higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T430(**E**)(N19)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N1

(11041861)

19 November 2015 (X-Paper)
9:00–12:00

This question paper consists of 5 pages and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY 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 FIVE examples of danger zones where applicable flameproof electrical appliances must be used. (5)

1.2 State FIVE aspects with regard to good housekeeping in the workshop. (5)

1.3 Bad quality work is often blamed on incorrect/improper tools being used.

Is the above-mentioned statement TRUE or FALSE? Give TWO reasons to support your answer. (3)

[13]

QUESTION 2

2.1 Define Ohm's Law. (4)

2.2 THREE similar resistors of 3 Ω each are connected in parallel. This combination is connected across a battery with a voltage of 6 V.

2.2.1 Draw a neat fully labelled diagram of the circuit mentioned above. (4)

Calculate the following:

2.2.2 The total resistance of the circuit (4)

2.2.3 The current flow through each resistor (7)

2.2.4 The total current flowing through the circuit (2)

2.2.5 The power used by the circuit (2)

2.2.6 The energy required by the circuit in ONE HOUR (4)

[27]

QUESTION 3

3.1 Make a neat, fully labelled sketch of a current-carrying conductor showing the magnetic lines of force and their relative direction. (6)

3.2 State THREE ways in which the magnetic flux of a solenoid can be strengthened. (3)

3.3 A single-phase transformer with a voltage of 6 600 V on the primary draws a current of 5 A from the supply.

If the transformer ratio is 25 : 1 and there are 110 turns on the secondary side, calculate the following:

3.3.1 The current flowing through the secondary coil

3.3.2 The number of turns on the primary coil

(2 x 2) (4)
[13]

QUESTION 4

4.1 Compare, by making use of a suitable TABLE, FIVE aspects with regard to the advantages and disadvantages of primary cells and secondary cells (lead-acid). (10)

4.2 What material is used to make generator brushes? (1)

4.3 What instrument is used to measure the relative density of the electrolyte in a lead-acid cell? (1)
[12]

QUESTION 5

5.1 What happens when the conductors of an alternator move at right angles through a magnetic field? (1)

5.2 Describe the following terms with reference to a sine wave:

5.2.1 Period (1)

5.2.2 Root-mean-square (RMS) value (6)

5.3 Show, by means of a neat, fully labelled circuit diagram, how a voltmeter can be connected directly across the supply. (5)
[13]

QUESTION 6

6.1 Define an *insulator.* (3)

6.2 Give FIVE examples of insulators which are generally used in the electrical industry. (5)

6.3 What do you understand by the term *earthed*? (5)
[13]

QUESTION 7

7.1 What FOUR tests does the Code of Practice stipulate for all electrical installations to ascertain that they are safe and function properly? (4)

7.2 THREE similar capacitors of 240 µF are connected in series.

Calculate the total capacitance. (5)
[9]

TOTAL: 100

ELECTRICAL TRADE THEORY N1

FORMULA SHEET

RESISTORS

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

$$R_T = R_1 + R_2 + R_3 + ...$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$$

POWER

$$P = V \times I$$

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

$$P = \frac{V^2}{R}$$

ENERGY

$$W = P \times t$$

$$W = VI \times t$$

$$W = I^2 R \times t$$

$$W = \frac{V^2}{R} \times t$$

CELLS

$$E = V + (I \times r)$$

$$R_T = R + r$$

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

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

RESISTIVITY

$$R = \frac{\rho \times \ell}{a}$$

$$a = \frac{\pi \times d^2}{4}$$

TEMPERATURE COEFFICIENT

$$R_t = R_o(1 + L_o t)$$

TRANSFORMERS

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

CAPACITORS

$$C_T = C_1 + C_2 + C_3 + ...$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ...$$

FREQUENCY

$$f = np$$

$$f = \frac{1}{T}$$

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MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

ELECTRICAL TRADE THEORY N1

19 NOVEMBER 2015

This marking guideline consists of 6 pages.

QUESTION 1

1.1
- Petrol pumps
- Wine cellars
- Flammable liquid reservoirs
- Coal bunkers
- Spray paint cubicles
- Grain mills **(any other suitable answer)** (Any 5 x 1) (5)

1.2
- Working areas and walkways must be kept clear.
- Floors must be skid-free.
- Spilled slippery substances must be wiped up at once.
- Equipment and materials must be stacked in an orderly manner.
- Guardrails must be installed on stairways et cetera.
- Roofs must be kept leak-free. **(any other suitable answer)**
- Lighting must be adequate.
- Warning systems (e.g. siren) must be installed.
- Effective emergency procedure must be in place.
- Emergency lighting must be provided when necessary. (Any 5 x 1) (5)

1.3 False√ **(True)** (1)

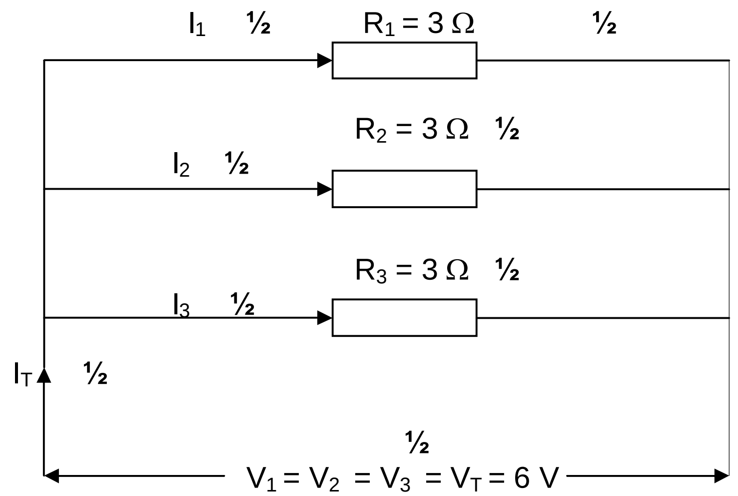
Hand tools must be:
- Well cared for
- Kept in good condition
- Used properly
- Used with due caution
- Kept rust-free
- Oiled if necessary
- Used only for the purpose for which they were made (3)

[13]

QUESTION 2

2.1 The currentã flowing in a direct-current circuitã is directly proportional to the appliedã voltage and inversely proportional to the resistance of that circuit, at a constant temperatureã. (4)

2.2 2.2.1



(4)

2.2.2 $1 \div R_T = 1 \div R_1 + 1 \div R_2 + 1 \div R_3$√
$= 1 \div 3 + 1 \div 3 + 1 \div 3$ √
$= (1 + 1 + 1) \div 3$
$= 1$ √
$\therefore\ R_T = 1\ \Omega$√ (4)

2.2.3 $I_1 = V_1 \div R_1$√ AND $I_2 = V_2 \div R_2$√ AND $I_3 = V_3 \div R_3$√
But $V_1 = V_2 = V_3 = V_T = 6\ V$ √
$\therefore$
$I_1 = 6 \div 3$ AND $I_2 = 6 \div 3$ AND $I_3 = 6 \div 3$
$= 2\ A$ √ $= 2\ A$√ $= 2\ A$√ (7)

2.2.4 $I_T = V_T \div R_T$ √ OR $I_T = I_1 + I_2 + I_3$
$= 6 \div 1$ $= 2 + 2 + 2$
$= 6\ A$ √ $= 6\ A$ (2)

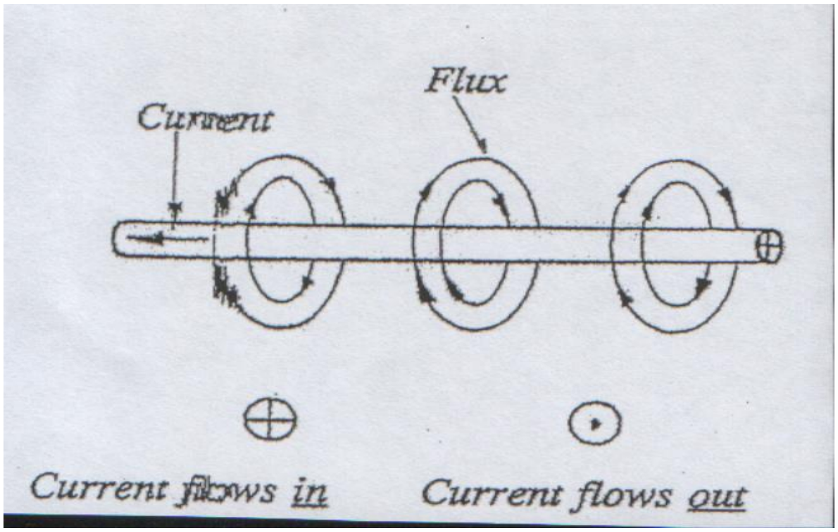
2.2.5 $P_T = I_T{}^2 R_T$√ OR $P_T = V_T I_T$ OR $P_T = V_T{}^2 \div R_T$
$= 6^2 \times 1$
$= 36\ W$ √ (2)

2.2.6 $E_T = P_T \times t$√
$= 36 \times (1 \times 60 \times 60)$√
$= 129\ 600\ W$√
$= 129{,}6\ kW$√ (4)

[27]

QUESTION 3

3.1



(2 marks only for unlabelled sketch) (6)

3.2
- Increase in the current flow
- Placing an iron core inside the solenoid (coil)
- Increase in the number of turns of the coil (3 x 1) (3)

3.3 3.3.1 Turns ratio = current ratio

Turns ratio = $I_2:I_1$

i.e. $N_1:N_2 = I_2:I_1$

$\therefore I_2$ = (turns ratio) x I_1 √

= (25 ÷ 1)(5)

= 125 A√ (2)

3.3.2 $N_1:N_2$ = turns ratio

N_1 = (turns ratio)(N_2) √

= (25 ÷ 1)(110)

= 2 750 turns√ (2)

[13]

QUESTION 4

4.1

PRIMARY CELLS	SECONDARY CELLS
• Not rechargeable • Low output • Short life expectancy • Low internal resistance • Low EMF per cell • Small and easy to handle • Reasonably cheap • Voltage drop due to polarisation • Ampere-hours are very low (Any FIVE)	• Rechargeable • High output for its size • Reasonably long life if well maintained • High internal resistance • High EMF per cell • Heavy compared with energy it stores • Relatively more expensive • Polarisation is minimal • High discharge current for short period (Any FIVE)

(10)

4.2 Carbon (1)

4.3 Hydrometer (1)
[12]

QUESTION 5

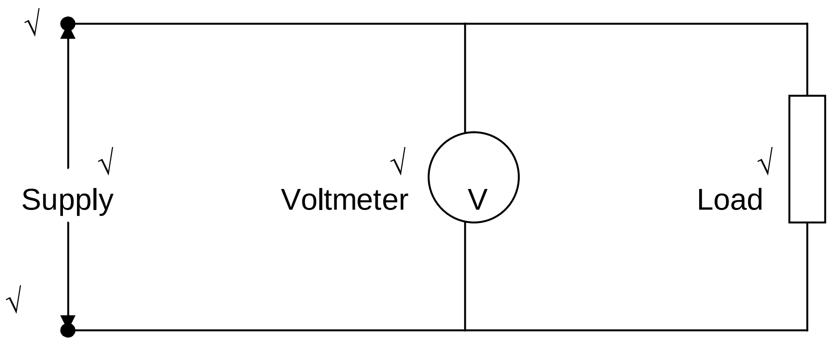
5.1 Maximum EMF is induced. (1)

5.2 5.2.1 The time taken to complete one cycle. (1)

5.2.2 That value of <u>current or voltage</u> that will produce the <u>same heating effect</u> as an <u>equivalent direct current</u>.

<u>RMS value</u> = <u>0,707</u> x the <u>maximum value</u> (6)

5.3



(2 marks only for unlabelled diagram) (5)
[13]

QUESTION 6

6.1 Any solid material preventing flow of electric current. (3)

6.2
- Vulcanised rubber
- Porcelain
- Silicon rubber
- Bakelite
- Polyvinyl chloride (PVC)
- Asbestos
- Micanite
- Glass
- Moulded resins and plastics
- Oil-impregnated paper (Any 5 x 1) (5)

6.3 Earthed means connected to the general mass of earth in such a manner as to ensure, at all times, an immediate discharge of electrical energy without danger. (5)

[13]

QUESTION 7

7.1
- Insulation resistance between live and neutral
- Insulation resistance between live, neutral and earth
- Polarity of switches
- Earth continuity (4)

7.2 $(1 \div C_T) = (1 \div C_1) + (1 \div C_2) + (1 \div C_3)$ √

$= (1 \div 240) + (1 \div 240) + (1 \div 240)$ √

$= (1 + 1 + 1) \div (240)$ √

$= \frac{1 + 1 + 1}{240}$ √

$\therefore C_T = (240 \div 3)$

$C_T = 80\ \mu F$ √ (5)

[9]

TOTAL: 100