higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

(8080602)

17 August 2021 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 6 pages and a formula sheet of 2 pages.

003Q1G2123

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS 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. Draw all sketches and diagrams in pencil.
5. Round off all final answers to THREE decimals.
6. Write neatly and legibly.

QUESTION 1

1.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 Resistance is directly proportional to the voltage in a circuit.

1.1.2 The atom is the smallest part of an element that can take part in a normal chemical reaction.

1.1.3 Mica is an insulating material

1.1.4 Oxygen atom has only six valence electrons

1.1.5 The positive temperature coefficient (PTC)means that when the resistance of a conductor is increased, its temperature will decrease.

(5 × 1) (5)

1.2 Choose the correct answer from COLUMN B, that matches a description in COLUMN A. Write only the letter (A-E) next to the question number (1.2.1-1.2.5) in the ANSWER BOOK.

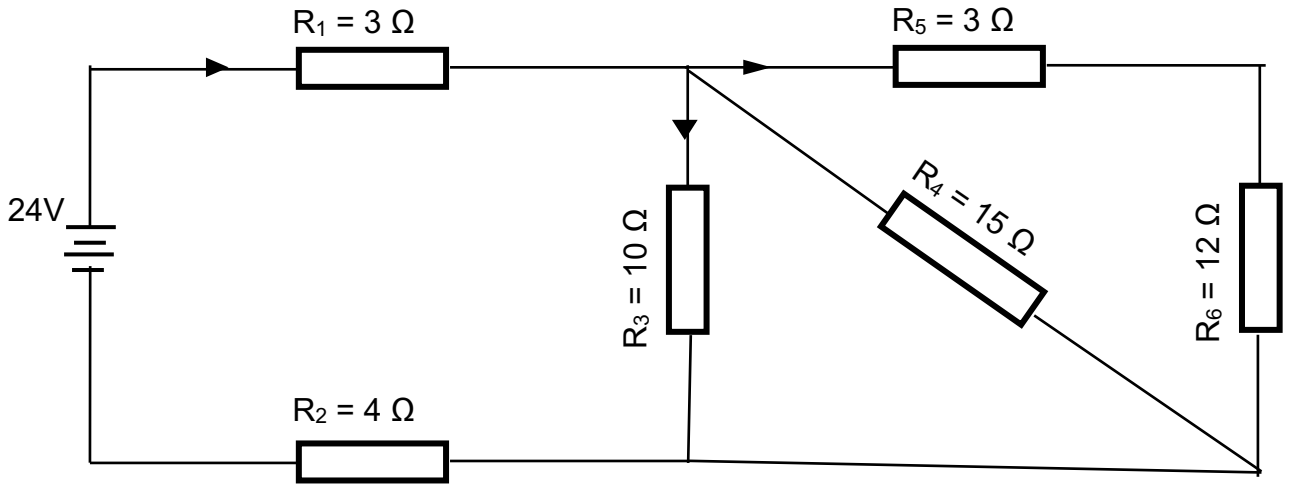
COLUMN A		COLUMN B	
1.2.1	Stores electric field	A	Inductor
1.2.2	PN-junction	B	N-type material
1.2.3	Allows current to flow	C	Diode
1.2.4	Excess of electrons	D	Capacitor
1.2.5	Stores magnetic field	E	Conductor

(5 × 1) (5)

[10]

QUESTION 2

2.1



Refer to the circuit diagram above and calculate:

2.1.1 The total resistance in the circuit (6)

2.1.2 The total current in the circuit (2)

2.1.3 The volt drop across resistor R_3 (3)

2.1.4 The value of the current passing through R_3 (2)

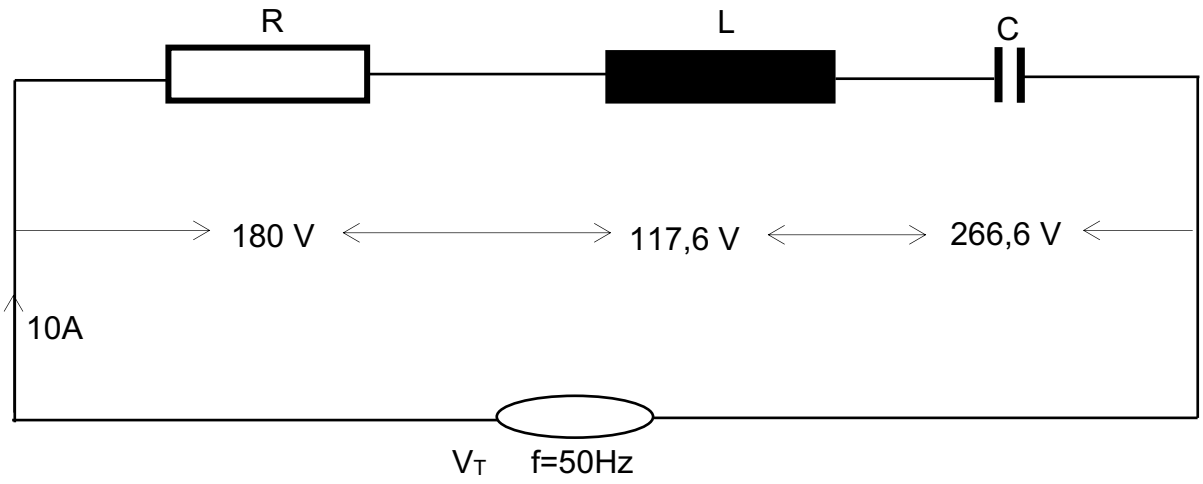
2.1.5 The power consumed by the resistor R_2 (3)

2.2 List FOUR factors that can affect the resistance of a conductor. (4)

[20]

QUESTION 3

An RLC circuit is shown below.



Determine:

3.1	The total voltage of the circuit	(4)
3.2	The impedance	(3)
3.3	The value of the resistor	(2)
3.4	The value of the capacitor	(4)
3.5	The value of the inductor	(4)
3.6	The phase angle	(3)

[20]

QUESTION 4

4.1	Explain the operating principle of a photodiode.	(4)
4.2	Also show the operating principle in question 4.1 by means of a drawing.	(4)
4.3	Complete the following sentence by writing only the missing word or words in the ANSWER BOOK. A light-dependent resistor is also known as a …	(2)
4.4	Draw a circuit symbol for the light dependent resistor (LDR)	(2)
4.5	Draw the construction, circuit symbol and characteristic curve of a light-emitting diode (LED).	(6)

[18]

QUESTION 5

5.1 Draw a neat, labelled circuit configuration of a common collector using an NPN-transistor and show the input and output waveforms. (6)

5.2 The transistor had both input and output characteristic curves.

Draw a neat, labelled diagram of the output characteristic curve and clearly show the saturation, cut-off and active regions. (5)

5.3 Refer to QUESTION 5.2 and explain how a transistor operates under each region. (3 × 2) (6)

[17]

QUESTION 6

6.1 An operational amplifier has an input impedance of 600 Ω and is connected to a 10 Ω speaker.

Calculate the voltage across the speaker if the current measured may not exceed 2 mA with a gain of 40 dB for the amplifier. (7)

6.2 A current of 45 A must be measured. The meter has an internal resistance of 150 Ω and full-scale deflection of 20 mA.

Calculate:

6.2.1 The value of the shunt current (2)

6.2.2 The value of the shunt resistor (3)

6.3 Draw a neat, labelled circuit of the ampere meter used in QUESTION 6.2. (3)

[15]

TOTAL : 100

FORMULA SHEET

DIRECT CURRENT THEORY

$V = I \cdot R$

$P = V \cdot I$

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

$P = I^2 \cdot R$

$R_T = R_1 + R_2$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$

$I_1 = \frac{R_2}{R_1 + R_2} \times I_T$

ALTERNATING CURRENT THEORY

$t = \frac{1}{f}$

$e = E_m Sin\theta$

$e = E_m Sin\omega t$

$e = E_m sin2\pi ft$

$i = I_m Sin\theta$

$i = I_m Sin\omega t$

$V_{rms} = 0{,}707 V_{max}$

$I_{rms} = 0{,}707 I_{max}$

$V_{ave} = 0{,}637 V_{max}$

$I_{ave} = 0{,}637 I_{max}$

$\text{Form factor} = \frac{\text{rms value}}{\text{average value}}$

$\text{Crest factor} = \frac{\text{maximum value}}{\text{rms value}}$

$E_{ave} = \frac{e_1 + e_2 + e_3 + e_4 + e_5 + \ldots\ldots e_n}{n}$

$I_{ave} = \frac{i_1 + i_2 + i_3 + i_4 + i_5 + \ldots\ldots i_n}{n}$

$\omega = 2\pi f$

$E_{rms} = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 + e_4^2 + e_5^2 + \ldots\ldots e_n^2}{n}}$

$I_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + i_4^2 + i_5^2 + \ldots\ldots i_n^2}{n}}$

$X_L = 2\pi fL$

$X_C = \frac{1}{2\pi fC}$

$V = I \cdot R$

$V_T = \sqrt{{V_R}^2 + {V_C}^2}$

$V_T = \sqrt{{V_R}^2 + {V_L}^2}$

$V_T = \sqrt{{V_R}^2 + (V_L \sim V_C)^2}$

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

$Z = \sqrt{R^2 + {X_L}^2}$

$Z = \sqrt{R^2 + {X_C}^2}$

$I = \frac{V_T}{Z}$

$I_R = \frac{V_T}{R}$

$I_L = \frac{V_T}{X_L}$

$I_C = \frac{V_T}{X_C}$

$I_T = \sqrt{{I_R}^2 + {I_X}^2}$

$I_X = I_L \sim I_C$

$V_L = I \cdot X_L$

$V_C = I \cdot X_C$

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

$\theta = tan^{-1}\frac{I_X}{I_R}$

$\theta = cos^{-1}\frac{I_R}{I_T}$

$\theta = cos^{-1}\frac{R}{Z}$

$f_r = \frac{1}{2\pi\sqrt{LC}}$

MEASURING INSTRUMENTS

$$R_{SH} = \frac{I_M R_M}{I_{SH}} \qquad R_S = \frac{V}{I_M} - R_M$$

TRANSISTORS

$$I_E = I_C + I_B$$

DECIBEL RATIOS

$$N = 10\,log\frac{P_{OUT}}{P_{IN}} \qquad N = 20\,log\frac{I_{OUT}}{I_{IN}} + 10\,log\frac{R_{OUT}}{R_{IN}} \qquad N = 20\,log\frac{V_{OUT}}{V_{IN}} + 10\,log\frac{R_{IN}}{R_{OUT}}$$

If R_{IN}=R_{OUT}:

$$N = 20\,log\frac{V_{OUT}}{V_{IN}} \qquad N = 20\,log\frac{I_{OUT}}{I_{IN}}$$

RESISTANCE

$$R = \frac{\rho\ell}{A} \qquad A = \frac{\pi d}{4}$$