higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

16 November2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 6 pages and 1 formula sheet.

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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 according to the numbering system used in this question paper.
4. Use the value of π as 3,142.
5. Start each question on a new page.
6. All the final answers must be approximated accurately to THREE decimal places.
7. Use only a blue or black pen.
8. Write neatly and legibly.

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QUESTION 1

1.1 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–G) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	Component that stores energy in the form of an electromagnetic field	A	farads
1.1.2	Neither a good conductor nor a good insulator	B	bipolar junction transistor
1.1.3	Consists of two PN-junctions	C	conductor
1.1.4	Unit of measurement for capacitance	D	proton
1.1.5	Has a charge of +1,6 × 10^{-19}	E	semiconductor
		F	inductor
		G	rectification

(5 × 1) (5)

1.2 Choose the correct term from those in brackets. Write only the answer next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1 A diode will pass current in (both/one) direction(s).

1.2.2 A (positive/negative) ion is an atom that has lost an electron.

1.2.3 Phosphorous has (five/three) valence electrons.

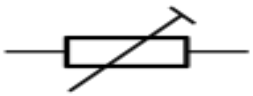
1.2.4 A silver tolerance band of a resistor represents a (5%/10%) tolerance.

1.2.5 Doping is when impurity atoms are intentionally added to an (extrinsic/intrinsic) semiconductor material.

(5 × 1) (5)

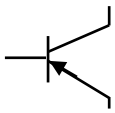
1.3 State FIVE disadvantages of primary cells. (5)

1.4 Identify the following IEC symbols of electronic components. Write only the answer next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.

1.4.1 

1.4.2 

1.4.3 

1.4.4 

1.4.5 

(5 × 1) (5)
[20]

QUESTION 2

2.1 Refer to FIGURE 1 below and calculate the following:

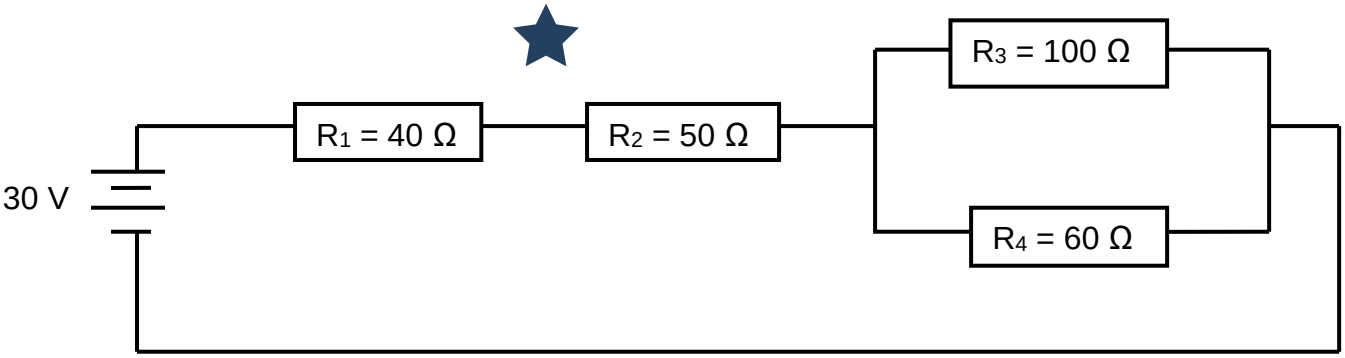


FIGURE 1

2.1.1 The total resistance of the circuit (7)

2.1.2 The total current of the circuit (3)

2.1.3 The voltage drop across the parallel section (3)

2.1.4 The colour code of resistor R_3 if it has a tolerance of 5% (4)

2.2 Name THREE applications of magnets in our everyday lives. (3)
[20]

QUESTION 3

3.1 Complete the following sentences by writing only the missing word or words next to the question number (3.1.1–3.1.6) in the ANSWER BOOK.

An ammeter must be connected in 3.1.1 ... in order to measure 3.1.2 ...
A voltmeter must be connected in 3.1.3 ... in order to measure 3.1.4 ...
An ohmmeter must be connected in 3.1.5 ... in order to measure 3.1.6 ... (6)

3.2 Calculate the cross-sectional area of a 0,5 m long heating element wire with a diameter of 1,5 mm. The resistivity of the wire is $1,2 \times 10^{-6}$ Ωm. (3)

3.3 A copper coil has a resistance of 0,5 Ω at 0 °C. Calculate its resistance at 25 °C. Take the temperature coefficient as 0,004/°C. (3)

3.4 A circuit consists of four series-connected cells, each with an EMF of 2,5 V and an internal resistance of 0,2 Ω. The circuit is then completed by means of two parallel external resistances of 7 Ω and 5 Ω, respectively.

3.4.1 Draw a neat, labelled sketch of the abovementioned circuit. (4)

3.4.2 Calculate the total current flowing through the circuit. (4)

[20]

QUESTION 4

4.1 Name THREE losses that can occur in a transformer. (3)

4.2 A transformer has 1 500 turns on its primary coil and 500 turns on its secondary coil. If a current of 4 A is applied in the primary coil, calculate the following:

4.2.1 The turns ratio (2)

4.2.2 The current through the secondary coil (4)

4.3 Explain the difference between *direct current (DC)* and *alternating current (AC)*. (4)

4.4 Define *Faraday's law*. (3)

4.5 Name FOUR factors on which the inductance of an inductor depends. (4)

[20]

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QUESTION 5

5.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (5.1.1–5.1.5) in the ANSWER BOOK.

5.1.1 A doped semiconductor material is known as an extrinsic material.

5.1.2 Elements containing four valency electrons are said to be tetravalent.

5.1.3 The depletion region of a PN-junction of a semiconductor diode is wider under forward-bias conditions.

5.1.4 A trivalent atom is a donor atom.

5.1.5 A transistor can be used as a switch or an amplifier.

(5 × 1) (5)

5.2 Name ONE application of a PN-junction diode. (1)

5.3 Three capacitors, C_1, C_2 and C_3, with values of 10 μF, 20 μF and 35 μF, respectively, are connected in parallel.

Calculate the following:

5.3.1 The total capacitance (3)

5.3.2 The total charge of the combination if 30 V is applied (3)

5.4 Draw neat, labelled sketches of a PN-junction diode used in the following modes, clearly showing the difference between the depletion regions as well as the polarities.

5.4.1 Forward-biased (4)

5.4.2 Reverse-biased (4)

[20]

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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