higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE (VOCATIONAL)

# ELECTRICAL PRINCIPLES AND PRACTICE
## NQF LEVEL 2

(12041002)

**21 November 2023 (Y-paper)**
**13:00–16:00**

**This question paper consists of 6 pages and a 1-page formula sheet.**

199Q1N2321

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2
TIME: 3 HOURS
MARKS: 100

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**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. Start each section on a new page.
5. Use only a blue or black pen.
6. Round off your answers to TWO decimal places.
7. Write neatly and legibly.

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## QUESTION 1

1.1 Give the SI base units for the following the physical quantities:

1.1.1 Amount of a substance

1.1.2 Temperature

1.1.3 Length

1.1.4 Time

1.1.5 Mass

(5 × 1) (5)

1.2 Define *steradian* as it applies to plane and solid angles. (2)

1.3 Name the following prefixes that are commonly used in engineering:

1.3.1 $\times 10^{-6}$

1.3.2 $\times 10^{-9}$

1.3.3 $\times 10^{12}$

(3 × 1) (3)

**[10]**

## QUESTION 2

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

2.1.1 An atom consists of electrons and protons only.

2.1.2 The electrons orbiting in the outer shell are called valence electrons.

2.1.3 A conductor is a material that blocks the flow of current in a circuit.

2.1.4 Electromotive force is measured over an open circuit and its value is always less than the potential difference.

2.1.5 Conductivity is a measure of a material's ability to carry electrical voltage.

(5 × 1) (5)

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2.2 The resistance of an aluminium conductor at 0 ºC is 15 Ω. Calculate the resistance of the conductor at a temperature of 50 ºC. The temperature coefficient of aluminium at 0 °C is 0,0038/ºC. (3)

2.3 State Ohm's law. (3)

2.4 An electric kettle with a power rating of 3 kW is connected across a 220 V, 50 Hz supply.

Determine the following quantities:

2.4.1 The current drawn by the kettle.

2.4.2 The resistance of the heating element.

2.4.3 Electrical energy consumed in one hour.

(3 × 2) (6)

2.5 Name TWO types of conductors used in the electrical industry. (2)

2.6 Differentiate between *direct current* and *alternating current.* (2)

2.7 Discuss Fleming's left-hand rule. (4)

**[25]**

## QUESTION 3

3.1 Two 2,4 V cells, each with an internal resistance of 1,2 Ω, are connected in series across a 15-Ω resistor.

Calculate the following:

3.1.1 The total internal resistance of the battery. (1)

3.1.2 The total resistance of the circuit. (1)

3.1.3 The total emf. (1)

3.1.4 The current flowing through the circuit. (3)

3.1.5 The voltage drop across the 15-Ω resistor (2)

3.2 State THREE advantages of load balancing. (3)

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3.3 An installation has a three-phase, four-wire system, 220/380 V, 50 Hz supply. You have to distribute the following loads among the three phases.

- 9 × heaters of 1 050 W each (H)
- 3 × floodlights of 200 W each (FL)
- 15 × light fittings of 60 W each (LF)

3.3.1 Calculate the possible load per phase. (6)

3.3.2 Show by means of a table how you would spread the load evenly among the three phases.

| Red | White | Blue |
|---|---|---|
| | | |

(3)

3.4 Explain the operational principle of a single-phase transformer operating on no-load. (5)

**[25]**

## QUESTION 4

4.1 Choose a word from COLUMN B that matches the description in COLUMN A. Write only the letter (A–F) next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

| COLUMN A | | COLUMN B | |
|---|---|---|---|
| 4.1.1 | Current resulting from an insulation failure or bridging insulation | A | earthing arrangement |
| 4.1.2 | Fault current that flows to earth | B | earthed |
| 4.1.3 | All electric connections and devices involved in the earthing of a system, an installation and equipment | C | earthing terminal |
| | | D | earth electrode |
| 4.1.4 | So connected to the mass of earth to ensure, at all times, an immediate discharge of electrical energy without danger | E | earth fault current |
| | | F | fault current |
| 4.1.5 | One or more conductive parts that are embedded in the earth for the purpose of making effective electrical contact with the general mass of the earth | | |

(5 × 1) (5)

4.2 Name FIVE parts that require earthing according to the SABS code of practice. (5)

4.3 List any TWO types of earth electrodes. (2)

4.4 Explain the operation of an attraction-type moving-iron instrument. (3)
**[15]**

## QUESTION 5

5.1 Compile a parts list for the circuit diagram shown below: (5)

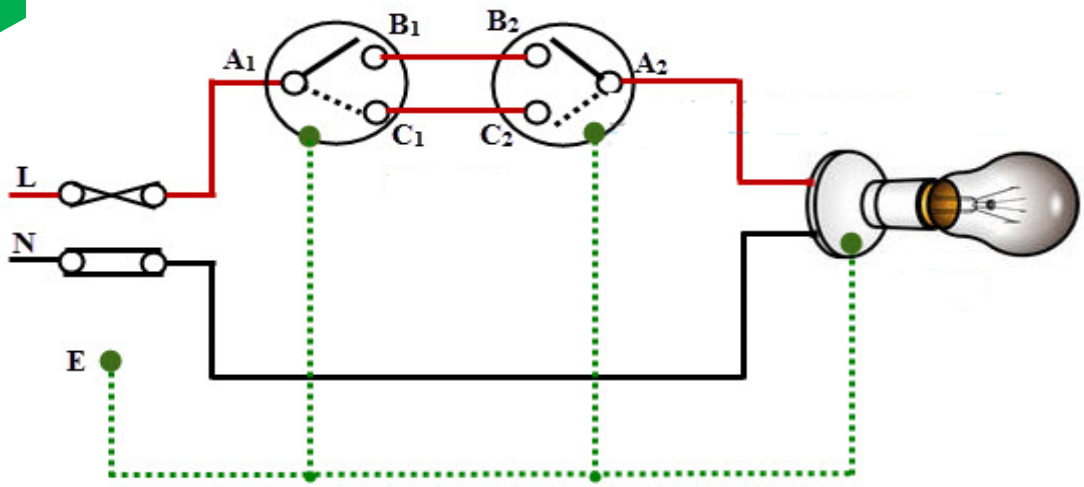



**FIGURE 1**

5.2 Name and explain THREE common types of diagrams that one will encounter in the field of electricity. (6)

5.3 Draw a circuit diagram to show how two socket outlets can be supplied from one circuit breaker. (4)
**[15]**

## QUESTION 6

6.1 List THREE properties of annealed copper. (3)

6.2 Name FOUR protective devices that are found in any type of installation and will guarantee the safety of people, circuits and equipment. (4)

6.3 Lead acid batteries contain corrosive battery electrolyte and generate highly flammable hydrogen gas.

List THREE aspects of caring for and maintaining lead acid batteries. (3)
**[10]**

**TOTAL: 100**

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(12041002)

## FORMULAE SHEET

## ELECTRICAL PRINCIPLES AND PRACTICE L2

1. $E = V + Ir$
2. $R_t = R_0(1 + \alpha T)$
3. $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$
4. $R_T = R_1 + R_2 + R_3 + \cdots$
5. $V = I.R$
6. $I_T = \frac{V_T}{R_T}$
7. $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_1}{I_2}$
8. $R = \frac{\rho l}{A}$
9. $emf_T = emf_1 + emf_2 + emf_3$
10. $emf_T = emf_1 = emf_2 = emf_3 = \cdots$
11. $r_T = r_1 + r_2 + r_3$
12. $\frac{1}{r_T} = \frac{1}{r_1} = \frac{1}{r_2} + \frac{1}{r_3}$
13. $I_T = \frac{emf_T}{R_T + r_T}$
14. $v = d/t$
15. $\overline{v} = \Delta s/\Delta t$
16. $v = \Delta s/\Delta t$
17. $F = m \times a$
18. $W = m \times g$
19. $w = F \times s$
20. $\tau = F \times r$
21. $\rho = \frac{m}{V}$
22. $P = E/t$
23. $B = \frac{\Phi}{A}$
24. $H = \frac{mmf}{l}$
25. $V_T = I_T R_{se} + I_T R_m$

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