higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 3

(12041003)

7 November 2018 (X-Paper)
09:00–12:00

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

NCV

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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.

NC(V)

SECTION A

QUESTION 1

1.1 Define the term *energy.* (2)

1.2 What happens to an atom when it loses an electron from its outermost shell? (2)

1.3 Calculate the resistance of a copper conductor with a length of 5,75 km and a cross-sectional area of 10 mm^2. Take the resistivity of copper to be 0,0173 µΩ.m. (5)

1.4 Name TWO factors that a change in resistance caused by a rise in temperature depends on. (2)

1.5 Temperature coefficient is the effect that temperature has on the resistance of material.

1.5.1 State TWO materials that have a temperature coefficient of 0.

1.5.2 What effect will temperature have on materials in QUESTION 1.5.1?

(2 × 2) (4)

[15]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK.

2.1.1 An emf is induced whenever a conductor cuts or is being cut by the magnetic field.

2.1.2 The magnitude of the induced emf is indirectly proportional to the rate at which the magnetic flux passing through the coil is varied.

2.1.3 The direction of the induced emf depends on the direction of the field lines.

2.1.4 Reluctance is the strength of a magnetic field in a coil of wire.

2.1.5 The right-hand grip rule is used to identify the direction of force on a wire carrying a current through a magnetic field.

(5 × 1) (5)

2.2 Classify the TWO main groups of magnets (no description is needed). (2)

2.3 Define the *weber*. (2)

2.4 Magnetomotive force (mmf) is the strength of a magnetic field in a coil of wire.

2.4.1 State the TWO factors that influence mmf. (4)

2.4.2 What is the unit of mmf? (1)

2.5 TWO overhead conductors are supported 85 cm apart. The current flow in each of them is 300 A in the same direction.

2.5.1 Calculate the force between the two conductors. (4)

2.5.2 State whether the force in QUESTION 2.5.1 is attractive or repulsive. (2)

[20]

QUESTION 3

3.1 An unknown resistor (R_x) is connected in parallel with a 60 Ω resistor. This combination is then connected in series with a 30 Ω resistor. The supply to the whole circuit is 6V/0,12 A.

Draw the circuit diagram. (2)

3.2 With reference to the circuit diagram in QUESTION 3.1, calculate the following:

3.2.1 The total resistance of the circuit (2)

3.2.2 The resistance of the parallel network (2)

3.2.3 The value of the unknown resistor (3)

3.2.4 The voltage drop across the series resistor (2)

3.2.5 The power dissipated in the 60 Ω resistor (3)

3.3 List FOUR of the common causes of battery failure. (4)

3.4 Two capacitors of 6 µF (C_1) and 4 µF (C_2) are connected in parallel. This combination is then connected in series to a third capacitor of 12 µF (C_3). The complete circuit is connected to a 12 V DC supply.

Calculate:

3.4.1 The total capacitance (C_T).

3.4.2 The total charge (Q_T).

(2 × 3) (6)

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3.5 Joseph Henry discovered the electromagnetic phenomenon of self-inductance. He also discovered mutual inductance, independently of Michael Faraday.

Differentiate the following terms by providing the definition of each:

3.5.1 Self-inductance

3.5.2 Mutual inductance

(2 × 2) (4)

3.6 Briefly explain the function of a Buchholz relay as generally used in large oil-immersed transformers. (2)

[30]

QUESTION 4

4.1 The permanent magnet moving-coil instrument gives the most accurate DC measurements.

Describe the operation of this instrument. (3)

4.2 A moving-coil instrument with an internal resistance of 5 Ω gives full-scale deflection when 10 mA passes through it.

Calculate:

4.2.1 The value of a shunt resistor required to be used with the instrument to measure a current of 2 A.

4.2.3 The value of a series resistor required to be used with the instrument to measure the voltage up to 12 V.

(2 × 3) (6)

4.3 You are required to build a temporary series circuit on a breadboard using a battery of 12 V, one resistor and one lamp.

Describe in FOUR steps how to measure current using a multimeter. (4)

4.4 The multimeter in QUESTION 4.3 displays a value of 12 A.

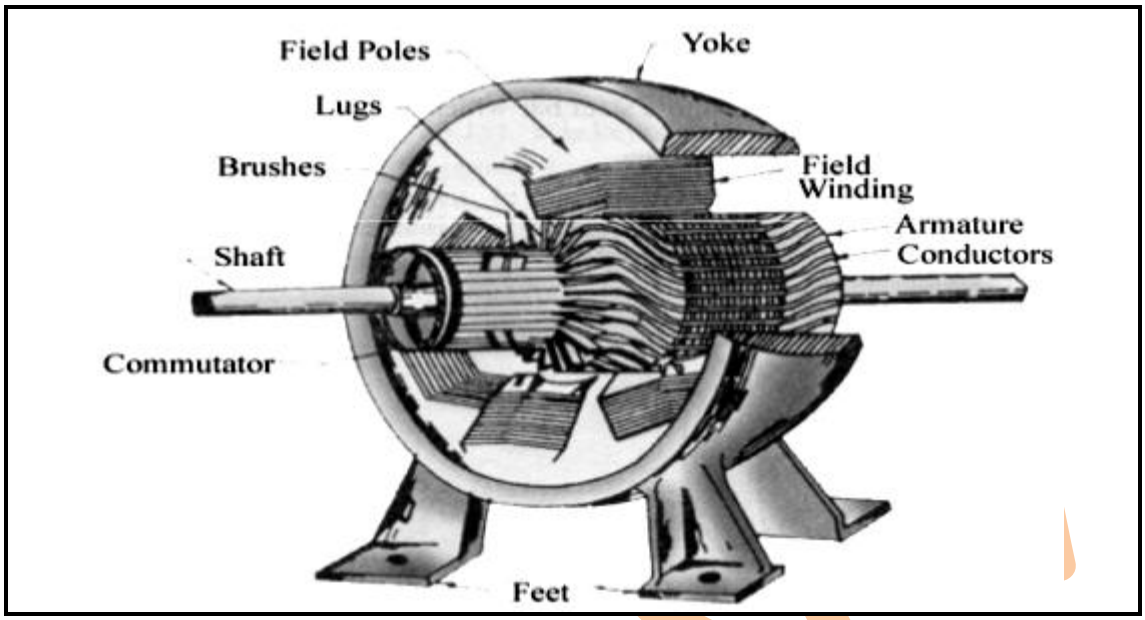
What is wrong with this value? (2)

[15]

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QUESTION 5

5.1



State TWO purposes of a yoke as used in the construction of a DC machine in the figure above. (4)

5.2 List FOUR methods used to improve commutation. (4)

5.3 List the FOUR main parts of a basic DC generator. (4)

5.4 Make a sketch of the load characteristic of a shunt generator. (3)

5.5 From the circuit in QUESTION 5.4, explain why there is a drop of the voltage at full load current. (2)

5.6 Copper losses occur due to currents in the various windings of the machine.

Name THREE parts where copper losses occur. (3)

[20]

TOTAL: 100

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ELECTRICAL PRINCIPLES AND PRACTICE L3

FORMULA SHEET

1. $Q = I\,t$
2. $I = \frac{Q}{t}$
3. $E = V + I\,r$
4. $V = I\,R$
5. $P = V\ I$
6. $E = Pt$
7. $\frac{R_1}{R_2} = \frac{1+\alpha t_1}{1+\alpha t_2}$
8. $R_t = R_0(1+\alpha t)$
9. $R_T = R_O[1+\alpha_0\,(t-\theta)]$
10. $R = \frac{\rho \ell}{A}$
11. $A = \frac{\pi d^2}{4}$
12. $A = \pi r^2$
13. $\beta = \frac{\phi}{A}$
14. $Mmf = N\,I$
15. $H = \frac{Mmf}{l}$
16. $F = B\,I\,l$
17. $E = B\,l\,v$
18. $F = 2\times10^{-7} \times \frac{I_1 I_2}{d}\ N/m$
19. $R_T = R_1 + R_2 + R_3$
20. $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
21. $R_T = \frac{R_1 \times R_2}{R_1 + R_2}$
22. $V_1 = \left(\frac{R_1}{R_t}\right) V_T$
23. $I_1 = \left(\frac{R_2}{R_1 + R_2}\right) I_T$
24. $I = \frac{Emf}{R_T + r_T}$
25. $E = \frac{1}{2}\ C\,V^2$
26. $C_T = C_1 + C_2 + C_3$
27. $C_T = \frac{C_1 \times C_2}{C_1 + C_2}$
28. $C = QV$
29. $E = -L\frac{\Delta\ I}{t}$
30. $L_T = L_1 + L_2 + L_3 \pm 2L_m$
31. $L = N\frac{\Delta\,\phi}{\Delta\,I}$
32. $P = V\ I\ Cos\phi$
33. $P = \sqrt{3}\ I_L\ V_L \cos\theta$
34. $S = VI$
35. $S = \sqrt{3}\ I_L\ V_L$
36. $KVA = \frac{V_1 I_1}{1000}$
37. $V_L = \sqrt{3}\,V\ p\,h$
38. $I_L = \sqrt{3}\ I_p$
39. $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$
40. $\eta = \frac{P_0}{P_{in}} \times 100$
41. $\tan\phi = \sqrt{3}\left(\frac{W_1 - W_2}{W_1 + W_2}\right)$
42. $E = V - I_a\,R_a$
43. $R_{sh} = \frac{I_m\,R_m}{I_{sh}}$
44. $E_{gen} = V + Ia\,Ra$
45. $R_{Se} = \frac{V_t}{I_t} - R_m$

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