higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T620(E)(A4)T
AUGUST EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

4 August 2016 (X-Paper)
09:00–12:00

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 State THREE advantages of a lead-acid cell. (3)

1.2 Draw a sawtooth wave to show both positive and negative values. (2)

1.3 Draw a square wave to show both positive and negative values. (2)

1.4 State Faraday's law. (3)

1.5 State the laws of magnetism. (2)

1.6 Define *polarisation* of cells. (2)

1.7 Explain the term *electromagnet*. (2)

1.8 State FOUR factors that determine the strength of an electromagnet. (4)

[20]

QUESTION 2

2.1 Sketch the IEC symbols of the following components:

2.1.1 Preset resistor

2.1.2 Battery

2.1.3 Variable resistor

2.1.4 Electrolytic capacitor

2.1.5 PNP transistor

(5 × 1) (5)

2.2 THREE cells with an EMF of 1,5 V and an internal resistance of 0,18 Ω each are connected across a 3,8 Ω resistor.

2.2.1 Sketch a complete circuit diagram. (2)

2.2.2 Calculate the total current flow in the circuit when a 3,8 Ω resistor is connected across the cells. (4)

2.3 Describe what will be experienced at the output of each of the following components when a direct current is applied to the input of each:

2.3.1 Capacitor

2.3.2 Diode

(2 × 2) (4)

2.4 Explain what is meant by *covalent bonding*. (2)

2.5 Give THREE factors that will influence the resistance of the conductive material. (3)
[20]

QUESTION 3

3.1 Refer to FIGURE 1 below and calculate the following:

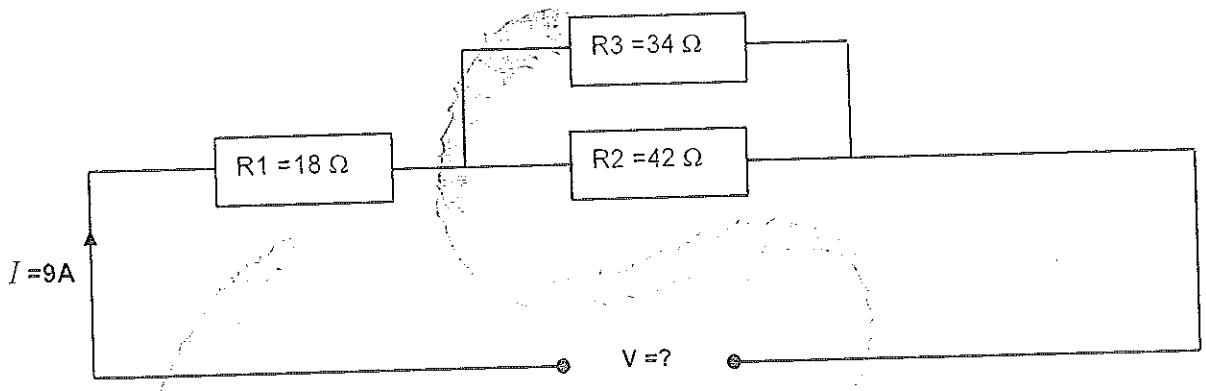

FIGURE 1

3.1.1 Resistance across the parallel section (4)

3.1.2 Total resistance of the circuit (3)

3.1.3 Voltage drop across the parallel section (3)

3.1.4 Power consumed by resistor R1 (3)

3.2 A 30 m long conductor with a diameter of 4 mm has a resistivity of 0,017 micro-ohm-metres.

Calculate the following:

3.2.1 Cross-sectional area of the conductor (4)

3.2.2 Resistance of the conductor

HINT: Convert mm to m (3)
[20]

QUESTION 4

4.1 FOUR capacitors with values 2 μF, 4 μF, 8 μF and 16 μF are connected in parallel.

Calculate the following:

4.1.1 Total capacitance of the circuit

4.1.2 Charge across the capacitor when the applied voltage is 50 V.

(2 × 3) (6)

4.2 A transformer has 4 400 windings on the primary coil and 2 000 windings on the secondary coil. The input voltage is 440 volts and the current through the secondary coil is 4 amperes.

Calculate the following:

4.2.1 Output voltage
4.2.2 Current through the primary coil

(2 × 4) (8)

4.3 Draw a labelled circuit diagram to illustrate how an ammeter is connected to a load. (3)

4.4 Describe the composition of a capacitor. (3)
[20]

QUESTION 5

5.1 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (5.1.1–5.1.10) in the ANSWER BOOK.

5.1.1 A voltmeter is always connected in (parallel/series) in a circuit.

5.1.2 A (resistor/capacitor) is a component that stores energy.

5.1.3 A (galvanometer/transistor) is an instrument designed to measure extremely small currents.

5.1.4 A diode is made up of (four/two) components.

5.1.5 A diode has a (low/high) resistance when it is forward biased.

5.1.6 A P-type semi-conductor material has a/an (deficiency/excess) of electrons.

5.1.7 A transformer operates on the principle of (self-/mutual) induction.

5.1.8 The tolerance value of a resistor with a yellow colour band is (15%/1%).

5.1.9 Valence electrons exist in the (lowest/highest) energy level of an atom.

5.1.10 Doping is when impurity atoms are intentionally added to the (extrinsic/intrinsic) material.

(10 × 1) (10)

5.2 Name the elements of a transistor. (3)

5.3 Name TWO uses of a transistor. (2)

5.4 Define *induction.* (2)

5.5 Draw a labelled circuit diagram to show the *forward biasing* condition of a diode. (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

NATIONAL CERTIFICATE

AUGUST EXAMINATION

INDUSTRIAL ELECTRONICS N1

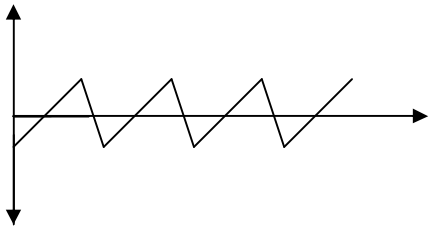
4 AUGUST 2016

This marking guideline consists of 6 pages.

QUESTION 1

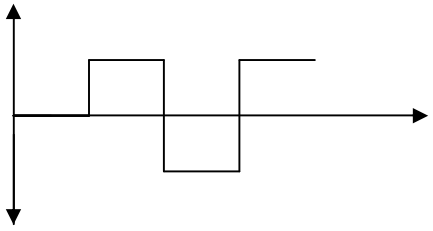
1.1
- It is rechargeable.
- It has a greater capacity. OR can supply heavy loads
- It is ideally suited for emergency backup applications.
- It has a longer life span. (Any 3 × 1) (3)

1.2



(2)

1.3



(2)

1.4 The voltage induced in the conductor is directly proportional to the rate at which the conductor cuts the magnetic lines of force. (3)

1.5 Like poles attract each other and unlike poles repel each other. (2)

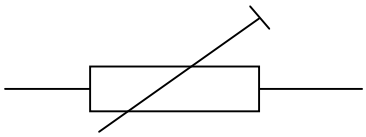
1.6 The collection of hydrogen around the positive carbon electrode. (2)

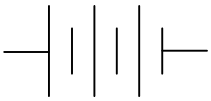
1.7 When the current is passed through a coil of wire an electromagnet is created. (2)

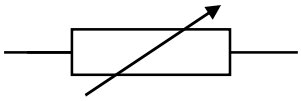
1.8
- The strength of the current flowing through the coil
- The number of windings in the coil
- The nature of the core (permeability)
- The ratio of the coil length to its diameter (4)

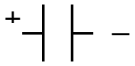
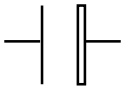
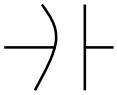
[20]

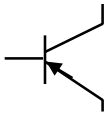
QUESTION 2

2.1.1  **OR** 

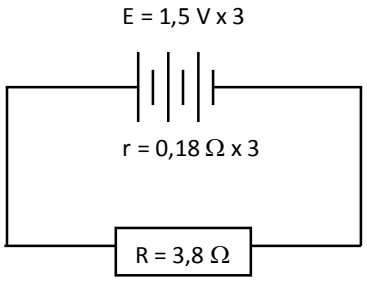
2.1.2 

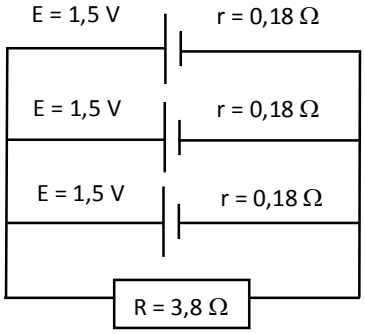
2.1.3  **OR** 

2.1.4  **OR**  **OR** 

2.1.5  (5)

2.2 2.2.1





(2)

2.2.2

$$I = \frac{E_T}{R + r_t}$$

$$I = \frac{(1{,}5 \times 3)}{3{,}8 + (0{,}18 \times 3)} \quad \surd\surd$$

$$I = 1{,}04\ A \quad \surd\surd$$

OR

$$I = \frac{E_T}{R + r_t}$$

$$I = \frac{(1{,}5)}{3{,}8 + (0{,}06)}$$

$$I = 0{,}39\ A$$

(4)

2.3 2.3.1 A capacitor tends to block direct current.

2.3.2 The direct current will pass in one direction only.

(2 × 2) (4)

2.4 When two valence electrons between two atoms link together. (2)

OR The mutual sharing of valence electrons between atoms.

2.5
- The length of the conductor
- The cross-sectional area of the conductor
- The type of material that the conductor is made of
- The temperature of the conductor

(Any 3 × 1) (3)

[20]

QUESTION 3

3.1 3.1.1

$$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_p} = \frac{1}{42} + \frac{1}{34} \quad \surd$$

$$\frac{1}{R_p} = \frac{34+42}{1\,428}$$

$$\frac{1}{R_p} = \frac{76}{1\,428}$$

$$\frac{R_p}{1} = \frac{1\,428}{76} \quad \surd$$

$$R_p = 18{,}79\ \Omega \quad \surd\surd$$

(4)

3.1.2

$$R_T = R_1 + R_P$$

$$R_T = 18 + 18{,}79 \quad \surd$$

$$R_T = 36{,}79\ \Omega \quad \surd\surd$$

(3)

3.1.3

$$V_T = I_T \times R_P$$

$$V_T = 9 \times 18{,}79 \quad \surd$$

$$V_T = 169{,}11\,V \quad \surd\surd$$

(3)

3.1.4

$$P = I^2 \times R$$

$$P = 9^2 \times 18 \quad \surd$$

$$P = 1\,458\,W \quad \surd\surd$$

(3)

3.2 3.2.1

$$A = \frac{\pi d^2}{4} \quad \surd$$

$$A = \frac{\pi \times 0{,}004^2}{4} \quad \surd$$

$$A = 12{,}57 \times 10^{-6}\ m^2 \quad \surd\surd \qquad (4)$$

3.2.2

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

$$R = \frac{0{,}017 \times 10^{-6} \times 30}{12{,}57 \times 10^{-6}} \quad \surd$$

$$R = 0{,}04\ \Omega \quad \surd\surd \qquad (3)$$

[20]

QUESTION 4

4.1 4.1.1

$$C_T = C_1 + C_2 + C_3 + C_4$$

$$C_T = 2 + 4 + 8 + 16 \quad \surd$$

$$C_T = 30\ \mu F \quad \surd\surd$$

4.1.2

$$Q = C \times V$$

$$Q = 30 \times 10^{-6} \times 50 \quad \surd$$

$$Q = 1\,500\ \mu C \quad \surd\surd$$

(2 × 3) (6)

4.2 4.2.1

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

$$Vs = \frac{2\,000 \times 440}{4\,400} \quad \surd$$

$$Vs = 200\ V \quad \surd\surd$$

4.2.2

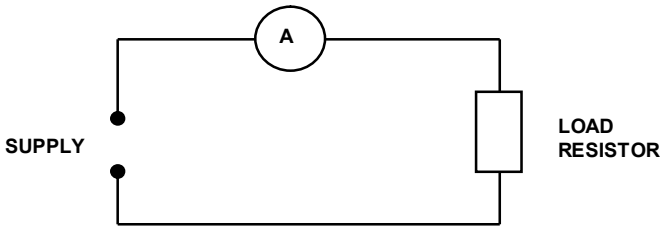
$$Ip = \frac{Is \times Ns}{Np} \quad \surd$$

$$Ip = \frac{2\,000 \times 4}{4\,400} \quad \surd$$

$$Ip = 1{,}82\ A \quad \surd\surd$$

(2 × 4) (8)

4.3



(3)

4.4 A capacitor consists of two parallel metallic plates separated by a layer of insulating material called dielectric. (3)

[20]

QUESTION 5

5.1
5.1.1 Parallel
5.1.2 Capacitor
5.1.3 Galvanometer
5.1.4 Two
5.1.5 Low
5.1.6 Deficiency
5.1.7 Mutual
5.1.8 (Award mark for answer)
5.1.9 Highest
5.1.10 Intrinsic

(10 × 1) (10)

5.2
- Collector
- Base
- Emitter

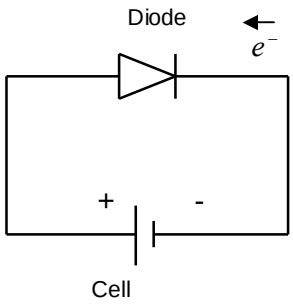
(3)

5.3
- As an amplifier
- As an electronic switch

(2)

5.4 The ability of a conductor to induce a voltage when the current changes. (2)

5.5



(3)

[20]

TOTAL: 100