higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N3

(11041263)

7 April 2020 (X-paper)
09:00–12:00

This question paper consists of 9 pages and 1 formula sheet.

124Q1A2007

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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 10142–1:2003 for the Wiring of Premises.
5. Sketches must be neat, labelled and large enough to show detail clearly.
6. Calculations must be given to THREE decimals.
7. Write neatly and legibly.

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QUESTION 1: DOMESTIC APPLIANCES

1.1 Name the indicated components of the oven thermostat in FIGURE 1 by writing only the answer next to the question number (1.1.1–1.1.6) in the ANSWER BOOK.

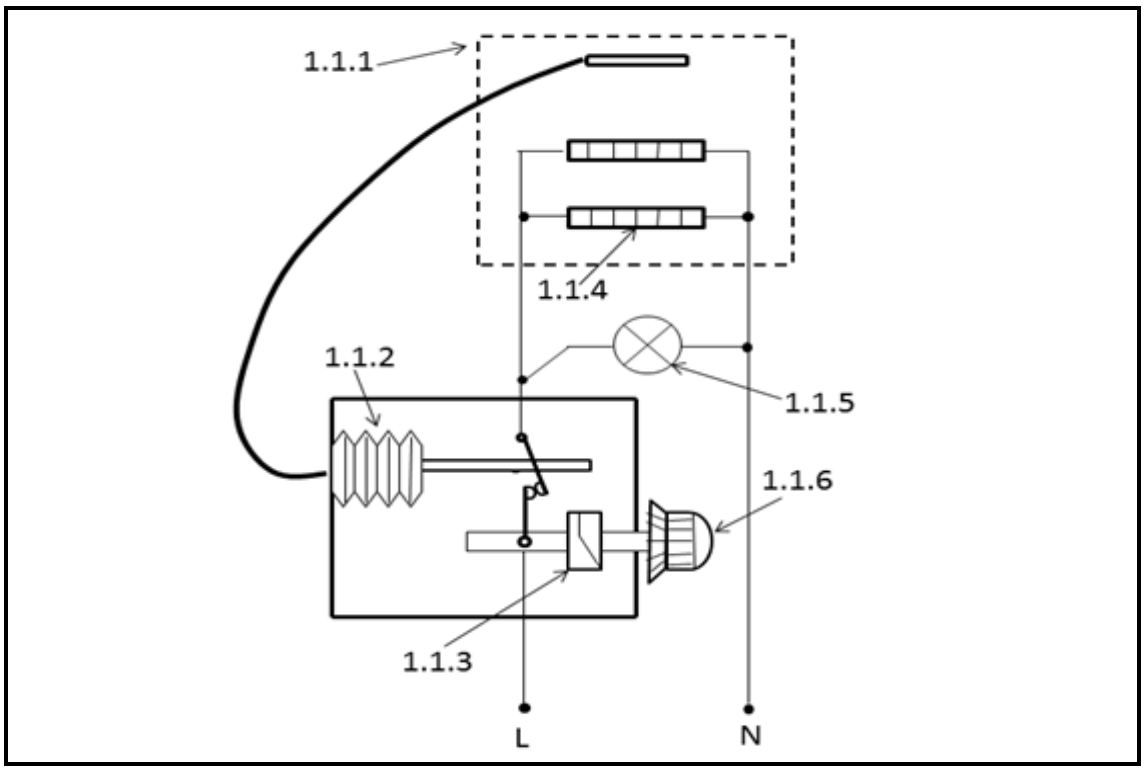

FIGURE 1 (6)

1.2 Briefly explain the operation of the oven thermostat circuit shown in QUESTION 1.1. (4)
[10]

QUESTION 2: PROTECTION

2.1 Which conductor in a single-phase domestic installation should be disconnected by the earth-leakage relay when it is activated? (2)

2.2 Make a neat, labelled sketch of a thermal magnetic-type circuit breaker. (4)

2.3 Give TWO reasons why circuit breakers installed in different subcircuits of a domestic installation have different ratings. (4)
[10]

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QUESTION 3: ILLUMINATION

3.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–C) next to the question number (3.1.1–3.1.4) in the ANSWER BOOK.

3.1.1 Cold-cathode neon lamps are used for indicating lights on these electrical appliances:

A Fridges, stoves and washing machines
B Stoves, fridges and panels
C Microwaves, stoves and fridges

3.1.2 Function of a glow starter in a fluorescent lamp:

A Limits the current of the lamp
B Starts the lamp by opening the circuit
C Opens the circuit to provide a voltage kick for ignition

3.1.3 Purpose of a choke in a hot-cathode lamp:

A Supplying high-voltage surge required for starting
B Limiting current in DC-supplied lamp circuit
C Increasing current required by circuit

3.1.4 Vaporised mercury emits a … light.

A blue-green
B white
C yellow-green

(4 × 1) (4)

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3.2 Study the circuit in FIGURE 2 below and answer the questions.

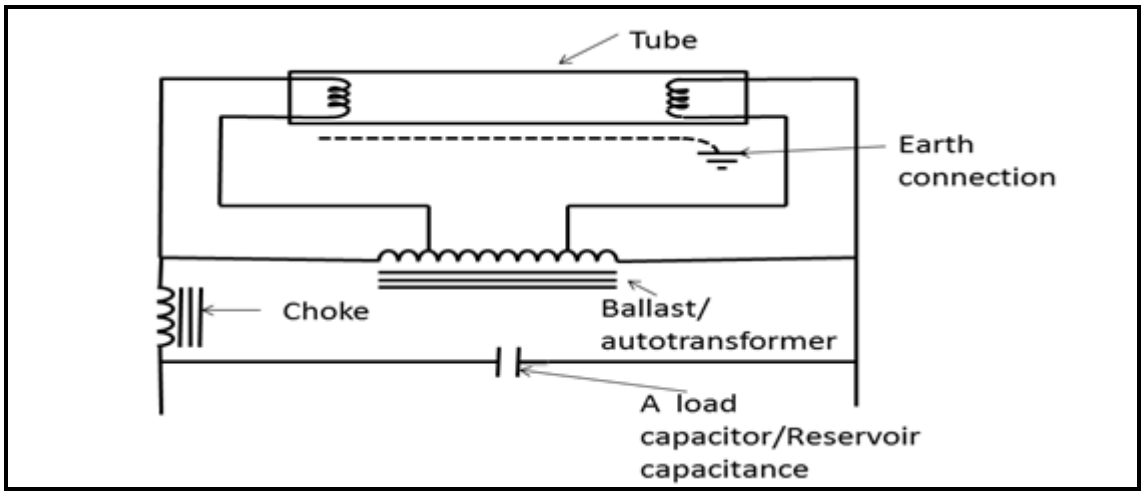

FIGURE 2

3.2.1 Identify the lamp. (1)

3.2.2 State the purpose of the choke in the circuit diagram. (2)

3.2.3 Explain how the lamp in FIGURE 2 is started up. (3)

[10]

QUESTION 4: ALTERNATING-CURRENT THEORY

An alternating voltage waveform has a maximum value of 311 volts at a frequency of 50 Hz.

Calculate each of the following:

4.1 Effective and average values of the voltage (4)

4.2 Value registered on a voltmeter (1)

4.3 Time taken to reach 168 V from zero going positive (3)

4.4 Time taken for this voltage to reach its maximum value (2)

[10]

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QUESTION 5: SERIES RLC CIRCUITS

Study the circuit in FIGURE 3 and answer the questions.

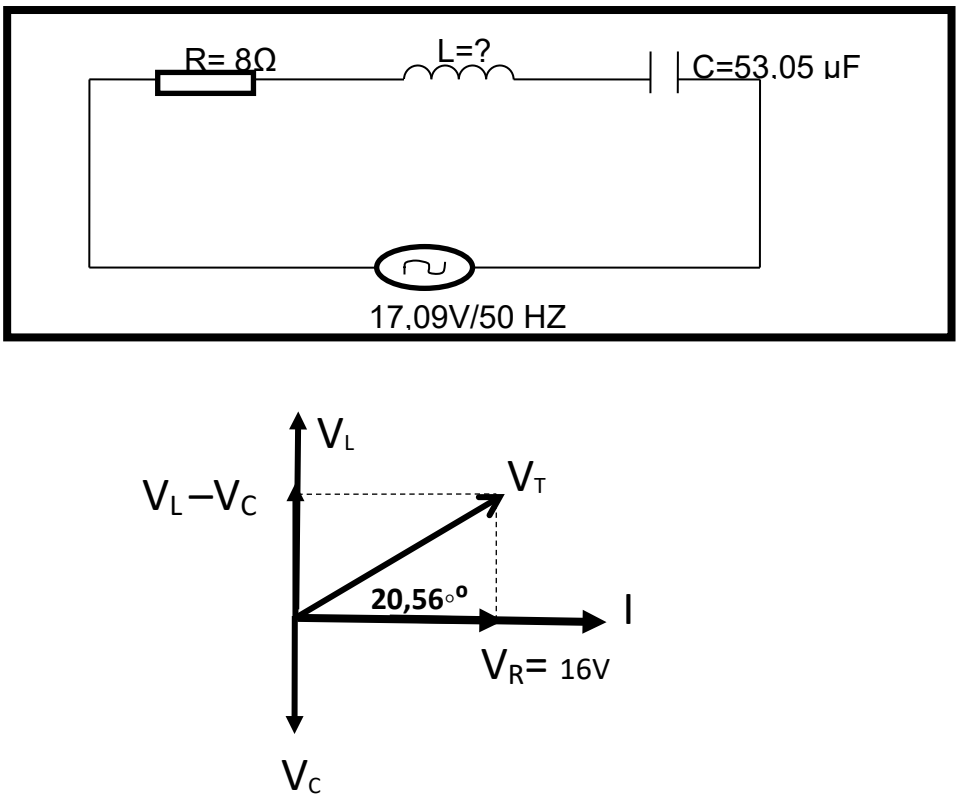

FIGURE 3

Calculate the following:

5.1 Total current flowing through the circuit (2)

5.2 Capacitive reactance of the circuit (2)

5.3 Voltage drop across the capacitor (2)

5.4 Inductive reactance of the circuit (4)

[10]

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QUESTION 6: THREE-PHASE AC SYSTEMS

6.1 A three-phase delta-connected motor draws a current of 10 A at full load from a 415 V supply.

Calculate each of the following:

6.1.1 Phase voltage across the windings (1)

6.1.2 Phase current drawn by the motor (3)

6.1.3 Apparent power rating of the motor (2)

6.2 Draw a neat and fully labelled diagram showing how a load is connected in delta. (4)
[10]

QUESTION 7: TRANSFORMERS

7.1 A 750 kVA star/delta transformer with a turns ratio of 10:1 has a secondary line voltage of 2, 2 kV

Calculate each of the following:

7.1.1 Primary phase and line voltages (4)

7.1.2 Primary line current (2)

7.1.3 Power delivered at full load with a lagging power factor of 0, 8 (2)

7.2 State the purpose of instrument transformers used in AC circuits. (2)
[10]

QUESTION 8: DC MACHINES

8.1 Name any TWO types of field coil connections used in DC motors. (2)

8.2 State the function of each of the following components as applicable to DC motor starters:

8.2.1 No-volt release coil

8.2.2 Series resistor

8.2.3 Overload relay

(3 × 1) (3)

8.3 Briefly explain the operating principle of a DC motor. (2)

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8.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (8.4.1–8.4.3) in the ANSWER BOOK.

8.4.1 The effect of armature reaction can be minimised by increasing the field flux.

8.4.2 The direction of rotation of dc motors may be changed by reversing the direction of the current through the field windings and the armature windings simultaneously.

8.4.3 The Growler is commonly used to test for faults on an armature.

(3 × 1) (3)
[10]

QUESTION 9: AC MACHINES

9.1 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–F) next to the question number (9.1.1–9.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
9.1.1	Started by DOL, star-delta, or auto-transformer	A	capacitor-start split - phase motor
9.1.2	Drives fans, electric drills and other small appliances	B	single-phase series motor
9.1.3	Used for water pumps in washing machines	C	wound-rotor motor
9.1.4	Used on refrigerator compressors	D	squirrel-cage motor
9.1.5	Started by rotor-resistance starter	E	shaded-pole induction motor
		F	capacitor-start, capacitor-run

(5 × 1) (5)

9.2 Draw a neat, labelled circuit diagram to show how the direction of rotation of a capacitor-start split-phase motor may be reversed. (3)

9.3 State TWO properties of the starter circuit of a large three-phase motor. (2)
[10]

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QUESTION 10: MEASURING INSTRUMENTS AND ELECTRONICS

10.1 Explain each of the following terms in semiconductor theory:

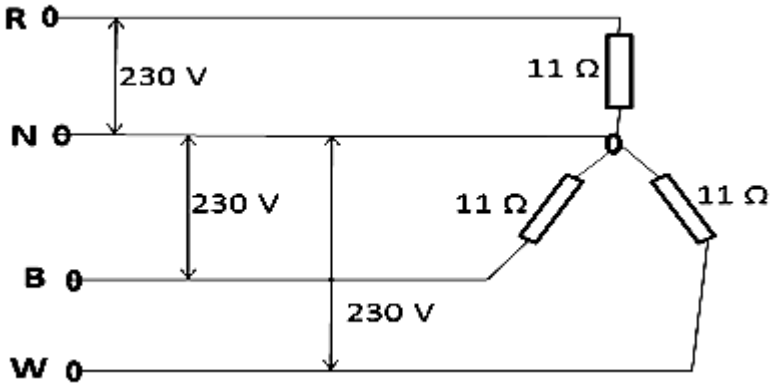
10.1.1 Junction

10.1.2 Depletion layer

(2 × 1) (2)

10.2 Redraw the circuit given in FIGURE 4 in your ANSWER BOOK and show how three wattmeters are to be connected in order to measure the total power drawn by the load which has an impedance of 11 Ω per phase.

Note: No calculations are necessary.



(6)

FIGURE 4

10.3 How can the range of the following instruments be increased?

10.3.1 DC voltmeter

10.3.2 DC ammeter

(2 × 1) (2)

[10]

TOTAL: 100

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ELECTRICAL TRADE THEORY N3

FORMULA SHEET

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

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

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

$X_L = 2\pi f L$

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

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

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

$V_R = I_T R$

$V_{XL} = I_T X_L$

$V_{XC} = I_T X_C$

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

$P = I^2 R$

$P = \sqrt{3}\ V_L\ I_L\ Cos$

$S = VI$

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

DELTA

$V_L = V_{PH}$

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

STAR

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

$I_L = I_{PH}$

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

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

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

$\omega = 2\pi f$

$I = I_m \sin$

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

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

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

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

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

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

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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