higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2

(12041002)

7 November 2017 (X-Paper)
09:00–12:00

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

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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.

QUESTION 1

1.1 There are seven SI base units in the International System of Units.

Give the basic SI units of each of the following physical quantities:

1.1.1 Electric current

1.1.2 Mass

1.1.3 Time

(3 × 1) (3)

1.2 Complete TABLE 1 below by writing down only the answer next to the question number (1.2.1 – 1.2.3) in the answer book.

Prefix	Symbol	Multiplying factor	Scientific notation
1.2.1	G	1 000 000 000	10^9
Kilo	k	1 000	1.2.2
1.2.3	µ	0,000 001	10^{-6}

TABLE 1

(3 × 1) (3)

1.3 Convert $4{,}95 \times 10^{-4}$ to decimal notation. (1)

1.4 Calculate the force required to move a 900g object with an acceleration of 5 m/s^2. (2)

1.5 What physical quantity is measured in metre per second (m/s)? (1)

[10]

QUESTION 2

2.1 Electric current is a flow of electrons through a conductor.

Briefly explain the term *conventional current flow*. (2)

2.2 A load having a resistance of 30 Ω is connected across a 240 V supply.

Calculate the following:

2.2.1 The value of the current flowing through the load

2.2.2 The energy consumed after TWO hours in MJ

(2 × 2) (4)

2.3 Calculate the length of a copper conductor having a resistance of 5 Ω and a diameter of 3 mm. Take the resistivity of the copper as 0, 0173 µΩm. (4)

2.4 The resistance of a coil of copper wire at 0 °C is 50 Ω. Take the temperature coefficient of resistance of copper wire at 0 °C to be $4,3 \times 10^{-3}$/°C.

Calculate the resistance of the coil at 70 °C. (4)

2.5 Sketch a sinusoidal waveform on a XY axis and clearly show the following:

- Average value
- RMS value
- Peak value
- Peak-to-peak value
- Periodic time (5)

2.6 Briefly explain each of the following concepts and give the unit in which they are measured:

2.6.1 Magnetic flux

2.6.2 Magnetic flux density

2.6.3 Magnetomotive force

(3 × 2) (6)
[25]

QUESTION 3

3.1 Three cells, each with an emf of 1,5 V and an internal resistance of 0,2 Ω, are connected in series across a 12 Ω resistor.

Calculate the following:

3.1.1 The total emf of the battery (1)

3.1.2 The total internal resistance of the battery (1)

3.1.3 The total current flowing through the circuit (2)

3.1.4 The potential difference across the 12 Ω resistor (2)

3.2 Two resistors with values of 2 Ω and 4 Ω are connected in series. This series combination is then connected in parallel with a 3 Ω resistor across a 12 V supply.

Calculate the following:

3.2.1 The total resistance of the circuit (3)

3.2.2 The total current in the circuit (I_T). (2)

3.2.3 The magnitude of the current flowing through the 3 Ω resistor. (2)

3.2.4 The volt drop across the 4Ω resistor ($V_{4\Omega}$). (2)

3.3 When connecting single-phase loads to a three-phase supply, the electrician must ensure that these loads are equally distributed among the three phases.

Give TWO advantages of load balancing. (2)

3.4 An ideal transformer with a voltage ratio of 2 760/230 volts has 300 primary turns.

Calculate the following:

3.4.1 The turns ratio (2)

3.4.2 The number of secondary turns (3)

3.4.3 The primary current when the transformer delivers a secondary current of 15 A at 230 volts (3)

[25]

QUESTION 4

4.1 The purpose of earthing is to ensure an immediate discharge of leakage currents to earth.

List FIVE devices and systems that require earthing according to the SABS Code of Practice (SANS 10142). (5)

4.2 Briefly explain the principle of operation of a moving-iron, repulsion-type instrument. (3)

4.3 State how the following measuring instruments are connected in low-voltage circuits:

4.3.1 Frequency meter

4.3.2 Ammeter

4.3.3 Voltmeter

4.3.4 Ohmmeter

(4 × 1) (4)

4.4 State THREE safety precautions to consider when using a clamp meter / tong tester. (3)

[15]

QUESTION 5

5.1 An alarm circuit is about to be installed in a domestic installation. The circuit will be supplied from a 220 V single-phase surface mount (NOT flush mounted) socket outlet.

Compile a parts list with ratings needed for the installation of this socket outlet circuit. The list must satisfy the requirements of the SABS Code of Practice (SANS 10142). (8)

5.2 Draw a neat, labelled circuit diagram of a geyser subcircuit that conforms to standard practice. (5)

5.3 List TWO requirements of a typical electrical circuit diagram. (2)

[15]

QUESTION 6

6.1 Copy TABLE 2 below in the ANSWER BOOK. Complete the table by stating ONE *property* and ONE *application* of the listed insulators.

Insulator	Properties	Application
Mica	6.1.1	6.1.2
Oil-impregnated paper	6.1.3	6.1.4
Porcelain	6.1.5	6.1.6

TABLE 2

(6 × 1) (6)

6.2 Briefly describe the operation of a core-balanced single-phase earth leakage relay. (4)

[10]

TOTAL: 100

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	$\mathrm{P} = \frac{F}{A}$
10	$E = V + Ir$	11	$V = IR$	12	$P = VI$
13	$P = I^2 R$	14	$P = \frac{V^2}{R}$	15	$\mathrm{E} = P \times t$
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	$R_T = R_1 + R_2 + R_3$	29	$\frac{1}{R_T} = \frac{1}{R_1} = \frac{1}{R_2} = \frac{1}{R_3}$	30	$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$
31	$I_T = I_1 = I_2 = I_3$	32	$I_T = I_1 + I_2 + I_3$	33	$I_T = \frac{V_T}{R_T} R$
34	$V_T = V_1 + V_2 + V_3$	35	$V_T = V_1 = V_2 = V_3$	36	$V_T = I_T R_T$
37	$E = V + Ir$	38	$P = VI$	39	$Q = I^2 Rt$
40	$R_{sh} = \frac{I_m R_m}{I_{sh}}$	41	$V_m = I_m R_m$	42	$R_{se} = \frac{V}{I} - R_m$