



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T510(E)(A6)T

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

(11041872)

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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. Answers must be given to TWO decimal places.
 7. Write neatly and legibly.
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QUESTION 1: CONDUCTORS AND CABLES

- 1.1 Give TWO reasons why an installation with a low power factor is costly to the consumer.  (2)

- 1.2 Determine the maximum short-circuit current that a PVC insulated cable, which has aluminium conductors with a cross-sectional area of 20 mm², can carry for a maximum period of 2 seconds. Use the following table below:

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

- 1.3 Copy the table below in the ANSWER BOOK and then complete the UNIT of measurement and SYMBOL for each electricity quantity. 


NAME	SYMBOL	UNIT
E.g. Resistance	R	Ohms
a) Reactive power	1.3.1...	1.3.2...
b) Maximum current rating of cable	1.3.3 ...	1.3.4...
c) Apparent power	1.3.5 ...	1.3.6...

(6)
[11]

QUESTION 2: SWITCHGEAR, CONTACTORS AND RELAYS




- 2.1 Explain how time delay is afforded in a thermal magnetic type circuit-breaker. (4)

- 2.2 Name FOUR types of joints which may be used to join low-voltage conductors. (4)


- 2.3 Mention TWO electrical devices that can be remotely operated to open and close a circuit.  (2)

- 2.4 Describe why miniature circuit breakers are factory sealed. (2)
[12]

QUESTION 3: DC MOTORS AND STARTERS

- 3.1 Explain the purpose of the following components found in the face-plate starter to start a large DC motor.
- 3.1.1 The spring-loaded arm during start up  (1)
- 3.1.2 The NVR (no voltage relay) when the motor is running at full speed (1)
- 3.1.3 The overload-coil when an overload current occurs whilst the motor is running at full speed (2)
- 3.2 Indicate whether the following statements are TRUE or FALSE. Write only 'True' or 'False' next to the question number (3.2.1–3.2.4) in your ANSWER BOOK.
- 3.2.1 DC series motors need capacitors to start.
- 3.2.2 Compound motors are not common because they are expensive.
- 3.2.3 A compound motor is a combination of long shunt wound motor and a separately excited motor. 
- 3.2.4 To reverse the direction of rotation of a DC series motor you need to reverse the connection to the supply. (4 × 1) (4)
- 3.3 How are the field coils of a compound motor connected to achieve the following:
- 3.3.1 A cumulative effect
- 3.3.2 A differential effect  (2 × 1) (2)
- 3.4 Explain what happens to the speed of a series motor as the load decreases. (2)

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

- 4.1 Name the TWO main parts of the induction motor. (2)
- 4.2 Name the instrument that is used to carry out different tests on the stator windings of a three-phase motor.  (1)
- 4.3 Name THREE tests that can be carried out on the stator winding of a three-phase motor and include an indication of the value of the readings that you would expect to find in each case. (3 × 2) (6)

- 4.4 Complete the following sentences by using the words provided in the list below. Write only the word(s) next to the question number (4.4.1 – 4.4.6) in the ANSWER BOOK.

slowly; supply; quickly; big, small; switching; cheaply; easily

A direct-on-line starter is used to start a motor (4.4.1) ..., (4.4.2) ... and (4.4.3) ... while supplying a high starting torque. Direct-on-line starting is when a motor is started by (4.4.4) ... it directly across the (4.4.5) ... Direct-on-line starting is applied when the motor and starting torque are relatively (4.4.6) ...



(6 × 1)

(6)
[15]

QUESTION 5: EARTHING

- 5.1 Between the supplier and consumer, the ground is being used as the earth continuity conductor.

5.1.1 Which conductors on the consumer's side are connected to earth?

5.1.2 Which conductors on the supplier's side are connected to earth?



(2 × 1)

(2)

- 5.2 How is earthing of overhead lines effected?

(2)

- 5.3 Describe a protective conductor.

(2)

- 5.4 What is the main function of an earth-tag washer

(2)

- 5.5 State the code of practice with regard to the following:



5.5.1 Tampering with earth continuity conductors

5.5.2 Prospective fault current and excessive heating of earth-continuity conductors

(2 × 2)

(4)
[12]

QUESTION 6: PROTECTION

- 6.1 Explain the following terms relating to circuit breakers



6.1.1 Manual reset




6.1.2 Snap action contacts

(2 × 1)

(2)

- 6.2 State the effect of the following factors on protective devices:
- 6.2.1 Severe starting of electric motors (1)
- 6.2.2 Cold ambient temperature  (2)
- 6.3 Give the name of the device that can be used for the following:
- 6.3.1 Detect a dangerous earth-fault current and disconnect an installation or circuit from the supply
- 6.3.2 Neutralise high voltage surges by discharging them to earth 
- 6.3.3 Neutralise low voltage surges by discharging them to earth
- 6.3.4 Disconnect the supply if the current being drawn is too high
- 6.3.5 Disconnect the supply when one of the phases falls away (5 × 1) (5)
- [10]**

QUESTION 7: MEASURING INSTRUMENTS

- 7.1 State the function of a wattmeter (2)
- 7.2 Give the name of instrument you would use for determining the phase shift between current and voltage.  (1)
- 7.3 Explain, without drawing a circuit diagram, how a frequency meter is connected to a single-phase system. (2)
- 7.4 Which other instrument is connected in the same manner as a frequency meter? (1)
- [6]**

QUESTION 8: TRANSFORMERS

- 8.1 A 300 kVA, three-phase transformer is connected in a star/delta connection. The delta-connected secondary line voltage is 380 V and the transformation ratio is 15:1.

Calculate:

- 8.1.1 The supply line voltage (4)
- 8.1.2  The load line current (2)
- 8.1.3 The load phase current (2)

8.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (8.2.1–8.2.4) in the ANSWER BOOK.

8.2.1 The equation for the turns ratio of a transformer is $V_P/V_S = N_P/N_S = I_P/I_S$.



8.2.2 An ideal transformer is a transformer assumed to have no losses.

8.2.3 The phase voltage of a delta-connected system is equal to the line voltage.

8.2.4 The line current of a delta-connected system is equal to $\sqrt{3}$ times the phase current.

(4 × 1) (4)
[12]

QUESTION 9: ELECTRONICS

9.1 Name TWO classifications of power ratings of diodes. (2)

9.2 Answer the following questions under transistors:



9.2.1 Name TWO types of transistors.

9.2.2 Explain how the transistor reacts in the cut-off region.

(2 × 2) (4)

9.3 Complete the following sentences by using the words provided in the list below. Write only the word(s) next to the question number (9.3.1–9.3.4) in the ANSWER BOOK.



continuous current; reverse voltage; active; power;
avalanche breakdown voltage; trigger pulse; transistor

9.3.1 The... region of a transistor is when the collector current is proportional to be the base current.

9.3.2 The value of the reverse bias voltage that causes the zener diode to conduct is called the ...

9.3.3 The ... rating is the maximum power that the device is capable of consuming.



9.3.4 The ... rating is the maximum steady state current that a diode can conduct without exceeding the allowable temperature.'

(4 × 1) (4)
[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 $I_{fc} = \frac{CIF \times A}{\sqrt{t}}$