higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T670(**E**)(A1)T
AUGUST EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1

(8080641)

1 August 2014 (Y-Paper)
13:00–16:00

This question paper consists of 6 pages and 1 formula sheet.

QUESTION 1

1.1 Choose an item/word from COLUMN B that matches a description in COLUMN A. Write only the letter (A–O) next to the question number (1.1.1–1.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1.1	The junction voltage of a Germanium diode	A	silicon
		B	need maintenance
1.1.2	THREE elements of a transistor	C	series
1.1.3	Will help in finding the poles of the earth	D	0,2 v
1.1.4	An advantage of a primary cell	E	0,6 v
1.1.5	An example of a semi-conductor material	F	transformer
		G	parallel
1.1.6	Mutual induction	H	a transistor
1.1.7	The connection of a voltmeter in a circuit	I	relatively cheap
1.1.8	A permanent magnet will always rest with its poles facing this position	J	emitter, base, collector
		K	collector, cathode, base
1.1.9	Can be used as an electronic switch	L	mica
		M	north-south
1.1.10	The junction voltage of a silicon diode	N	east
		O	campus

(10 x 1) (10)

1.2 Give the SI units in which the following are measured:

1.2.1 Inductance

1.2.2 Electromotive force

1.2.3 Temperature co-efficient of resistance

1.2.4 Potential difference

1.2.5 Frequency

(5 x 1) (5)

1.3 Sketch the IEC symbols for the following components:

1.3.1 An P-N-P transistor

1.3.2 A polarised capacitor

1.3.3 An Inductor

1.3.4 A pre-set resistor

1.3.5 An air core transformer

(5 x 1) (5)
[20]

QUESTION 2

2.1 FOUR cells connected in series have an EMF of 2,5 volts each and an internal resistance of 0,3 Ω each. A 10 Ω resistor is connected across the cells.

2.1.1 Sketch and label the circuit diagram. (2)

2.1.2 Calculate the total current flow in the circuit. (4)

2.2 The value of a resistor can be known by using its colour bands.

Give the value of a resistor colour coded: Red; Brown; Orange; Silver. (4)

2.3 The strength of an electromagnet is determined by various factors.

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

2.4 State TWO advantages of secondary cells. (2)

2.5 Explain the difference between *a permanent magnet* and *an electromagnet.* (4)
[20]

QUESTION 3

3.1 Calculate the resistance of a 6m long conductor with a cross-sectional area of $1{,}1 \times 10^{-5} m^2$.

The resistivity of the metal is $0{,}058 \times 10^{-6}$ Ωm. (3)

3.2 A conductor has got a resistance of 18 Ω at 0^0 C.

If the conductor is heated up to 80^0 C, what will be its resistance? Take α as 0,0042 Ω/^{0}C. (4)

3.3 A transformer with 2 000 windings on the secondary side has a secondary voltage of 24 volts and a secondary current of 4 A.

Calculate the primary voltage if the current flow through the primary coil is 500 mA. (4)

3.4 THREE resistors connected in series across a 110 V supply have the following values: R1 = 27 Ω; R2 = 30 Ω and R3 = 36 Ω. The current flow across the circuit is 1,3 A.

3.4.1 Calculate the total resistance of the circuit.

3.4.2 Calculate the power consumed by the resistor R2.

3.4.3 Calculate the voltage drop across the 30 Ω resistor.

(3 x 3) (9)
[20]

QUESTION 4

4.1 A circuit consists of TWO capacitors with values of 10 μF, 15 μF which are connected in series.

Calculate:

4.1.1 The total capacitance of the circuit. (4)

4.1.2 The charge across the circuit with an applied voltage of 12 V. (3)

4.2 There are THREE factors that affect the capacitance of a capacitor. What effect will the following factors have on the capacitance of a capacitor?

4.2.1 The distance between the plates.

4.2.2 The cross-sectional area of the plates.

4.2.3 The type of the insulating material.

(3 x 3) (9)

4.3 Explain the following terms:

4.3.1 *Polarisation* of cells.

4.3.2 *Ampere-hour* of a battery.

(2 x 2) (4)
[20]

QUESTION 5

5.1 Explain the term *doping*. (4)

5.2 State Lenz's Law (4)

5.3 Show by means of a neat, labelled circuit diagram how an ammeter is connected to the load. (4)

5.4 Name the terminals of a diode. (2)

5.5 Explain how a junction barrier of a diode is formed. (4)

5.6 Name TWO advantages of using a transistor as a switch. (2)

[20]

TOTAL: 100

INDUSTRIAL ELECTRONICS N1

FORMULA SHEET

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

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

$$P = V \times I$$

$$R_t = R_1 + R_2 + ... + R_n$$

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

$$C_t = C_1 + C_2 + ... + C_n$$

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

$$Q = C \times V$$

$$L_t = L_1 + L_2 + ... + L_n$$

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

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

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

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

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MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

INDUSTRIAL ELECTRONICS N1

1 AUGUST 2014

This marking guideline consists of 6 pages.

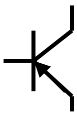
QUESTION 1

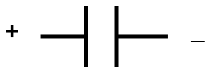
1.1
1.1.1 D
1.1.2 J
1.1.3 O
1.1.4 I
1.1.5 A
1.1.6 F
1.1.7 G
1.1.8 M
1.1.9 H
1.1.10 E

(10 x 1) (10)

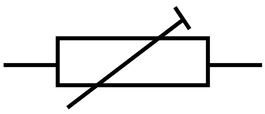
1.2
1.2.1 Henry or H
1.2.2 Volt or V
1.2.3 Ohm per degree Celcius or $\Omega/^{0}C$
1.2.4 Volt or V
1.2.5 Hertz or Hz

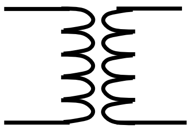
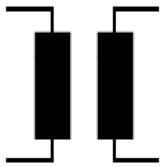
(5 x 1) (5)

1.3
1.3.1 

1.3.2  OR 

1.3.3  OR 

1.3.4  OR 

1.3.5  OR 

(5 x 1) (5)
[20]

QUESTION 2

2.1 2.1.1

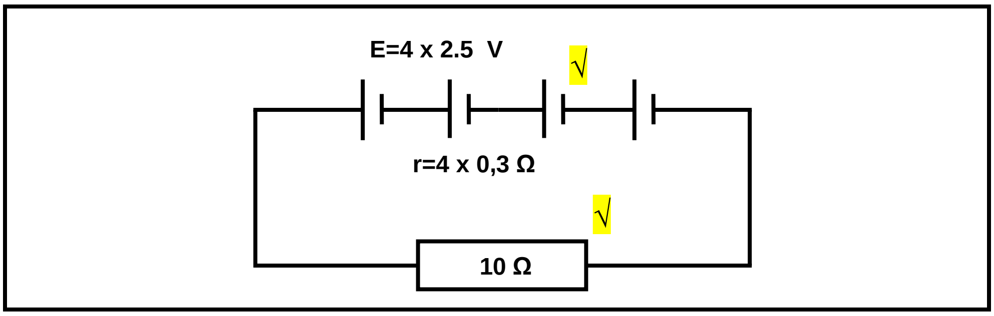


FIGURE 2 (2)

2.1.2

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

$$I = \frac{(4 \times 2{,}5)}{10 + (4 \times 0{,}3)}$$ √ √

$$I = 0{,}893A$$ √√ (4)

√√ √ √

2.2 21 000 Ω, ± 10% OR 21 k Ω, ± 10% (4)

2.3
- The amount of current flowing through the electromagnet
- The amount of turns in the coil
- The type of material used in the core or permeability of the core
- The ratio of the coil length to the coil diameter (4)

2.4
- Have a greater capacity than primary cells
- Ideally suited for emergency backup
- Rechargeable
- Have a longer life span (2)
- Can handle heavy loads (Any 2 x 1)

2.5 Permanent magnet: It is a magnetised material that keeps its magnetism for a long period of time. √√

Electromagnet: A magnetised material that keeps its magnetism for as long as there is electric current flowing √√ (4)

[20]

QUESTION 3

3.1

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

$$R = \frac{0{,}058 \times 10^{-6} \times 6}{1{,}1 \times 10^{-5}} \quad \surd$$

$$R = 0{,}032 \ \Omega \quad \surd\surd$$

(3)

3.2

$$R_T = R_0(1 + \alpha_0 t)$$

$$R_T = 18[1 + 0{,}0042 \times 80] \quad \surd\surd$$

$$R_T = 24{,}048\,\Omega \quad \surd\surd$$

(4)

3.3

$$V_P = \frac{Vs \times Is}{Ip} \quad \surd$$

$$Vp = \frac{24 \times 4}{500 \times 10^{-3}} \quad \surd$$

$$Vp = 192\,V \quad \surd\surd$$

(4)

3.4 3.4.1

$$R_T = R_1 + R_2 + R_3$$

$$R_T = 27 + 30 + 36 \quad \surd$$

$$R_T = 93\,\Omega \quad \surd\surd$$

3.4.2

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

$$P = 1{,}3^2 \times 30 \quad \surd$$

$$P = 50{,}7\,W \quad \surd\surd$$

OR

$$V = I \times R \qquad P = I \times V$$

$$V = 1{,}3 \times 30 \qquad P = 1{,}3 \times 39$$

$$V = 39V \qquad P = 50{,}7\,W$$

3.4.3

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

$$V = \frac{50{,}7}{1{,}3} \quad \surd$$

$$V = 39\,V \quad \surd\surd$$

OR

$$V = I \times R$$

$$V = 1{,}3 \times 30$$

$$V = 39V$$

(3 x 3) (9)

[20]

QUESTION 4

4.1 4.1.1

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$$
$$\frac{1}{C_T} = \frac{1}{10} + \frac{1}{15} \quad \surd$$
$$\frac{1}{C_T} = \frac{3+2}{30}$$
$$C_T = \frac{30}{5} \quad \surd$$
$$C_T = 6\mu F \quad \surd\surd$$

OR

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$$
$$\frac{1}{C_T} = \frac{1}{10} + \frac{1}{15}$$
$$\frac{1}{C_T} = 0{,}16667$$
$$C_T = \frac{1}{0.16667}$$
$$C_T = 6\mu F$$

(4)

4.1.2

$$Q = C_T \times V$$
$$Q = 6 \times 10^{-6} \times 12 \quad \surd$$
$$Q = 72\mu C \quad \surd\surd$$

(3)

4.2 4.2.1 The greater the distance between the plates, the smaller the capacitance √√ (or vice versa). √

OR

The capacitance is inversely proportional √√ to the distance between the plates. √

4.2.2 The larger the surface area, the greater the capacitance √√ (or vice versa). √

OR

The capacitance is directly proportional √√ to the surface area of the plates. √

4.2.3 The poor the insulating material (or dielectric material) √, the lower the capacitance √ (or vice versa). √

(3 x 3) (9)

4.3 4.3.1 The collection of hydrogen√ around the positive electrode√ of a cell. (2)

4.3.2 The unit of measure√ used to indicate the capacity√ of lead-acid cell. (2)

[20]

QUESTION 5

5.1 When impurity√ atoms are intentionally√ added to the intrinsic√ or pure semi-conductor material√, the semi-conductor is said to be doped. (4)

5.2 The direction√ of the induced current√ must be such that its own magnetic field will oppose√ the action that produced the induced current. √

OR

The emf induced in an electric circuit√ always acts in such a direction√ that the current it drives around the circuit opposes√ the change in magnetic flux which produced the emf. √ (4)

5.3

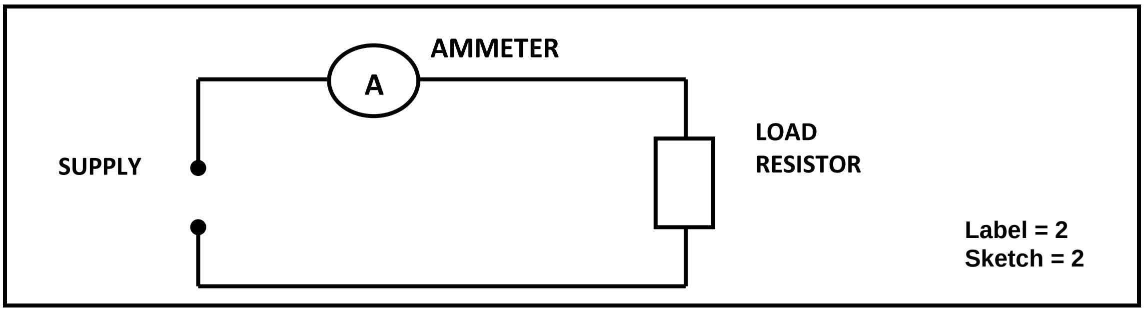


FIGURE 3 (4)

5.4 Anode; Cathode (2)

5.5 The holes will diffuse into the N-type semi-conductor√√ while some of the valence electrons will diffuse into the P-type semi-conductor. √√ This leaves behind a barrier junction that has no charge carriers. √√ (Any 4 X 1) (4)

5.6
- A small base-emitter current can switch the transistor 'on' or 'off'.
- There is no wear and tear on switchgear.
- Switching times are faster.
- There is control over long distances. (Any 2 x 1) (2)

[20]

TOTAL: 100