higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N3

(11041263)

22 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

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

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N3
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. Sketch must be neat, labelled and large enough to show the required detail.
6. Formulae used in Electrical Trade Theory N3 can be found at the end of the question paper.
7. Answers must be given to TWO decimal places.
8. Write neatly and legibly.

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QUESTION 1: DOMESTIC APPLIANCES

FIGURE A below shows an electrical technician chasing a wall and FIGURE B a stove appliance to be installed. Study the pictures and answer the questions below.

FIGURE A

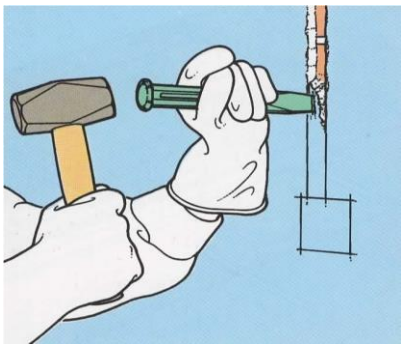

FIGURE B



1.1 Explain how one would go about connecting a stove to a single phase point (distribution board) such that all wiring regulations are adhered to. (6)

1.2 Draw a circuit diagram of a stove sub-circuit from the distribution board to the stove. (4)

[10]

QUESTION 2: PROTECTION

3.1 Identify the following appliances and indicate whether they require to be earthed, does not require earthing or required to be bonded together and earthed. Write the correct answer next to the question number (3.1.1–3.1.3) in the ANSWER BOOK.

3.1.1



3.1.2



3.1.3



(3 × 2) (6)

2.2 Mention TWO of the most common types of fuses with which you are familiar with. (2)

2.3 What size of 220 V AC current is considered to be dangerous to humans? (2)
[10]

QUESTION 3: ILLUMINATION

3.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

3.1.1 A disadvantage of a sodium-vapour discharge lamp is that colours are not distinguishable under its yellow light.

3.1.2 A choke will limit the current in a DC supplied lamp circuit.

3.1.3 Vaporised mercury emits a yellow-green light.

3.1.4 Light emitting diodes are semiconductor diodes which do not emit light when a voltage is applied across them.

3.1.5 A glow starter actually starts the lamp by opening the circuit.

(5 × 1) (5)

3.2 FIGURE 3.1 shows an incandescent lamb with a bayonet cap. Label the components identified by an arrow in the sketch below. Write the answer next to the number (3.2.1–3.2.5) in your ANSWER BOOK.

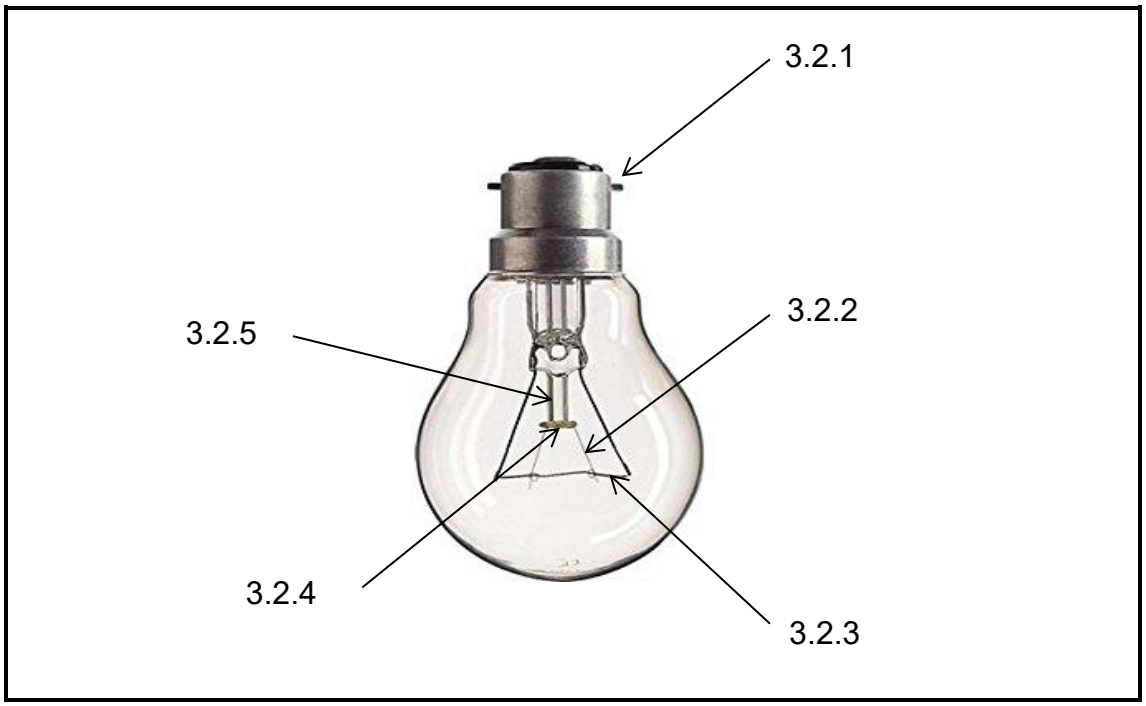

FIGURE 3: Incandescent lamb

(5 × 1) (5)
[10]

QUESTION 4: ALTERNATING CURRENT THEORY

An alternating current supply is represented by the equation $i = 250 \sin wt$

Determine the following:

4.1	The maximum value	(1)
4.2	The average value	(2)
4.3	The effective value	(2)
4.4	The frequency	(2)
4.5	The instantaneous value 0,008 seconds from the start of the cycle	(3)

[10]

QUESTION 5: SERIES RLC CIRCUITS

A series circuit comprises a resistor of 3 ohms, a coil of inductive reactance 6 ohms and a capacitor of capacitive reactance 9 ohms.

Calculate the following:

5.1	The impedance of the circuit	(3)
5.2	The current flow	(2)
5.3	The voltage drops across each component	(3)
5.4	The inductor of the inductive in henry	(2)

[10]

QUESTION 6: THREE PHASE AC SYSTEMS

In a balanced, three-phase delta circuit, the phase voltage is 380 V and the phase current is 5, 77 A. If the phase angle is 25,84° lagging,

calculate the following:

6.1	The input power in kW	(5)
6.2	The apparent power in kVA	(3)
6.3	The line current taken by the circuit	(2)

[10]

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QUESTION 7: TRANSFORMERS

7.1 What is the purpose of a transformer? (2)

7.2 A delta-star connected transformer has 1 100 V across its primary side and 220 V on the secondary side. If it delivers 12 kW at a power factor of 0,8.

Calculate the following:

7.2.1 The secondary line voltage (2)

7.2.2 The secondary line current (2)

7.2.3 The primary line current (4)
[10]

QUESTION 8: DC MACHINES

8.1 State TWO items in everyday use in which you will find DC motors. (2)

8.2 Briefly explain the function of each of the following components of a DC motor:

8.2.1 The brushes

8.2.2 The field coil

(2 × 2) (4)

8.3 Draw a circuit diagram indicating the connections of the field coils and the armature of a short-shunt compound motor. (4)
[10]

QUESTION 9: AC MACHINES

9.1 Explain the meaning of the term, *synchronous speed*. (2)

9.2 Show by means of TWO neat, labelled diagrams in each case, how you would reverse the direction of rotation of the following:

9.2.1 A single-phase series motor (4)

9.2.2 Capacitor-start, split-phase motor (4)
[10]

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QUESTION 10: MEARURING INSTRUMENTS AND ELECTRONICS

10.1 Briefly explain how are the following meters are adapted to measure DC values that are too high:

10.1.1 An ammeter

10.1.2 A voltmeter

10.1.3 A wattmeter.

(3 × 2) (6)

10.2 Make a neat, labelled sketch of a moving-coil ammeter showing ALL essential parts. (4)

[10]

TOTAL: 100

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ELECTRICAL TRADE THEORY N3

FORMULA SHEET

$I_T = \frac{V}{Z}$

$I_{ACTIVE} = I_T \cos \emptyset$

$I_{REACTIVE} = I_T \sin \emptyset$

$X_l = 2\pi f L$

$Xc = \frac{1}{2\pi f C}$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$\emptyset = Cos^{-1}(\frac{R}{Z})$

$V_R = I_T R$

$V_{XL} = I_T X_L$

$V_{XC} = I_T X_C$

$V = \sqrt{V_R{}^2 + (V_{XL} - V_{XC})^2}$

$P = I^2 R$

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

$S = VI$

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

DELTA

$V_L = V_{PH/F}$

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

STAR

$V_L = \sqrt{3} V_{PH/F}$

$I_L = I_{PH/F}$

$\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P}$

$N = \frac{f.60}{P}$

$s = \frac{n - n_r}{n}$

$w = 2\pi f$

The next five formulae are also true for voltage

$i = I_m \sin$

$I_{ms} = 0{,}707\, I_m$

$I_{ave} = 0{,}632\, I_m$

$I_{rms} = \sqrt{\frac{i1^2 + i2^2 + \cdots in^2}{n}}$

$I_{ave} = \frac{i_1 + i_2 + .. i_n}{n}$

$\text{Form factor} = \frac{RMS - Value}{AVE - Value}$

$\text{Crest factor} = \frac{MAX - Value}{RMS - Value}$

SERIES

$R_T = R_1 + R_2 + \cdots R_n$

PARALLEL

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_n}$

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