higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2

(12041002)

8 November 2018 (X-Paper)
09:00–12:00

This question paper consists of 7 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. ALL final answers must be accurately approximated to TWO decimals.
5. Write neatly and legibly.

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QUESTION 1

1.1 Mass is a scalar quantity.

Define *mass.* (2)

1.2 Certain quantities are either too large or too small and are therefore best described by a prefix.

Complete the table below by naming the following prefixes.

PREFIX NAME	PREFIX SYMBOL	MEANING
1.2.1	k	x 10^{3}
1.2.2	n	x 10^{-9}
1.2.3	M	x 10^{6}
1.2.4	G	x 10^{9}
1.2.5	p	x 10^{-12}

(5 × 1) (5)

1.3 The tip of a steel rod is pressed against someone's skin with unknown force.

Calculate the density of the needle if it has a mass of 0,2 kg and occupies a volume of 0,6 m^3. (3)

[10]

QUESTION 2

2.1 A platinum resistance thermometer uses the change in resistance to measure temperature. Suppose $R_0 =$ 50 Ω at $T_0 = 20\ ^{\circ}C$ $R_O = 50\,\Omega$. The coefficient of expansion is 3,92 × 10^{-3} per degree Celsius within this temperature range. Calculate the resistance when $T = 50\ ^{\circ}C$. (4)

2.2 Alternating currents and voltages are represented by sinusoidal waves.

Sketch the sine wave form of an alternating voltage and clearly show its amplitude and frequency. (4)

2.3 Electrical consumers could request either a single-phase or three-phase supply from the supply authority.

State the common voltages associated with these supply systems. (2)

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2.4 Three-phase systems have many advantages compared to single-phase systems.

Name any THREE such advantages. (3)

2.5 A magnet is a material or object that produces a magnetic field.

State what is meant by the following terms associated with magnetism:

2.5.1 Magnetic poles

2.5.2 Magnetic flux density

2.5.3 Magnetic field strength

(3 × 2) (6)

2.6 When sketching the lines of magnetic fields, there are some requirements that must be taken into consideration.

Explain THREE of these requirements. (3)

2.7 The magnetic field is the area around a magnet in which objects are affected by magnetic forces.

Make a neat sketch to show the magnetic field lines around a bar magnet. (3)

[25]

QUESTION 3

3.1 Complete the following sentences by filling the missing word(s). Write only the word(s) next to the question number (3.1.1–3.1.3) in the ANSWER BOOK.

3.1.1 When resistors are connected in series, their total resistance is …

3.1.2 The sum of the voltage drops across each of these series connected resistors is …

3.1.3 The currents through three series connected resistors are …

(3 × 1) (3)

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3.2 An electrical circuit contains 12 cells each with an open circuit voltage of 1,5 V. The cells are grouped as follows:

- FOUR cells in series with each other.
- THREE such groupings in parallel with each other.

If the total current flowing through the circuit is 3 A with a 0,8 Ω resistor connected across the terminals of the battery, calculate:

3.2.1 The total EMF of the battery

3.2.2 The total internal resistance of the battery

3.2.3 The internal resistance of each cell

(3 × 3) (9)

3.3 Two resistors with resistances of 3 Ω and 6 Ω, respectively are connected in parallel across a battery with a potential difference of 12 V.

Calculate the following:

3.3.1 The total resistance of the circuit

3.3.2 The current flowing through the 3 Ω resistor

(2 × 2) (4)

3.4 The wiring code of practice requires that the load be balanced across the three phases of a three-phase supply.

State THREE advantages of load balancing in a three-phase system. (3)

3.5 Transformers are used to either step up or step down alternating voltages.

Briefly explain the operation of a single-phase transformer. (3)

3.6 A single phase transformer with 300 turns on the primary side and 30 turns on the secondary side draws a current of 0,2 A from a 250 V supply.

Calculate the transformers' secondary current. (3)

[25]

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QUESTION 4

4.1 The code of practice requires that all exposed conductive parts of an installation be earthed.

State what *earthing* means. (2)

4.2 Give THREE reasons why proper earthing is important in electrical installations. (3)

4.3 Measuring instruments can be classified as digital or analogue instruments.

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

4.4 There are mainly two types of moving iron type instruments: attraction type and repulsion type instruments.

Briefly explain the operation of an attraction type instrument. (4)

4.5 Electrical instruments measure the various electrical quantities such as voltage, current, power, etc.

Name THREE basic precautions to be taken when using measuring and testing instruments. (3)
[15]

QUESTION 5

5.1 In the electrical sector, circuit diagrams are very important.

Draw a simple light circuit diagram to show how TWO luminaires are controlled by a single switch. (4)

5.2 Compile a parts list of the circuit drawn in QUESTION 5.1 above. (3)

5.3 Make a neat sketch to show the wiring diagram of a stove circuit.

NOTE: Your sketch must include a double pole isolator. (6)

5.4 When drawing electrical circuit diagrams you need to know certain important requirements.

Name TWO of these requirements. (2)
[15]

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QUESTION 6

6.1 Materials commonly used in the electrical industry can be classified as conductors or insulators and they have specific properties.

Copy and complete the following table below:

TYPE OF MATERIAL	PROPERTIES	CONDUCTOR OR INSULATOR	APPLICATION
Tin	6.1.1	6.1.2	6.1.3
Aluminium	6.1.4	6.1.5	6.1.6

(6 × 1) (6)

6.2 Batteries are an important source of direct current.

State FOUR safety precautions to be taken into account when maintaining a lead-acid battery. (4)

[10]

TOTAL: 100

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

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