higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T750**(E)**(A3)T

# NATIONAL CERTIFICATE

# INDUSTRIAL ELECTRONICS N1

(8080641)

**3 August 2018 (X-Paper)**
**09:00–12:00**

**This question paper consists of 7 pages and 1 formula sheet.**

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N1
TIME: 3 HOURS
MARKS: 100

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**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. Use only BLUE or BLACK ink.
5. Start each question on a NEW page.
5. Keep subsections of questions together.
6. Use the value for $\pi$ as 3,142.
7. Approximate ALL final answers accurately to THREE decimal places.
8. Write neatly and legibly.

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## QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.10) in the ANSWER BOOK.

1.1.1 Rectifier diodes will conduct when …

A the P-type material is connected to the positive supply and the N-type to the negative supply.
B the P-type and N-type materials are connected to the positive supply.
C the N-type material is connected to the positive supply and the P-type to the negative supply.
D the diode is reverse biased.

1.1.2 Current is measured with an instrument called a …

A galvanometer
B ampere meter
C clamp meter
D volt meter

1.1.3 ONE disadvantage of an analogue meter is that …

A the ohms scale is linear.
B the display is easy to read.
C it has an auto-shut off feature.
D readings are not very accurate.

1.1.4 Germanium atoms have …

A six valence electrons.
B eight valence electrons.
C no valence electrons.
D four valence electrons.

1.1.5 An insulator …

A is an element that allows current to flow because it has many free electrons.
B is an element that has an abundance of neutrons.
C allows current to flow because it forms covalent bonds.
D does not allow current to flow because it has no free electrons.

1.1.6 The colour code for a 6 Ω resistor with a 10% tolerance value is …

A blue black black silver.
B blue brown black silver.
C blue black gold gold.
D blue black gold silver.

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1.1.7 A semiconductor is …

A a good conductor.
B a bad insulator.
C neither a good conductor nor a good insulator in its pure state.
D extrinsic material.

1.1.8 The junction voltage of silicon is …

A 0,6 volts
B 0,06 volts
C 0,3 volts
D 0,03 volts

1.1.9 A bipolar transistor has …

A two junctions.
B three junctions.
C one barrier layer.
D no junctions.

1.1.10 ONE factor that affects capacitance is …

A temperature.
B number of turns.
C dielectric constant.
D current.

(10 × 1) (10)

1.2 THREE resistors with the following values are connected in parallel to a 50-volt DC supply:

$R_1$ = 15 Ω; $R_2$ = 20 Ω and $R_3$ = 30 Ω

Calculate the following values:

1.2.1 The total resistance of the circuit (4)

1.2.2 The total current flow through the circuit (3)

1.2.3 The voltage drop across the 15-Ω resistor (1)

1.2.4 The power consumed by the 30-Ω resistor (3)

1.3 Give the colour code of a 20-Ω resistor which has a tolerance of 5%. (4)
**[25]**

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## QUESTION 2

2.1 A copper conductor has a length of 50 metres and a diameter of 6 mm.

Determine the resistance of this conductor if it has a resistivity of 0,018 µΩ m. (8)

2.2 A conductor with a temperature coefficient of 0,0058 ohm per ºC has a resistance of 15 Ω at 0 ºC.

Calculate the resistance if the temperature is increased to 50 º/C. (3)

2.3 THREE cells, each with an EMF of 1,5 volts and an internal resistance of 0,5 Ω, are connected to each other in series. This battery is then connected across a 15-Ω resistor.

Calculate the following:

2.3.1 The total EMF of the battery (2)

2.3.2 The total internal resistance of the battery (2)

2.3.3 The total resistance of the circuit (3)

2.3.4 The current drawn by the circuit (4)

2.3.5 The voltage drop across the 15-Ω resistor (3)

**[25]**

## QUESTION 3

3.1 Choose the correct word or words from those given in brackets. Write only the word or words next to the question number (3.1.1–3.1.10) in the ANSWER BOOK.

3.1.1 Transformers operate on the principle of (self-induction/magnetic induction/mutual induction).

3.1.2 Polarisation is the formation of (hydrogen bubbles/oxygen bubbles) around the carbon rod of a cell.

3.1.3 A Zener diode can conduct in (one direction/two directions).

3.1.4 A horse-shoe magnet has (two/four) poles.

3.1.5 N-type semiconductor material is (intrinsic/extrinsic).

3.1.6 A capacitor blocks the flow of (direct/alternating) current.

3.1.7 A peak-to-peak value is (one/two/four) times the amplitude of a sine wave.

3.1.8 Magnetic lines of force move from (north/south) inside a magnet.

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3.1.9 The term *EMF* is used when referring to an (open/closed) circuit.

3.1.10 The outermost shell of an atom is called the (valence/free/covalent) shell.

(10 × 1) (10)

3.2 THREE capacitors with the following values are connected in parallel across a 100-volt supply:

$C_1$ = 10µF; $C_2$ = 5µF; $C_3$ = 25µF

Calculate the following:

3.2.1 The total capacitance of the circuit

3.2.2 The charge across the circuit

(2 × 3) (6)

3.3 A transformer has a turns ratio of 20:1. When it is connected to the mains supply of 240 volts, a current of 1,25 amperes flows through the primary winding.

Determine the following:

3.3.1 The current flow through the secondary windings

3.3.2 The voltage across the secondary windings

(2 × 3) (6)

3.4 Give THREE advantages of secondary cells. (3)

**[25]**

**QUESTION 4**

4.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

4.1.1 Electrons are positively charged particles.

4.1.2 Like poles of a magnet are attracted to each other.

4.1.3 The number of turns of copper wire influences the strength of an electromagnet.

4.1.4 The crystal lattice structure of germanium is similar to that of silicon.

4.1.5 An ohm meter is always connected in parallel with a resistor with the power switched off.

(5 × 1) (5)

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4.2 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–O) next to the question number (4.2.1–4.2.10) in the ANSWER BOOK.

| COLUMN A | | COLUMN B | |
|---|---|---|---|
| 4.2.1 | An atom that has four valence electrons | A | electrons |
| 4.2.2 | The time required to complete one cycle of a sine wave form | B | transistor |
| 4.2.3 | Majority charge carriers of N-type materials | C | trivalent |
| 4.2.4 | Used to measure current | D | power |
| 4.2.5 | Can be used as an electronic switch | E | capacitor |
| 4.2.6 | Error of parallax | F | inductor |
| 4.2.7 | The rate of doing work | G | digital meter |
| 4.2.8 | Is available in various sizes | H | tetravalent |
| 4.2.9 | Stores an electrical charge | I | holes |
| 4.2.10 | Gives very accurate readings | J | ampere meter |
| | | K | analogue meter |
| | | L | secondary cell |
| | | M | frequency |
| | | N | primary cell |
| | | O | volt meter |

(10 × 1) (10)

4.3 Define the following terms:

4.3.1 Lenz's law (4)

4.3.2 Forward bias (3)

4.3.3 Doping (3)

**[25]**

**TOTAL: 100**

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# 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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