earth the total installation.
- 5.2.4 The rating of an earth-leakage relay is 20 mA. However, the SANS Code of Practice stipulates that the earth-leakage protection device shall not exceed 30 mA. (4 × 1) (4)
- 5.3 The metal frame of a stove has an earth terminal.  
Explain the *earthing chain* that exists to eventually connect the stove to the earth electrode outside the house. (3)
- 5.4 What is the aim of bonding? (2)
- [12]**

**QUESTION 6: PROTECTION**

- 6.1 Describe the construction of a bimetal-type overload relay (3)
- 6.2 Explain how surge protection is activated. (2)
- 6.3 Explain where the earth-leakage relay must be installed in a domestic electrical installation. (3)
- 6.4 State the purpose of an earth-leakage protection device. (2)
- [10]**

## QUESTION 7: MEASURING INSTRUMENTS

- 7.1 What is the function of a frequency meter? (2)
- 7.2 A voltmeter labelled A, an ammeter labelled B and a frequency meter labelled C are connected in a circuit to measure the voltage, current and frequency respectively as shown in the FIGURE 1 below.

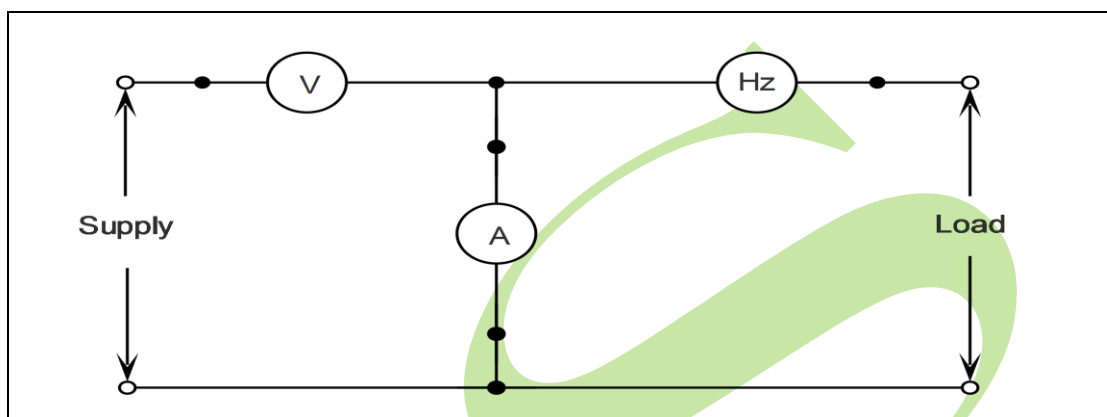


FIGURE 1

- 7.2.1 State if the voltmeter is connected properly. If you answer no, how should it be connected? (1)
- 7.2.2 State if the ammeter is connected properly. If you answer no, how should it be connected? (1)
- 7.3 Explain how the watt-hour meter is able to give a reading which is proportional to the energy consumed. (2)
- [6]**

**QUESTION 8: TRANSFORMERS**

- 8.1 An 11 000 V to 380 V delta/star three-phase transformer unit is 96% efficient. It delivers 500 kW at a power factor of 0,9.

Calculate:

8.1.1 The secondary phase voltage (1)

8.1.2 The primary line circuit (4)

- 8.2 What is the purpose of transformer tapings? (2)

- 8.3 A single-phase transformer has 800 turns on the primary winding which is connected to a 240 V AC supply. The voltage and current on the secondary side is 16 volts and 8 A respectively.

Determine:

8.3.1 The number of turns on the secondary side (1)

8.3.2 The value of the primary current (1)

8.3.3 The turns ratio (1)

8.3.4 The voltage per turn (2)

[12]

**QUESTION 9: ELECTRONICS**

- 9.1 Make labelled sketches of the IEC symbols for the TWO common types of transistors used. (4)

- 9.2 Draw a neat circuit diagram that will illustrate how a single diode can be used as a half-wave rectifier. (2)

- 9.3 Explain what is meant by *continuous-current rating*. (2)

- 9.4 Explain how a thyristor operates as a power-controlling device. (2)

[10]

**TOTAL: 100**

**ELECTRICAL TRADE THEORY N2****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

$$P = VI \cos \phi$$

REACTIVE POWER

$$Q = VI \sin \phi$$

**THREE-PHASE**

APPARENT POWER

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

TRUE POWER

$$P = \sqrt{3} V_L I_L \cos \phi$$

REACTIVE POWER

$$Q = \sqrt{3} V_L I_L \sin \phi$$

FAULT CURRENT

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