



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N2**

(11041872)

**9 April 2020 (X-paper)
09:00–12:00**

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


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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. Start each question on a new page.
 5. Use only a black or blue pen.
 6. Write neatly and legibly.
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QUESTION 1: CONDUCTORS AND CABLES

- 1.1 Cable can carry fault currents that are much higher than their rated current.
Name THREE factors that affect the permissible fault current that a cable can carry.  (3)
- 1.2 Determine the full-load line current of a 380 V, 60 kW, three-phase motor that has a full-load power factor of 0, 8. (3)
- 1.3 Name FOUR types of inductive loads used in an AC circuit. (4)
- 1.4 In which unit is apparent power measured? (1)
- [11]**

QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS

- 2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.3) in the ANSWER BOOK.
- 2.1.1 The casing of a circuit breaker is moulded glass fibre.
- 2.1.2 A circuit breaker may be used as a local switch disconnecter provided that it complies with the standards of a switch disconnecter. 
- 2.1.3 The contacts of a circuit breaker are generally made of silver tungsten. (3 × 1) (3)
- 2.2 Use the table below to compare relays and contactors with regard to factors as indicated by the headings by filling in the missing word(s) next to the question number (2.2.1 – 2.2.6) in the ANSWER BOOK.
- | Comparison | Relays | Contactors |
|--------------|--------|------------|
| Construction | 2.2.1 | 2.2.2 |
| Function | 2.2.3 | 2.2.4 |
| Operation | 2.2.5 | 2.2.6 |
- (6 × 1) (6)
- 2.3 List THREE types of joints used to join conductors in high-voltage applications.  (3)
- [12]**

QUESTION 3: DC MOTORS AND STARTERS

- 3.1 Complete the following sentence by writing only the missing word or words next to the question number (3.1.1 – 3.1.2) in the ANSWER BOOK.



If the direction of a current through the field windings of a compound motor is to be reversed, the current through both the (3.1.1) ... and the (3.1.2) ... must be reversed. (2 × 1)

(2)

- 3.2 Give ONE disadvantage of a series motor. (1)

(1)

- 3.3 Refer to FIGURE 1 below and answer the following questions:

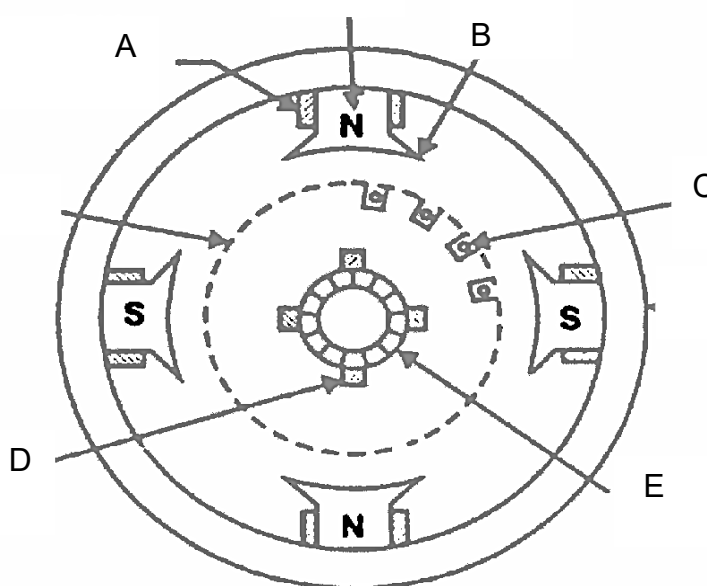


FIGURE 1

- 3.3.1 Identify FIGURE 1 above. (1)

(1)



- 3.3.2 Identify the parts labeled A to E. Write only the answer next to the letter (A – E) in the ANSWER BOOK. (5 × 1)

(5)


- 3.4 Draw a labelled circuit diagram of a series motor. (3)

[12]

QUESTION 4: AC MOTORS AND STARTERS

- 4.1 Name TWO types of windings that can be found on a capacitor-start / capacitor-run motor. (2)
- 4.2 Explain the purpose of a centrifugal switch as used in a single-phase induction motor. (2)
- 4.3 With reference to AC motors, explain what is meant by the following: 
- 4.3.1 Stator
- 4.3.2 Rotor (2 × 1) (2)
- 4.4 Explain why the rotor of an induction motor cannot rotate at synchronous speed. (2)
- 4.5 Compare the following types of rotors with reference to their construction:
- 4.5.1 Squirrel-cage rotors
- 4.5.2 Wound rotors  (2 × 1) (2)
- 4.6 Name FIVE advantages of three-phase induction motors. (5)
- [15]**

QUESTION 5: EARTHING

- 5.1 A distribution system consists of overhead lines and an outdoor substation. The outdoor substation contains switch disconnectors, surge arrestors, overload protection and star-delta transformers
- Explain how each of the following is earthed in this system:
- 5.1.1 Transformers (2)
- 5.1.2 Overhead lines (2)
- 5.1.3 Entire substation  (3)
- 5.2 Briefly explain the term *floating earth*. (2)
- 5.3 Give THREE reasons why the supplier's neutral conductor in a low-voltage system is earthed. (3)
- [12]**

QUESTION 6: PROTECTION

6.1 Explain how time delay is obtained with bi-metal type overload relay. (2)

6.2 Briefly explain the effect of ambient temperature on the accuracy of thermal overload relays. (4)



6.3 The earth-leakage device has a test button that requires the user to test regularly for correct operation, thus ensuring that earth protection is optimal.

Explain the condition that exists and the resulting action when the test button is pressed.

(4)
[10]

QUESTION 7: MEASURING INSTRUMENT

7.1 Explain the function of an energy meter. (2)

7.2 Name TWO coils that a wattmeter in a single-phase system consists of. (2)

7.3 Give TWO types of wattmeters. (2)

[6]

**QUESTION 8: TRANSFORMERS**

8.1 The turn's ratio of a single-phase transformer is 25:1.

Calculate the following:

8.1.1 The secondary voltage when the transformer is connected to a 220 V AC supply

8.1.2 The input current if the transformer delivers 10 A (2 × 2) (4)

8.2 A 220 / 11 V single-phase step-down transformer has 2000 primary turns.

Determine the following:




8.2.1 The transformer ratio


8.2.2 The number of secondary turns (2 × 2) (4)

- 8.3 A three-phase delta-delta transformer is connected to a 2,2 kV supply. The secondary phase voltage is measured and found to be 220 V.

Determine the following:

- 8.3.1 The primary phase voltage  (1)
- 8.3.2 The secondary line voltage (1)
- 8.3.3 The primary phase current when it draws its full load current of 120 A from the supply (2)
- [12]**

QUESTION 9: ELECTRONICS

- 9.1 Explain how the Zener diode operates in reverse-bias mode. (3)
- 9.2 Explain the difference in current flow in NPN- and PNP-transistors. (2)
- 9.3 Answer the following questions on P-N junction diodes:
- 9.3.1 State what happens when the reverse voltage of a diode is exceeded.  (1)
- 9.3.2 Explain the function of a rectifier. (2)
- 9.3.3 When is the diode said to be forward-biased? (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	$P = VI \cos \phi$
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	$I_{fc} = \frac{CIF \times A}{\sqrt{t}}$