higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2

(12041002)

8 December 2020 (X-paper)
09:00–12:00

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

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Please turn over

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 Define each of the following physical quantities:

1.1.1 Length

1.1.2 Electric current

1.1.3 Temperature

1.1.4 Mass

(4 × 1) (4)

1.2 State TWO rules regarding prefixes used with an SI unit of measurement. (2)

1.3 If a bus travels 20 km in 1 hour, calculate the speed of the bus in meters per second. (4)

[10]

QUESTION 2

2.1 Explain the following terms

2.1.1 Negative charge

2.1.2 Atom

2.1.3 Free electron

(3 × 1) (3)

2.2 Calculate the length of an aluminium conductor with a diameter of 10 mm and a resistance of 1,75 Ω. Take the resistivity of an aluminium conductor to be 0,026 $\mu\Omega$.m. (4)

2.3 An electric iron with a power rating of 1 kW is connected across a 220 V supply.

Calculate the following:

2.3.1 The current drawn by the iron (2)

2.3.2 The resistance of the heating element (2)

2.3.3 The energy consumed by the iron in 30 minutes. Express the answer in MJ. (3)

2.4 State Joule's law. (2)

2.5 Explain the following concepts:

2.5.1 Electron flow

2.5.2 Magnetic flux density

(2 × 2) (4)

2.6 Draw the waveform of a sinusoidal voltage with an amplitude of 12 V and a frequency of 50 Hz. Show the complete cycle. (3)

2.7 Explain TWO requirements when sketching magnetic field lines. (2)

[25]

QUESTION 3

3.1 Study the circuit diagram in FIGURE 1 and answer the questions.

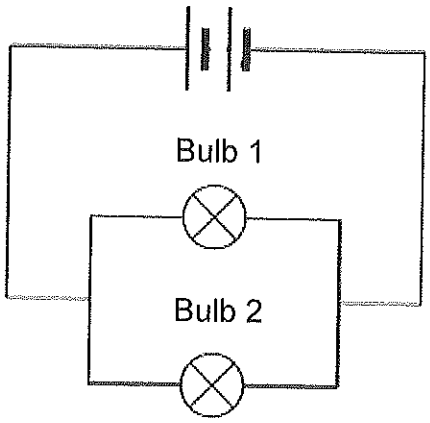


FIGURE 1

3.1.1 What happens to the potential difference of the circuit if bulb 1 blows? (2)

3.1.2 If bulb 1 is replaced with a working bulb what happens to the total current? (2)

3.2 THREE cells, each with an emf of 2,5 V and an internal resistance of 0,3 Ω, are connected in series and across an 18 Ω resistor.

Calculate each of the following:

3.2.1 Current flowing through circuit (4)

3.2.2 Potential difference across the 18 Ω resistor (2)

3.3 TWO resistors of 15 Ω and 22 Ω respectively are connected in parallel and this combination is connected in series with a 33 Ω resistor across a 9 V battery.

Calculate each of the following:

3.3.1 Total resistance of circuit (3)

3.3.2 Total current (2)

3.3.3 Voltage drop across parallel branch (2)

3.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.4.1–3.4.5) in the ANSWER BOOK.

3.4.1 The core of a transformer consists of laminated sheets which are insulated from one another.

3.4.2 An autotransformer is used to increase voltage when starting an induction motor.

3.4.3 Oil cooling is used in small transformers only.

3.4.4 In an ideal transformer the losses are disregarded.

3.4.5 Eddy currents occur in a piece of metal when the magnetic field around it changes. (5 × 1) (5)

3.5 A step-up transformer has a turns ratio of 5:12 and draws a current of 3 A from the supply.

Determine the secondary current. (3)
[25]

QUESTION 4

4.1 Define *earthing* with reference to electrical appliances and installations. (3)

4.2 NameTWO precautionary measures you will take when using an insulation tester. (2)

4.3 Explain the operation of an attraction-type moving-iron instrument. (3)

4.4 Describe step by step how would you measure current in a DC circuit with at least a load (resistor or diode), and a supply, using a multimeter. (7)
[15]

QUESTION 5

5.1 Draw the electrical wiring symbols for the following components:

5.1.1 Fuse

5.1.2 Electric Motor

5.1.3 Electric Bell

(3 × 1) (3)

5.2 Draw a neat and fully labelled circuit diagram of a stove subcircuit. Include an isolator in the drawing.

(6)

5.3 State the conductor and circuit breaker sizes for each of the following electrical subcircuits by writing only the answer next to the question number (5.3.1–5.3.6) in the ANSWER BOOK.

ELECTRICAL SUBCIRCUIT	CONDUCTOR SIZE	CIRCUIT BREAKER SIZE
Geyser	5.3.1	5.3.2
Stove	5.3.3	5.3.4
Socket outlet	5.3.5	5.3.6

(6 × 1) (6)

[15]

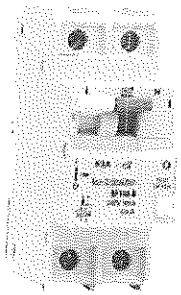
QUESTION 6

6.1 Describe the principle of operation of a lightning arrestor.

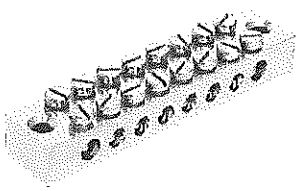
(4)

6.2 Identify the electrical components below found in a distribution board. Write only the answer next to the question number (6.2.1–6.2.3) in the ANSWER BOOK.

6.2.1



6.2.2



6.2.3

(3 × 1) (3)

6.3 Briefly explain the principle of operation of a lead-acid cell during the discharge process. (3)
[10]

TOTAL 100

ELECTRICAL PRINCIPLES AND PRACTICE L2

FORMULA SHEET

1. $v = \frac{d}{t}$

2. $\bar{v} = \frac{d}{t}$

3. $a = \frac{\Delta v}{\Delta t}$

4. $F = m \times a$

5. $W = m \times g$

6. $w = F \times s$

7. $\tau = F \times r$

8. $\rho = \frac{m}{v}$

9. $P = \frac{F}{A}$

10. $E = V + Ir$

11. $V = IR$

12. $P = VI$

13. $P = I^2R$

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

15. $E = P \times t$

16. $R = \frac{\rho \ell}{A}$

17. $A = \pi r^2$

18. $A = \frac{\pi D^2}{4}$

19. $R_T = R_0(1 + \alpha_0 T)$

20. $t = \frac{1}{f}$

21. $\beta = \frac{\phi}{A}$

22. $mmf = NI$

23. $H = \frac{mmf}{\ell}$

24. $H = \frac{NI}{\ell}$

25. $F = \beta I \ell$

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

27. $S = V_1 I_1 = V_2 I_2$

28. $R_T = R_1 + R_2 + R_3 + \cdots$

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

30. $R_T = \frac{R_1 \times R_2}{R_1 + R_2}$

31. $I_T = I_1 = I_2 = I_3 = \cdots$

32. $I_T = I_1 + I_2 + I_3 + \cdots$

33. $I_T = \frac{V_T}{R_T}$

34. $V_T = V_1 = V_2 = V_3 = \cdots$

35. $V_T = V_1 + V_2 = V_3 + \cdots$

36. $V_T = I_T \times R_T$

37. $V = E - Ir$

38. $Q = I^2Rt$

39. $R_{sh} \frac{I_m \times R_m}{I - I_m}$

40. $I_{sh} = I - I_m$

41. $R_{se} = \frac{V}{I} - R_m$