higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MOTOR ELECTRICAL THEORY N2

(11040612)

31 August 2021 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

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

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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NATIONAL CERTIFICATE
MOTOR ELECTRICAL THEORY N2
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. Sketches must be large, neat and fully labelled.
5. Write neatly and legibly.

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QUESTION 1

1.1 Two parallel resistors of 15 Ω and 4 Ω are connected in series to a resistor with an unknown value. The potential difference across the complete circuit is 4 V.

Calculate the following:

1.1.1 The value of the parallel resistors (2)

1.1.2 The value of the unknown resistor when a total current of 0,5 A flows through the circuit (2)

1.1.3 The voltage across the parallel resistors (4)

1.1.4 The current flow through the 5-ohm resistor (2)

1.2 State THREE possible causes of burnt armature windings and field coil windings in a starter motor. (3)

1.3 What are THREE possible faults that may be present in a defective brush holder of a starter motor? (3)

1.4 Explain the purpose of the twisted spline found on the armature shaft of a starter motor. (3)

1.5 Draw the following fully labelled diagrams:

1.5.1 A conductor moving through a magnetic field between two fixed magnets. Show the direction of the rotation of the conductor and the direction of the magnetic field. (5)

1.5.2 TWO labelled cycles of the expected output for QUESTION 1.5.1 (4)
[28]

QUESTION 2

2.1 Draw a neat, labelled circuit diagram of a full-wave battery charger. Clearly show the alternating input and the direct current output. (8)

2.2 A conductor is 800 mm long and moves at right angles through a magnetic field with a density of 0,3 T (Tesla).

If the EMF generated by the conductor is 1,1 V, calculate the velocity of the moving conductor. (5)

2.3 Give TWO examples of electrical equipment in a motor vehicle that uses electromagnetic coils. (2)
[15]

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QUESTION 3

3.1 Give a reason for a diode short-circuit. (2)

3.2 Make a neat, labelled sketch showing the forward and reverse characteristics of a silicon diode. (4)

3.3 Name TWO semi-conductor materials. (2)

3.4 Doping of semi-conductor materials.

3.4.1 Explain the process of doping semi-conductor materials (2)

3.4.2 What type of elements are used to dope the semi-conductor materials in QUESTION 3.3 (2)

3.5 Draw a fully labelled diagram of a bridged rectification circuit using FOUR diodes. Clearly indicate the input and output signals. (4 × 2) (8)

[20]

QUESTION 4

4.1 Assume that a certain fault in the starting system caused the starter-motor drive to remain locked with the ring gears.

If the ratio of the starter-motor drive to the ring gear is 1:10, calculate the starter armature speed while the drive is locked in the ring gear at an engine speed of 1 000 r/min. (3)

4.2 Explain, step by step, how to set the dynamic ignition timing of an engine by using a stroboscopic timing light. (3)

4.3 Describe the construction of a starter-motor armature. (6)

[12]

QUESTION 5

5.1 By means of two sketches show the procedure to test an N.P.N. transistor using a multi-meter. (4)

5.2 Explain the purpose of a diode in a circuit. (2)

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5.3 Write out the abbreviations below for systems or components used in motor vehicles in full.

5.3.1 ABS (2)

5.3.2 CPS (2)

5.3.3 EMS (2)

5.3.4 EBD (2)

5.3.5 GPS (2)

5.3.6 EFI (3)

5.4 Name THREE types of transistor amplifiers. (3)

5.5 Name the use of each transistor referred to in QUESTION 5.4 (3)

[25]

TOTAL: 100

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MOTOR ELECTRICAL THEORY N2

FORMULA SHEET

1. $I = \frac{V}{R}(A)$

2. $P = I.V\ (W)$

3. $Rt = R_1 + R_2 + R_3 + \ldots R_n\ (\Omega)$

4. $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \frac{1}{R_n}\ (\Omega^{-1})$

5. $V = E - I.r\ (v)$

6. $E = B.\ell.v\ (V)$

7. $F = B.\ell.I\ (N)$

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