higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T430(E)(M24)T

APRIL EXAMINATION

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N1

(11041861)

24 March 2014 (Y-Paper)
13:00–16:00

This question paper consists of 6 pages.

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

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1–1.20) in the ANSWER BOOK.

1.1   Current is the movement of protons in a specific direction.

1.2   Batteries are used to make electrons flow in a certain direction.

1.3   A high resistor has a high resistance and, therefore, does not oppose the flow of charge very much.

1.4   A watt is a unit of measure of energy.

1.5   1,5 µΩ is the same as 1,5 x 10^{-6}Ω.

1.6   The unit of amplitude is the hertz (Hz).

1.7   The sum of two resistors that are connected in parallel will always be smaller than the smaller of the two individual resistors.

1.8   Cells are single electrical energy sources which use chemical reaction to produce current.

1.9   A primary coil in a transformer is a coil in which AC voltage is induced.

1.10   In a transformer voltage is directly proportional to the turns contained in the windings.

1.11   A multimeter can be used to measure voltage, current or resistance.

1.12   A fuse is a safety device that will blow up (melt) if the current flowing through it goes beyond a specified value.

1.13   Copper conductors having a cross-section area greater than 2,5 mm² must not be stranded.

1.14   When bending a cable the radius may not be greater than specified by the manufacturer.

1.15   PVC-insulated cables are more expensive than paper-insulated cables.

1.16   A stationary appliance is that which is moved in the course of normal operation.

1.17   Geysers must be controlled by a switch disconnector.

1.18   Cooking appliances that are rated at more than 16 A must be on a separate circuit.

1.19   The maximum resistance of an earth continuity path is 1,7 kΩ.

1.20   A semiconductor is a material that is neither a good conductor nor a good insulator.

(20 x 1)   **[20]**

QUESTION 2

2.1   State the FIVE most important reasons (desirables) of good housekeeping.   (5)

2.2   Give THREE examples where colour coding can be used for identification purposes.   (3)

2.3   What is the purpose of danger cards when isolating items for inspection and repairs?   (2)

[10]

QUESTION 3

3.1   What electrical quantities make up Ohm's law?   (3)

3.2   Three resistors, R_1, R_2 and R_3 of values 4 Ω, 6 Ω and 12Ω respectively are connected across the same 24 V supply.

Make use of the given circuit diagram to calculate the following:
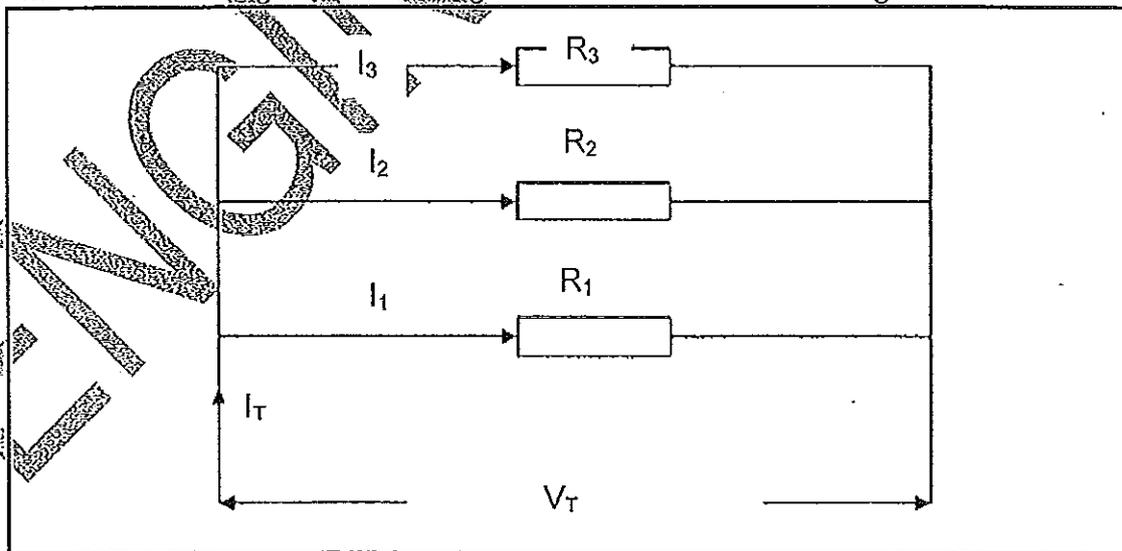
3.2.1   The total resistance of the circuit   (4)

3.2.2   The potential difference across each resistor   (2)

3.2.3   The current flowing through each resistor   (6)

3.2.4   The total current drawn from the supply   (2)

[17]

QUESTION 4

4.1 State TWO advantages of transformers. (2)

4.2 What are the THREE types of magnets? (3)

4.3 A single-phase step-up transformer has a supply voltage of 220 V and a turns ratio of 1 : 10. The secondary current is 5 A and the secondary coil is made up of 300 turns.

Calculate the following:

    4.3.1 The number of turns on the primary coil

    4.3.2 The primary current

    4.3.3 The secondary voltage

                                                    (3 x 2) (6)
                                                              [11]

QUESTION 5

5.1 Name Any THREE main components of a voltmeter or an ammeter. (3)

5.2 What is the difference between EMF and potential difference? (4)

5.3 Describe *frequency* with regard to a sinusoidal waveform, and give the standard unit used. (3)
                                                              [10]

QUESTION 6

6.1 Define a semiconductor and give TWO examples of it. (7)

6.2 What does the Code of Practice stipulate with regard to the position of a switch disconnector for a cooking appliance? (5)

6.3 What is the purpose of circuit breakers and fuses? (3)
                                                              [15]

QUESTION 7

7.1   State FOUR properties of a good insulator.   (4)

7.2   Briefly describe the meaning of stationary appliances.   (2)

7.3   A polarity test is carried out to ensure that three key safety-design features of an installation are met.   (3)

        State the THREE aspects that the test ensures.

7.4   What is the practical feature of LEDs?   (1)
                                                                                    [10]

QUESTION 8

8.1   Three capacitors of 12 µF, 9 µF and 10 µF are connected in parallel.

        Determine the total capacitance.   (2)

8.2   Determine the value of a resistor with the colour bands red, violet, orange and gold.   (5)
                                                                                    [7]

                                                                    TOTAL: 100
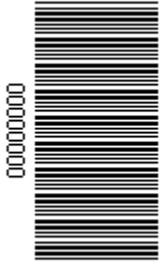
higher education
& training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

ELECTRICAL TRADE THEORY N1

24 MARCH 2014

This marking guideline consists of 6 pages.

QUESTION 1

1.1   False
1.2   True
1.3   False
1.4   False
1.5   True
1.6   False
1.7   True
1.8   True
1.9   False
1.10   True or False
1.11   True
1.12   True
1.13   False
1.14   False or True
1.15   False
1.16   False
1.17   True
1.18   True
1.19   False
1.20   True

(20 x 1)   **[20]**

QUESTION 2

2.1   • Time spent looking for goods is cut down√
        • Space is saved√
        • Injuries or deaths are avoided√   (or any suitable answer)
        • Damage to goods is prevented√
        • Fire hazards are reduced√   (5)

2.2   • Electrical equipment√
        • Distribution boards√   (or any suitable answer)
        • Start buttons√
        • Emergency stop buttons
        • Guards
        • Covers
        • Fresh-water pipes
        • Dirty water pipes
        • Safety valves
        • Walkways
        • Working areas
        • Storage spaces, etc.   (Any 3 x 1)   (3)

                                           √   √
2.3   Danger signs are used to ensure your safety and that of other workers.   (2)
        (or any suitable answer)   **[10]**

QUESTION 3

3.1
- Current flow (I) measured in ampere (A)√
- Applied voltage/Potential difference (V) measured in volt (V)√
- Resistance of the circuit (R) measured in ohm (Ω)√   (3)

3.2   3.2.1
$$1 \div R_T = 1 \div R_1 + 1 \div R_2 + 1 \div R_3$$
$$= (1 \div 4) + (1 \div 6) + (1 \div 12)\sqrt{}$$
$$= (3+2+1) \div 12\sqrt{}$$
$$= 0{,}5 \ \Omega^{-1}\sqrt{}$$

$$\therefore$$
$$\underline{R_T = 2 \ \Omega}\sqrt{}$$ (4)

3.2.2 $V_1 = V_2 = V_3 = V_T = \underline{24 \ V}$ (2)

3.2.3 $I_1 = V_1 \div R_1$ AND $I_2 = V_2 \div R_2$ AND $I_3 = V_3 \div R_3$
$$\therefore$$
$I_1 = 24 \div 4\sqrt{}$ AND $I_2 = 24 \div 6\sqrt{}$ AND $I_3 = 24 \div 12\sqrt{}$
    $\underline{= 6 \ A}\sqrt{}$ $\underline{= 4 \ A}\sqrt{}$ $\underline{= 2 \ A}\sqrt{}$ (6)

3.2.4 $I_T = V_T \div R_T$ OR $I_T = I_1 + I_2 + I_3$
     $= 24 \div 2\sqrt{}$ $= 6 + 4 + 2$
     $\underline{= 12 \ A}\sqrt{}$ $\underline{= 12 \ A}$ (2)
                                                      [17]

QUESTION 4

4.1
- Construction is simple√
- Efficiency at full load is high : ±97%√
- Operation is silent because they have no moving parts

                                       (Any 2 x 1)   (2)

4.2
- Natural magnets√   Temporary Magnet
- Electromagnets√
- Permanent magnets√   (3)

4.3   4.3.1
$$N_1 : N_2 = \text{Voltage ratio} = 1 : 10$$
$$N_1 \div N_2 = 1 \div 10\sqrt{}$$
$$N_1 = N_2 (1 \div 10)$$
$$= 300 (1 \div 10)$$
$$= \underline{30 \ \text{turns}}\sqrt{}$$

4.3.2
$$(I_1 \div I_2) = (N_2 \div N_1)\sqrt{}$$
$$I_1 = I_2 (N_2 \div N_1)$$
$$= 5 (300 \div 30)$$
$$= \underline{50 \ A}\sqrt{}$$

4.3.3 $V_2 \div V_1 = N_2 \div N_1$√

$V_2 = V_1 (N_2 \div N_1)$
= 220 (300 ÷ 30)
= <u>2 200 V</u>√

(3 x 2)   (6)
[11]

QUESTION 5

5.1
- Fixed field system√   Digital Display
- Controlling system√   Electronic circuitry
- Damping system√   Scale select device
- Pointer

(Any 3 x 1)   (3)

5.2   EMF is the voltage measured √ when a voltage source (e.g. a battery) is NOT connected to a loaded circuit√

Potential difference is the voltage measured when a voltage source (e.g. battery) is connected to a loaded circuit. √   (4)

5.3   Frequency is the number of cycles √ executed in one second and it is measured √ in hertz (Hz)√   (3)
[10]

QUESTION 6

6.1   A semiconductor is a

- solid material whose√
- electrical conductivity is√
- intermediate between that of a√
- conductor and that of an√
- insulator; and it is usually strongly temperature-dependent√
  or
- A semiconductor is a material that is niether a good insulator√√ nor a good conductor. √√
- insulator; and it is usually strongly temperature-dependent√

(7)

The two most commonly used semiconductors are:

- Silicon, and√
- Germanium√

6.2
- A built-in cooking appliance must be supplied through a switch disconnector√
- The switch disconnector may supply more than one appliance√
- The switch disconnector should be positioned
  - In the same room as the appliance√
  - Not lower than 0,5 m or higher than 2,2 m from the floor√
  - Preferably not above the cooking appliance√
- If it is further than 0,5 m from the appliance its purpose must be clearly indicated
- The switch disconnector may not be fixed to the appliance.

                                                           (Any 5 x 1)   (5)

6.3   The purpose of circuit breakers and fuses is to:

- detect overcurrents or√
- short-circuit currents and to√
- disconnect the faulty equipment or circuit from the supply.√   (3)
[15]

QUESTION 7

7.1
- Mechanically strong√
- Durable√
- Resistive to moisture (non-hygroscopic)√
- Resistive to electrical current√
- Resistant to natural elements
- Possesses high dielectric strength, etc.   (Any 4 x 1)   (4)

7.2   *Stationary appliances* are appliances that are not easily moved√ or cannot be moved while in operation,√ e.g. a stove or a fridge.   (2)

7.3
- All single-phase switches, fuses and circuit breakers must have been connected in the phase conductor√
- The centre contact of Edison-screw lampholders must have been connected to the phase conductors√
- The phase terminals (L) in all single-phase socket outlets must have been connected to the phase conductors√

                                                           (3)

7.4   LEDs can be combined to make up displays to form numbers or letters.√   (1)
Or " It emits light"   **[10]**

QUESTION 8

8.1 C_T $= C_1 + C_2 + C_3$
$= 12 + 9 + 10\sqrt{}$
$= \underline{31 \text{ µF}}\sqrt{}$ (2)

8.2   Red = $2\sqrt{}$
Violet = $7\sqrt{}$
Orange = $X 10^3\sqrt{}$
Gold = ± 5% tolerance$\sqrt{}$

R = 27 000 Ω, ± 5% tolerance
$= \underline{27 \text{ kΩ}, ± 5\% \text{ tolerance}}\sqrt{}$
                                                                                            (5)
                                                                                            [7]

                                                                     TOTAL   100