higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1051(E)(N23)T
NOVEMBER 2010

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

23 November (X-Paper)
09:00 – 12:00

This question paper consists of 5 pages and a formula sheet.

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. Write neatly and legibly.

QUESTION 1

1.1 State THREE factors that determine the strength of an electromagnet. (3)

1.2 Draw a sine wave and show the peak-to-peak value on the sine wave. (2)

1.3 State ONE advantage of the following:

1.3.1 Primary cells (1)
1.3.2 Secondary cells (1)

1.4 State TWO disadvantages of the following:

1.4.1 Primary cells (2)
1.4.2 Secondary cells (2)

1.5 Refer to FIGURE 1 and calculate the value of the load resistor, RL.

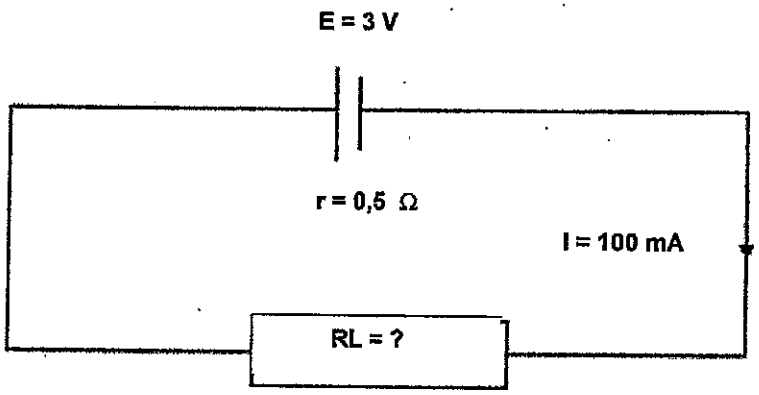

FIGURE 1

(4)

1.6 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (1.6.1 - 1.6.10) in the ANSWER BOOK.

1.6.1 Magnetic lines of force flow from (N - S/S - N) inside a bar magnet. (1)

1.6.2 Like poles (attract/repel) each other. (1)

1.6.3 A capacitor will (block/pass) direct current. (1)

1.6.4 Capacitors connected in parallel (increase/decrease) the total capacitance. (1)

1.6.5 If a neutral atom gains electrons, it becomes a (negative/positive) ion. (1)

1.6.6 Holes are (negative/positive) charge carriers. (1)

1.6.7 A transistor can be used as (an electronic switch/a relay). (1)

1.6.8 A transistor is made of (three/two) elements. (1)

1.6.9 The junction voltage of a silicon diode is (0,2 V/0,6 V). (1)

1.6.10 An anode of a diode is formed from (N/P) type semi-conductors. (1)

[25]

QUESTION 2

2.1 A copper conductor is 150 m long and has a cross-sectional area of 6 mm^2. The resistivity of copper is 1,728 × 10^{-6} Ωm. Determine the resistance of the conductor. (3)

2.2 A tube filled with mercury has a resistance of 9 Ω at 0 °C. If the tube is heated up to 25 °C, what will be the mercury resistance? Take the coefficient of resistance of mercury as 0,0042 Ω/°C. (3)

2.3 FOUR resistors with values of 72 Ω, 36 Ω, 24 Ω and 12 Ω respectively are connected in parallel across a 30 V DC supply.

2.3.1 Sketch the complete circuit diagram. (1)

Calculate the following:

2.3.2 The total resistance of the circuit (4)

2.3.3 The total current flow through the circuit (3)

2.3.4 The voltage drop across the 36 Ω resistance (1)

2.3.5 The power consumed by the 24 Ω resistance (4)

2.3.6 The colour code for the 72 Ω resistor with a tolerance of 10% (4)

2.4 Make a sketch to illustrate how a voltmeter is connected over a load resistor (RL), in a circuit. (2)
[25]

QUESTION 3

3.1 Three capacitors with values of 3 µF, 6 µF and 9 µF respectively are connected in series.

Calculate the following:

3.1.1 The total capacitance of the circuit (4)
3.1.2 The charge across the circuit with an applied voltage of 1 kV (3)

3.2 Sketch the IEC symbols of the following components:

3.2.1 A diode (1)
3.2.2 An N-P-N transistor (1)
3.2.3 An inductor (1)
3.2.4 A transformer (1)
3.2.5 A variable resistor (1)
3.2.6 An electrolytic capacitor (1)
3.2.7 A saw-tooth wave (1)

3.3 Describe the effect that a diode will have on a direct current. (1)

3.4 Describe the effect that the following components will have on an alternating current:

3.4.1 A transformer (2)
3.4.2 A diode (2)

3.5 Explain what effect the following will have on the resistance of a conductor:

3.5.1 The length of the conductor (2)
3.5.2 The cross-sectional area of the conductor (2)
3.5.3 The temperature of the conductor (2)
[25]

QUESTION 4

4.1 The primary voltage of a transformer is 220 V and the secondary voltage is 24 V. Calculate the secondary current if the primary current is 4 mA. (4)

4.2 Name the type of transformer in QUESTION 4.1. (1)

4.3 Show, by means of a sketch, the construction of a P-N-P transistor. (3)

4.4 State Lenz's law. (3)

4.5 State THREE factors that determine the capacitance of a capacitor. (3)

4.6 State FOUR advantages of a digital multimeter. (4)

4.7 Describe a P-type semi-conductor material. (2)

4.8 Construct a half-wave rectifier circuit. (3)

4.9 Sketch the input and output wave forms of the circuit in QUESTION 4.8. (2)
[25]

TOTAL: 100

INDUSTRIAL ELECTRONICS N1

FORMULA SHEET

$$I = \frac{V}{R}$$

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

$$P = V \times I$$

$$R_t = R_1 + R_2 + \ldots + R_n$$

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

$$C_t = C_1 + C_2 + \ldots + C_n$$

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

$$Q = C \times V$$

$$L_t = L_1 + L_2 + \ldots + L_n$$

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

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

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

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