higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

28 July 2021 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

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

072Q1G2128

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N1
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Start each question on a new page.
5. Write neatly and legibly.

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QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The nucleus of an atom …

A consists of electrons and neutrons.
B consists of protons and electrons and has a positive charge.
C has no charge. ■
D is made up of neutrons and protons.

1.1.2 Ohm's law relates to the relationship that exists between voltage, current and resistance and states that the …

A current is directly proportional to the resistance and inversely proportional to the voltage.
B resistance is inversely proportional to the current and directly proportional to the voltage.
C current is directly proportional to the voltage and inversely proportional to the temperature.
D voltage is directly proportional to the current and inversely proportional to the resistance.

1.1.3 Extrinsic semiconductor materials are …

A very poor conductors. ■
B very good insulators.
C combined with impurities.
D very good conductors and insulators.

1.1.4 Polarisation occurs when …

A oxygen bubbles form around the carbon rod of a carbon/zinc cell.
B hydrogen bubbles form at the negative terminal of a cell.
C the electrolyte in a cell becomes dry.
D hydrogen bubbles form around the positive electrode.

1.1.5 An increase in voltage at the terminals of an electrolytic capacitor will … ■

A increase the capacitance and decrease the charge.
B increase the charge but the capacitance will remain the same.
C decrease the capacitance.
D destroy the capacitor.

(5 × 1) (5)

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1.2 Complete the following sentences by writing only the missing word or words next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1 An electrolytic capacitor consists of … plates that are separated by a … (2)

1.2.2 NPN transistors are constructed from semiconductor materials and can be used as … or … (2)

1.2.3 An atom with an atomic number of 14 has … valence electrons. (1)

1.2.4 Secondary cells can be …, but … cells cannot. (2)

1.2.5 …, temperature, … and … are the four factors that affect the resistance of a conductor. (3)

1.3 A copper conductor has a resistance of 48,6 Ω at a temperature of 50 °C.

Determine the resistance of the conductor at 0 °C if the temperature coefficient is 0,00428 Ω/Ω °C. (4)

1.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.4.1–1.4.6) in the ANSWER BOOK.

1.4.1 In a closed circuit, the electrical pressure measured across a cell is called the electromotive force.

1.4.2 The conventional theory of current flow states that electrons flow from negative to positive in a closed circuit.

1.4.3 Ohm's law is on the relationship between voltage, current and resistance.

1.4.4 A voltmeter is always connected in series in a closed circuit.

1.4.5 A galvanometer can measure large currents.

1.4.6 A molecule is the smallest particle of an atom.

(6 × 1) (6)

[25]

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QUESTION 2

2.1 Two resistors with values of 6 Ω and 12 Ω, respectively, are connected in parallel with each other. This combination is then connected in series with a 16-ohm resistor that has a tolerance of 2%. The complete circuit is then connected across a 50-V DC supply.

2.1.1 Draw a circuit diagram to represent the above information. (5)

2.1.2 Calculate the total resistance of the circuit. (6)

2.1.3 Determine the current flow in the circuit. (3)

2.1.4 What is the colour code of the 16-ohm resistor? (4)

2.2 A circular copper conductor with a diameter of 6 mm has a length of 25 m. The resistivity of the conductor is $1,728 \times 10^{-6}$ ohm-metres.

Determine the following:

2.2.1 The cross-sectional area of the conductor. (4)

2.2.2 The resistance of the conductor. (3)

[25]

QUESTION 3

3.1 Three capacitors with the following values are connected in series across a 50-V supply:

$C_1 = 5\ \mu F$; $C_2 = 15\ \mu F$ and $C_3 = 25\ \mu F$

Calculate the following:

3.1.1 The total capacitance of the circuit (4)

3.1.2 The charge developed across all the capacitors in the circuit (3)

3.2 A main transformer has a turns ratio of 5:1. When the primary winding is connected to the main supply of 240 V, a current of 1,5 A flows through the secondary winding.

Calculate the following:

3.2.1 The voltage across the secondary winding

3.2.2 The current flow through the primary winding

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3.2.3 The number of turns on the primary winding if the secondary winding has 100 turns

3.2.4 One fault that a transformer can develop is burnt windings.

Explain briefly what this term means.

(4 × 3) (12)

3.3 Sketch the IEC circuit symbols for the following:

3.3.1 Electrolytic capacitor

3.3.2 Photo-diode

3.3.3 Variable resistor

3.3.4 Fuse

3.3.5 Iron-core transformer

3.3.6 Light-emitting diode

(6 × 1) (6)
[25]

QUESTION 4

4.1 Define the following terms:

4.1.1 Polarisation

4.1.2 Intrinsic semiconductor

4.1.3 Potential difference

4.1.4 Covalent bond

4.1.5 Doping

4.1.6 Ionisation

(6 × 2) (12)

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4.2 Four cells, each with an EMF of 2,1 V and an internal resistance of 0,5 Ω, are connected to one another in series. This battery is then connected across an external resistor with a value of 20 Ω.

Calculate the following:

4.2.1 The total EMF of the battery (1)

4.2.2 The total resistance of the circuit (3)

4.2.3 The internal resistance of the battery (1)

4.3 Draw a fully labelled diagram showing two bar magnets with their north poles facing each other. The direction of the flux line must be shown clearly inside as well as outside the magnets. (8)

[25]

TOTAL: 100

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INDUSTRIAL ELECTRONICS N1

FORMULA SHEET

$$V = I \times R$$

$$P = \frac{V^2}{R}$$

$$P = I^2 R$$

$$P = V \times I$$

$$I = \frac{E}{R + r}$$

$$Q = C \times V$$

$$R = \frac{\rho \ell}{A}$$

$$R_t = R_o(1 + \alpha_o \Delta t)$$

$$R_t = R_1 + R_2 + R_3 ..... R_n$$

$$C_t = C_1 + C_2 + C_3 ..... C_n$$

$$L_t = L_1 + L_2 + L_3 ..... L_n$$

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} ..... \frac{1}{C_n}$$

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} ..... \frac{1}{R_n}$$

$$\frac{1}{L_t} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} ..... \frac{1}{L_n}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

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