higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2

NOVEMBER EXAMINATION

(12041002)

2 November 2016 (X-Paper)
09:00–12:00

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

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 Apply the rules of scientific notation to calculate the following:

1.1.1 $(4{,}5 \times 10^{7}) \times (2 \times 10^{13})$

1.1.2 $(7{,}5 \times 10^{99}) \times (3 \times 10^{19})$

(2 × 2) (4)

1.2 Define the following terms:

1.2.1 Ampere (4)

1.2.2 Radian (2)

[10]

QUESTION 2

2.1 Define Ohm's law and also give the mathematical equation describing this law. (4)

2.2 2.2.1 Explain the concept *electromotive force.* (2)

2.2.2 Briefly explain the difference between *conventional current flow* and *electron current flow*. (4)

2.3 Calculate the resistance of a copper conductor with a length of 1,5 km and a cross-sectional area of 10×10^{-6} m^2. Take the resistivity of copper to be 0,0173 µΩm. (4)

2.4 Give FOUR advantages of alternating current (AC) as preferred to direct current (DC). (4)

2.5 2.5.1 State FOUR requirements for sketching magnetic lines. (4)

2.5.2 Explain how you would use the right-hand grip rule to identify the poles of a magnetic field. (3)

[25]

QUESTION 3

3.1 Two resistors of 2 Ω and 6 Ω are connected in parallel. This parallel combination is then connected in series with two other resistors of 1,5 Ω and 3 Ω. The circuit is connected across a 12 V DC supply.

3.1.1 Draw the circuit diagram (1)

3.1.2 Calculate the total resistance of the circuit (3)

3.1.3 Calculate the total current of the circuit (2)

3.1.4 Will there still be current flowing through the circuit if the 6 Ω resistor is blown? Give a reason for your answer. (2)

3.1.5 What will happen to the voltage drop across the resistors in the circuit if the 6 Ω resistor is short-circuited? Give a reason for your answer. (2)

3.2 Give TWO advantages of load-balancing. (2)

3.3 Show by means of a neat sketch how you would balance the following loads across a three-phase, four-wire system, 230/400 V, 50 Hz:

3.3.1 Single-phase circuit

- 6 × socket outlets

3.3.2 Three-phase circuit

- 3 × socket outlets

(8)

3.4 A transformer with 250 turns on the primary side and 25 turns on the secondary side draws a current of 0,5 A from a 230 V supply.

Calculate:

3.4.1 Secondary current (3)

3.4.2 Power rating of the transformer (2)

[25]

QUESTION 4

4.1 Measuring instruments can either be digital or analogue.

Give THREE advantages of digital meters compared to analogue meters. (3)

4.2 Earthing ensures the safety of persons or an installation.

State THREE devices that require earthing according to the SABS code of practice SANS 10142-1:2006. (3)

4.3 A measuring instrument is a device used for measuring a physical quantity.

Briefly explain the principle of operation of a moving coil instrument. (3)

4.4 Explain how you would eliminate a parallax error when reading an analogue meter. (3)

4.5 Indicate how the following electrical test instruments are practically inserted into electrical circuits in relation to the load:

4.5.1 Ammeter

4.5.2 Voltmeter

4.5.3 Frequency meter

(3 × 1) (3)
[15]

QUESTION 5

5.1 5.1.1 Draw a fully labelled circuit diagram using the correct electrical symbols for one luminaire controlled from two switches. (4)

5.1.2 Compile a parts list for the circuit in QUESTION 5.1.1 of at least FOUR parts that include component ratings. (4)

5.2 All domestic installation's sub-circuits are protected by circuit-breakers.

State the size of the circuit-breakers used to protect the following circuits:

5.2.1 Lights

5.2.2 Socket outlets

5.2.3 Geyser

5.2.4 Stove

(4 × 1) (4)

5.3 Draw the IEC electrical symbols for the following:

5.3.1 Transformer

5.3.2 Single-pole single throw switch

5.3.3 DC motor

(3 × 1) (3)
[15]

QUESTION 6

6.1 A thermostat is used to control the operating temperature of an oven.

Make a neat fully labelled wiring diagram to show how this is done. (6)

6.2 DC sources are divided into two main types of cells:

6.2.1 Give TWO examples of primary cells.

6.2.2 Give TWO examples of secondary cells.

(2 × 2) (4)
[10]

TOTAL: 100

ELECTRICAL PRINCIPLES AND PRACTICE

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