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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T690(**E**)(J28)T
AUGUST EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

28 July 2015 (Y-Paper)
13:00–16:00

This question paper consists of 6 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 according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

1.1 Give THREE characteristics of the magnetic lines of force. (3)

1.2 Explain the term *electromagnet*. (2)

1.3 Give TWO advantages of primary cells. (2)

1.4 Give TWO disadvantages of primary cells. (2)

1.5 State Lenz's Law. (3)

1.6

1.6.1 Sketch the circuit diagram of THREE cells connected in series with an EMF of 4,5 Volts each and an internal resistance of 0,13 Ω each. (2)

1.6.2 Calculate the total current flow in the circuit when a 5,4 ohm resistor is connected across the cells. (4)

1.7 Wave forms are classified according to their shapes.

Give TWO types of wave forms. (2)

[20]

QUESTION 2

2.1 Give THREE factors that will influence the capacitance of the capacitor. (3)

2.2 Give TWO uses for resistor devices. (2)

2.3

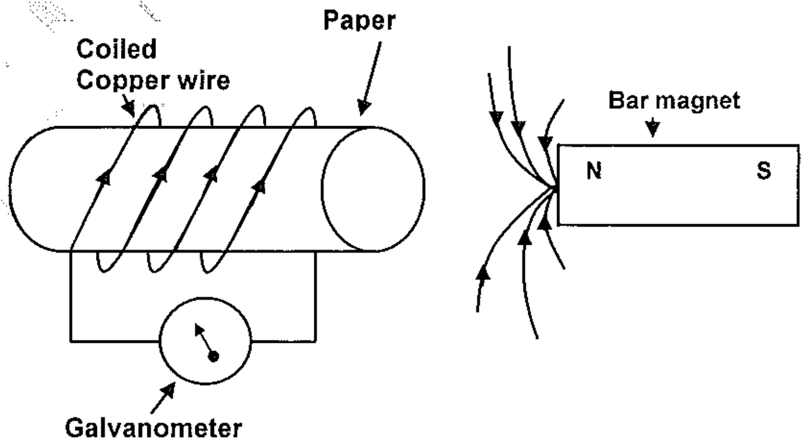

FIGURE 1

Refer to FIGURE 1 above, and briefly explain what will happen when:

2.3.1 The bar magnet is moved into the copper wire.

2.3.2 The bar magnet is moved out of the copper wire.

2.3.3 From the results above, what is your conclusion?

(3 x 2) (6)

2.4 Define *inductance.* (3)

2.5 A tube filled with Mercury has a resistance of 15 Ω at 0° C. If the tube is heated up to 65° C, what will be its resistance?

(Take the tube temperature coefficient of resistance as 0,0042 Ω/°C). (3)

2.6 Calculate the resistance of a 40 m long conductor with a cross-sectional area of $1,5 \times 10^{-7} m^2$. The resistivity of the metal is $0,058 \times 10^{-6}$ Ωm. (3)

[20]

QUESTION 3

3.1 Sketch the IEC symbols of the following components:

3.1.1 An NPN transistor

3.1.2 An inductor

3.1.3 A variable resistor

3.1.4 A transformer

3.1.5 A capacitor

(5 x 1) (5)

3.2 Refer to FIGURE 2 and calculate the following:

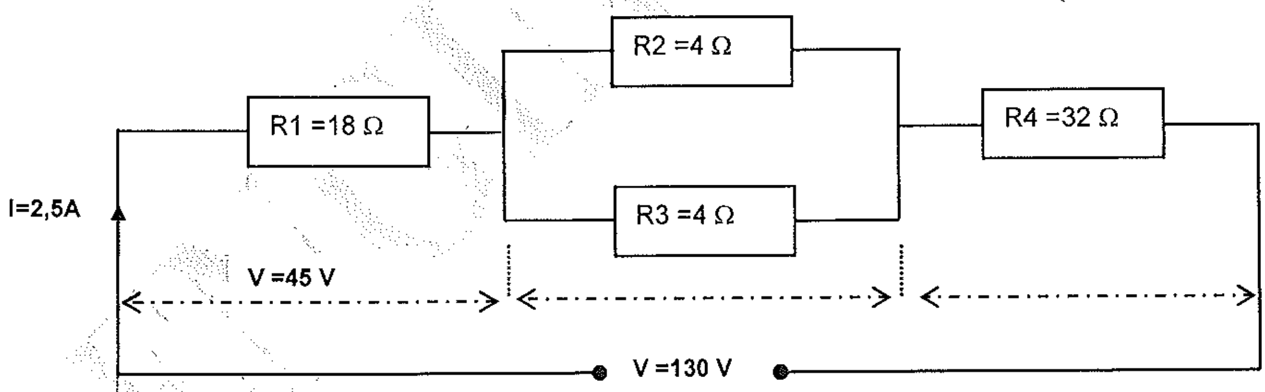

FIGURE 2

3.2.1 The resistance across the parallel section. (4)

3.2.2 The voltage across resistor R4. (3)

3.2.3 The total resistance of the circuit. (3)

3.2.4 The power consumed by the resistors in the parallel section. (4)

3.3 In N-type material, what are majority carriers? (1)

[20]

QUESTION 4

4.1 Give THREE elements of a transistor. (3)

4.2 THREE capacitors with values 20 μF, 40 μF and 80 μF that are connected in parallel.

Calculate the following:

4.2.1 The total capacitance of the circuit diagram.

4.2.2 The charge across the circuit with an applied voltage of 36 V.

(2 x 3) (6)

4.3 Make a neat, labelled sketch to show a discharging curve for a capacitor in terms of voltage and time. (3)

4.4 A transformer with a supply voltage of 230 V has a turns ratio of 5:1.

Calculate the following:

4.4.1 The secondary voltage.

4.4.2 The secondary current if the primary current is 18 mA.

(2 x 4) (8)

[20]

QUESTION 5

5.1 Define the following terms:

5.1.1 Valence electrons (2)

5.1.2 Doping (3)

5.2 Refer to the diagram of a bridge rectifier circuit below. Show the conduction path when A is positive and B negative. Redraw only the conduction path.

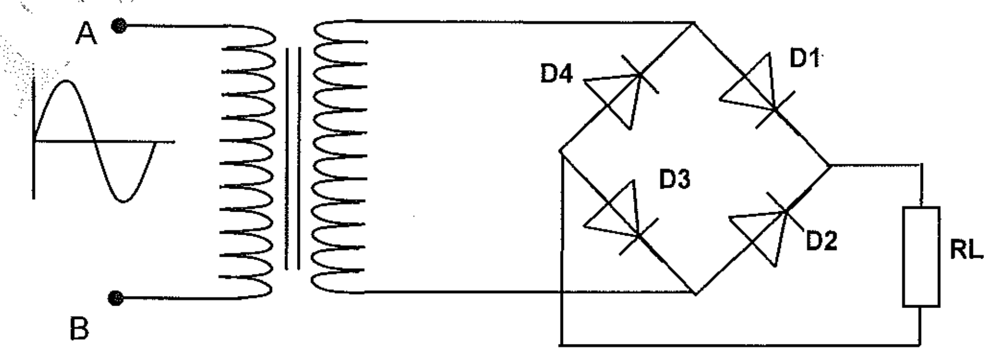

FIGURE 3 (5)

5.3 Choose the correct answer from those given in brackets. Write only the answer next to the question number (5.3.1–5.3.10) in the ANSWER BOOK.

5.3.1 A (resistor/diode) is assembled from one piece of N-material and one piece of P-material.

5.3.2 An/A (inductor/capacitor) possesses an ability to oppose any change in the existing current.

5.3.3 Germanium has got (FOUR/THREE) valence electrons.

5.3.4 The number of cycles which pass a given point in one second is (frequency/amplitude)

5.3.5 An N-type semi-conductor material has a/an (deficiency/excess) of electrons.

5.3.6 An ability of a conductor to induce a voltage in itself when the current change is known as (mutual induction/self-induction).

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

5.3.8 A process of gaining or losing electrons is known as (donating/ionisation).

5.3.9 A (transistor/computer) can be used as an electronic switch.

5.3.10 The charge on a hole is (positive/negative).

(10 x 1) (10)
[20]

TOTAL: 100

INDUSTRIAL ELECTRONICS N1

FORMULA SHEET

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

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

$$P = V \times I$$

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

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

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

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

$$Q = C \times V$$

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

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

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

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

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

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MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

INDUSTRIAL ELECTRONICS N1

28 JULY 2015

This marking guideline consists of 6 pages.

QUESTION 1

1.1
- Outside the magnet they move from the North Pole to the South Pole.
- Inside the magnet they move from the South Pole to the North Pole.
- They are continuous and form a complete path.
- They never intersect i.e. they never cross one another.
- They are parallel.
- They are invisible and pass through all materials.
- They always enter or leave a magnetic material at right angles. (Any 3 x 1) (3)

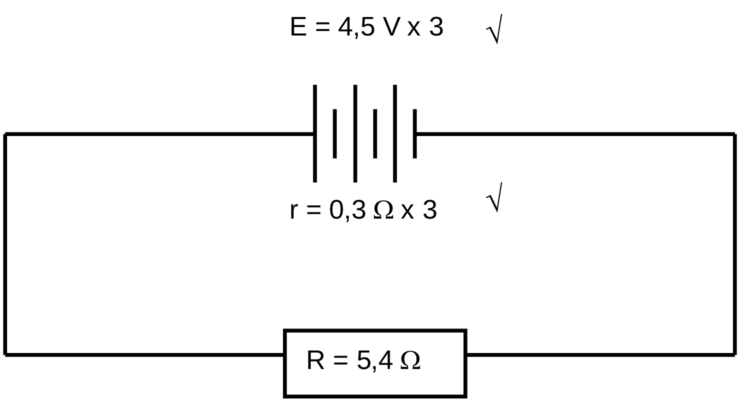
1.2 A coil of wire √ has become an electromagnet when the current is passed through it. √ (2)

1.3
- Inexpensive
- Disposable
- Replacements are readily available
- Typically lighter
- Available in various sizes (Any 2 x 1) (2)

1.4
- Not ideally suited for heavy loads.
- Not rechargeable
- Have a relatively short life span
- Becomes polarised when connected to a load. (Any 2 x 1) (2)

1.5 The emf induced in a coil or inductor always acts in such a direction that the current it drives opposes the change in magnetic flux which produces it. (3)

1.6 1.6.1



(2)

1.6.2

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

$$= \frac{(4,5 \times 3)}{5,4 + (0,13 \times 3)}$$ √ √

= 2,332 A √√ (4)

1.7
- Square wave
- Saw tooth wave
- Sine wave (Any 2 x 1) (2)

[20]

QUESTION 2

2.1
- The surface area of the plates
- The type of dielectric
- The distance between the plates (3)

2.2
- To limit current
- To cause a voltage drop
- To generate heat (Any 2 x 1) (2)

2.3

2.3.1 The galvanometer needle will give a momentary deflection.

2.3.2 The galvanometer needle will deflect in the opposite direction.

2.3.3 A current has been induced as long as there was a relative movement between the magnet and the coil.

(3 x 2) (6)

2.4 An ability of a conductor √ to induce a voltage in itself √ when the current changes √. (3)

2.5

$R_T = R_O(1+\alpha_O t)$

$R_T = 15(1+0{,}0042\times 65)$ √

$R_T = 19{,}095\Omega$ √√ (3)

2.6

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

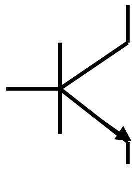
$R = \frac{0{,}058\times 10^{-6}\times 40}{1{,}5\times 10^{-7}}$ √

$R = 15{,}467\Omega$ √√ (3)

[20]

QUESTION 3

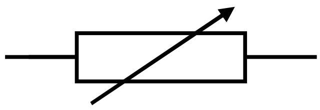
3.1 3.1.1



3.1.2

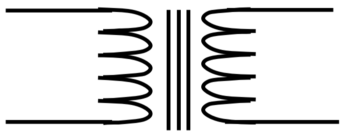
OR

3.1.3

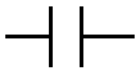


OR

3.1.4



3.1.5



(5 x 1) (5)

3.2 3.2.1

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_P} = \frac{1}{4} + \frac{1}{4} \quad \surd$$

$$\frac{1}{R_P} = \frac{1+1}{4}$$

$$\frac{1}{R_P} = \frac{2}{4}$$

$$\frac{R_P}{1} = \frac{4}{2} \quad \surd$$

$$R_P = 2\Omega \quad \surd\surd$$

OR

$$R_P = \frac{R_1 \times R_2}{R_1 + R_2} \quad \surd$$

$$R_P = \frac{4 \times 4}{4 + 4} \quad \surd$$

$$R_P = 2\Omega \quad \surd\surd$$

(4)

3.2.2

$$V_4 = I_T \times R_4$$

$$V_4 = 2{,}5 \times 32 \quad \surd$$

$$V_4 = 80V \quad \surd\surd$$

(3)

3.2.3

$$R_T = R_1 + R_P + R_4$$

$$R_T = 18 + 2 + 32 \quad \surd$$

$$R_T = 52\Omega \quad \surd\surd$$

OR

$$R_T = \frac{V_T}{I_T}$$

$$R_P = \frac{130}{2.5} \quad \surd$$

$$R_P = 52\Omega \quad \surd\surd$$

(3)

3.2.4 $P = I^2 \times R_p$ √ OR $P = \frac{V^2}{R_P}$ √

$P = 2{,}5^2 \times 2$ √ $P = \frac{5^2}{2}$ √

$P = 12{,}5W$ √√ $P = 12{,}5W$ √√ (4)

3.3 Electrons (1)

[20]

QUESTION 4

4.1
- Emitter
- Base
- Collector

(3)

4.2 4.2.1

$C_T = C_1 + C_2 + C_3$

$C_T = 20 + 40 + 80$ √

$C_T = 140\,\mu F$ √√

4.2.2

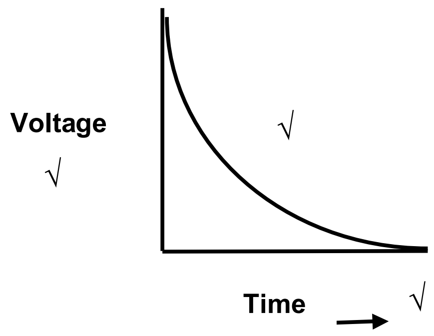
$Q = C \times V$

$Q = 140 \times 10^{-6} \times 36$ √

$Q = 5040\,\mu C$ OR 0,005 C √√

(2 x 3) (6)

4.3



(3)

4.4 4.4.1

$$Vs = \frac{Vp \times N_S}{N_P} \quad \surd$$

$$Vs = \frac{230 \times 1}{5} \quad \surd$$

$$Vs = 46\,V \quad \surd\surd$$

4.4.2

$$Is = \frac{Ip \times N_P}{N_S} \quad \surd$$

$$Is = \frac{18 \times 10^{-3} \times 5}{1} \quad \surd$$

$$Is = 0{,}09A \quad \surd\surd$$

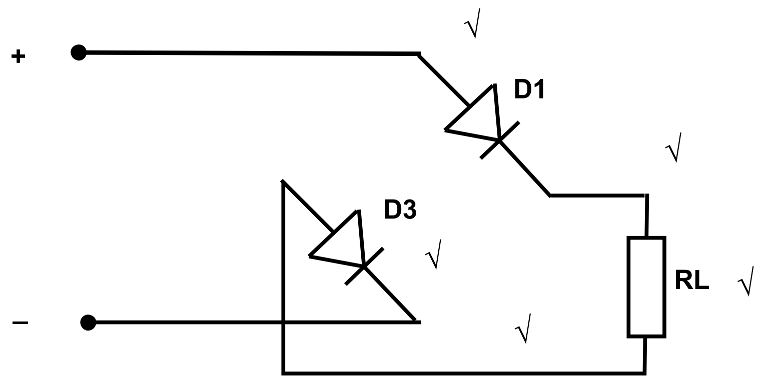
(2 x 4) (8)
[20]

QUESTION 5

5.1 5.1.1 Electrons in the outermost shell√ (highest energy level) of an atom√. (2)

5.1.2 When impurity atoms √ are intentionally added √ to the intrinsic or pure semi-conductor material √, the semi-conductor is said to be doped. (3)

5.2



(5)

5.3
5.3.1 Diode
5.3.2 Inductor
5.3.3 Four
5.3.4 Frequency
5.3.5 Excess
5.3.6 Self-induction
5.3.7 One
5.3.8 Ionisation
5.3.9 Transistor
5.3.10 Positive

(10 x 1) (10)
[20]

TOTAL: 100