higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T670**(E)**(N23)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

23 November 2015 (X-Paper)
9:00–12:00

This question paper consists of 6 pages and 1 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 Explain the left-hand rule for electromagnetism. (4)

1.2 State FOUR factors which determine the strength of an electromagnet. (4)

1.3 Give TWO advantages of a lead-acid cell. (2)

1.4 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (1.4.1–1.4.10) in the ANSWER BOOK.

1.4.1 The movement of electrons in one direction along a conductor is known as (electrical current/alternating current).

1.4.2 A neutral atom that gains electrons becomes a (negative/positive) ion.

1.4.3 The junction voltage of a silicon diode is (0,3 V/0,6 V).

1.4.4 A transistor is made out of (two/three) elements.

1.4.5 A diode will conduct when it is (forward/reverse) biased.

1.4.6 Like poles (repel/attract) each other.

1.4.7 Frequency is the number of (cycles/periods) of an alternating current which passes a given point in one second.

1.4.8 The magnetic lines of force flows from (south-to-north/north-to-south) outside a bar magnet.

1.4.9 An instrument used to measure extremely small currents is called a (galvanometer/hydrometer).

1.4.10 Specific gravity is measured with a (hydrometer/thermometer).

(10 x 1) (10)
[20]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (2.1.1–2.1.10) in the ANSWER BOOK.

2.1.1 Primary cells are available in one size only.

2.1.2 Carbon will form on the negative plate of a primary cell.

2.1.3 Secondary cells do not need maintenance.

2.1.4 According to Ohm's law, the current is proportional to the resistance in a circuit.

2.1.5 The functioning of a transformer depends on self-induction.

2.1.6 An EMF is always measured when the circuit is live.

2.1.7 A simple chemical cell has got three electrodes and an electrolyte.

2.1.8 Air can be used as an insulator in some appliances.

2.1.9 The lines of force are elastic in nature.

2.1.10 A horse-shoe magnet has got four poles.

(10 x 1) (10)

2.2 Name the units in which the following are measured:

2.2.1 Frequency

2.2.2 Inductance

2.2.3 Potential difference

2.2.4 The charge across the capacitive circuit

2.2.5 Temperature coefficient (5 x 1) (5)

2.3 Make a sketch of a sine wave and show the following:

2.3.1 A peak value

2.3.2 A peak-to-peak value

2.3.3 An amplitude

2.3.4 A cycle (4 x 1) (4)

2.4 What do we call elements with less than four valence electrons? (1)

[20]

QUESTION 3

3.1 Three resistors with values of 1,2 Ω; 3,6 Ω and 60 Ω respectively are connected in series across a 12 volts direct current supply.

Calculate the following:

3.1.1 The total resistance of the circuit (3)

3.1.2 The total current flow in the circuit (3)

3.1.3 The voltage drop across the 3,6 Ω resistor (4)

3.1.4 The power used by the 60 Ω resistor (4)

3.1.5 Give the colour code for the 1,2 Ω resistor with a tolerance of 10%. (4)

3.2 An insulator is a material which normally does not allow electric current to flow. Define an insulator in terms of atomic theory. (2)
[20]

QUESTION 4

4.1 A battery consisting of four cells is connected to a resistor with a value of 8,6 Ω. Each cell has an EMF of 3 V and an internal resistance of 0,25 Ω.

Calculate the following:

4.1.1 The total EMF of the battery.

4.1.2 The internal resistance of the battery.

(2 x 3) (6)

4.2 The resistance of a conductive material, like copper, may increase or decrease as a result of certain factors.

State the FOUR factors that will cause an increase or decrease on the resistance of a conductive material. (4 x 1) (4)

4.3 A conductor has a resistance of 0,68 ohms at 0 °C. The resistance temperature coefficient of the conductor is 0,0058 ohm per °C.

Calculate the resistance of the conductor at 60 °C. (3)

4.4 TWO capacitors with values of 90 μF and 15 μF are connected in series.

Calculate the total capacitance of the circuit. (4)

4.5 State Faraday's law. (3)
[20]

QUESTION 5

5.1 A step-down transformer has two coils of 1 200 windings and another of 400 windings.

With a voltage of 200 V on the 1 200 windings coil, calculate the voltage across the other coil. (4)

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

5.3 Show by means of a labelled sketch a simple construction of a PNP transistor (Not a symbol). (3)

5.4 Define a P-type semi-conductor material. (2)

5.5 Draw a simple circuit diagram to illustrate forward biasing of a diode. (3)

5.6 Indicate the following voltage readings for the circuit diagram in FIGURE 1 below:

5.6.1 Across the silicon diode

5.6.2 Across the lamp

(2 x 1) (2)

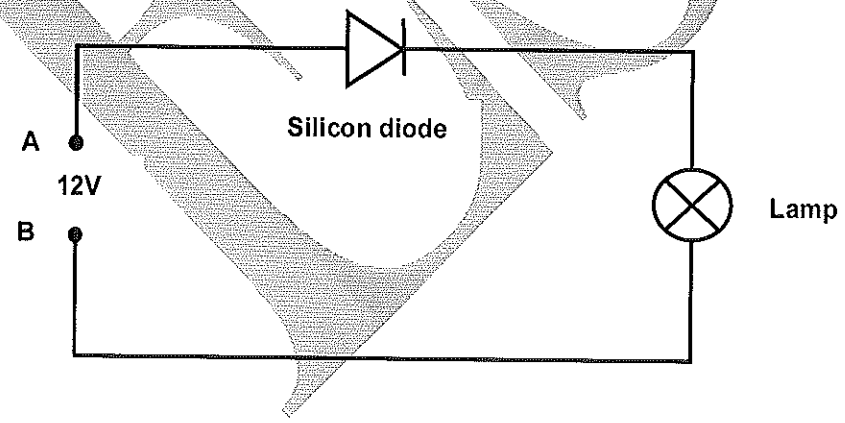

FIGURE 1

5.7 State the composition of an atom. (3)
[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

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This marking guideline consists of 6 pages.

QUESTION 1

1.1 Hold the conductor with the left hand; with the thumb pointing √ in the direction of the electron current flow √, the fingers will point √ in the direction of the field. √ (4)

1.2
- The strength of the current flow through the coil
- The amount of turns in the coil
- The type of the material used in the core
- The ratio of the length of the coil to the diameter of the coil (4 x 1) (4)

1.3
- Rechargeable
- Provide more current/Suitable for heavy loads
- Can be used repeatedly
- Longer service life (Any 2 x 1) (2)

1.4
1.4.1 Electrical current
1.4.2 Negative
1.4.3 0,6 V
1.4.4 Three
1.4.5 Forward
1.4.6 Repel
1.4.7 Cycles
1.4.8 North to south
1.4.9 Galvanometer
1.4.10 Hydrometer

(10 x 1) (10)
[20]

QUESTION 2

2.1
2.1.1 False
2.1.2 False
2.1.3 False
2.1.4 False
2.1.5 False
2.1.6 False
2.1.7 False
2.1.8 True
2.1.9 True
2.1.10 False (10 x 1) (10)

2.2
2.2.1 Hertz
2.2.2 Henry
2.2.3 Volts
2.2.4 Coulomb
2.2.5 Per degree Celsius (5 x 1) (5)

2.3

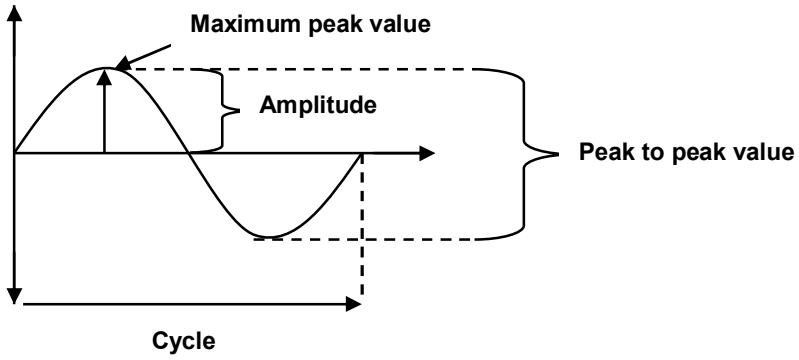

FIGURE 1 (4)

2.4 Conductors (1)
[20]

QUESTION 3

3.1 3.1.1

$$R_T = R_1 + R_2 + R_3$$
$$R_T = 1{,}2 + 3{,}6 + 60 \quad \surd$$
$$R_T = 64{,}8\ \Omega \quad \surd\surd$$

(3)

3.1.2

$$I_T = \frac{V}{R}$$
$$I_T = \frac{12}{64{,}8} \quad \surd$$
$$I_T = 0{,}185\ A \quad \surd\surd$$

(3)

3.1.3

$$V_1 = I_T \times R_2 \quad \surd$$
$$V_1 = 0{,}185 \times 3{,}6 \quad \surd$$
$$V = 0{,}666\ V \quad \surd\surd$$

(4)

3.1.4

$$P = I^2 R \quad \surd$$
$$P = 0{,}185^2 \times 60 \quad \surd$$
$$P = 2{,}054\ W \quad \surd\surd$$

(4)

3.1.5
- Brown
- Red
- Gold
- Silver

(4 x 1) (4)

3.2 An insulator is a material with a deficiency of free electrons √√. (2)
OR An insulator is a material that has exactly 8 valence electrons.
[20]

QUESTION 4

4.1 4.1.1

$$E_T = E_1 + E_2 + E_3 + E_4$$
$$E_T = 3 + 3 + 3 + 3 \quad \surd$$
$$E_T = 12\ V \quad \surd\surd$$

(3)

4.1.2

$$r_T = r_1 + r_2 + r_3 + r_4$$
$$r_T = 0{,}25 + 0{,}25 + 0{,}25 + 0{,}25 \quad \surd$$
$$r_T = 1\,\Omega \quad \surd\surd$$

(3)

4.2
- The temperature of the conductive material
- The cross-sectional area or diameter of the conductive material
- The length of the conductive material
- The type of material which the conductive material is made of (4 x 1)

(4)

4.3

$$R_T = R_O(1 + \alpha_O t)$$
$$R_T = 0{,}68\,(1 + 0{,}0058 \times 60) \quad \surd$$
$$R_T = 0{,}917\,\Omega \quad \surd\surd$$

(3)

4.4

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$$
$$\frac{1}{C_T} = \frac{1}{90} + \frac{1}{15} \quad \surd$$
$$\frac{1}{C_T} = \frac{1+6}{90}$$
$$\frac{1}{C_T} = \frac{7}{90} \quad \surd$$
$$\frac{C_T}{1} = \frac{90}{7}$$
$$C_T = 12{,}857\ \mu F \quad \surd\surd$$

(4)

4.5 When a conductor moves through a magnetic field √, a voltage is induced √ in the conductor. √ (3)
OR The voltage induced in the wire or conductor is proportional to the rate of change of the magnetic flux. **[20]**

QUESTION 5

5.1
$$Vs = \frac{Vp \times N_S}{N_P} \quad \surd$$
$$Vs = \frac{200 \times 400}{1\,200} \quad \surd$$
$$Vs = 66{,}667\,V \quad \surd\surd$$
(4)

5.2

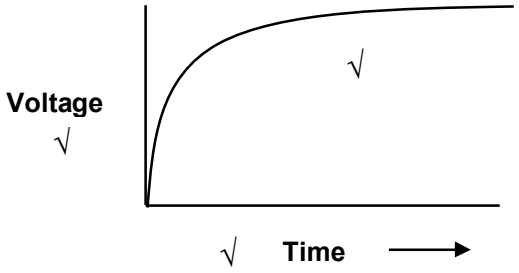

FIGURE 2 (3)

5.3

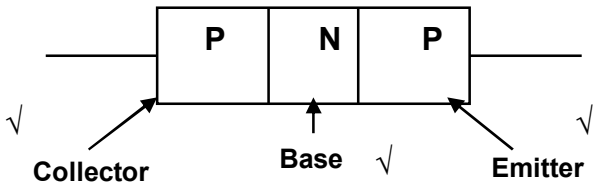

FIGURE 3 (3)

5.4 A material that has a deficiency of electrons OR A material which has an abundance of holes. (2)

5.5

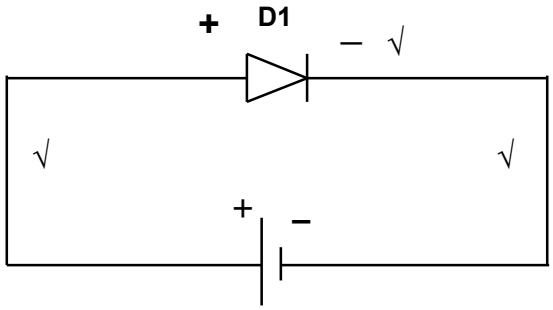

FIGURE 4 (3)

5.6 5.6.1 0,6 V

5.6.2 11,4 V (2 x 1) (2)

5.7
- An atom is composed of a nucleus that consists of protons and neutronsãã
- It has electrons that move in orbitsã (3)

[20]

TOTAL: 100