higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL SYSTEMS AND CONSTRUCTION
NQF LEVEL 4

(12041034)

28 November 2023 (X-paper)
09:00–12:00

This question paper consists of 7 pages.

Copyright reserved

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
ELECTRICAL SYSTEMS AND CONSTRUCTION
NQF LEVEL 4
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. Use only a black or blue pen.
5. Write neatly and legibly.

Copyright reserved

QUESTION 1

1.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1.1–1.1.10) in the ANSWER BOOK.

1.1.1 The main function of porcelain insulator strings in a busbar of a substation is to prevent short circuits.

1.1.2 Bushings of a power transformer is a hollow electrical conductor that allows electricity to pass safely.

1.1.3 A Buchholz relay in a power transformer is used to detect faults inside the transformer.

1.1.4 A substation has a backup supply of batteries used for communication and control systems in cases of power cuts.

1.1.5 A capacitor bank in a substation is used to protect a substation against lightning.

1.1.6 Crushing the coal in a pulveriser will minimise the percentage of the ash to the ash hopper.

1.1.7 Flue gas stack in a coal-fired power station is used to change wet steam into a liquid.

1.1.8 Steam turbines in a power station are coupled to the generator.

1.1.9 An economiser in a power station recovers some of the heat from the flue gases leaving through the chimney.

1.1.10 A surface condenser is a mechanical device that removes dissolved gasses from boiler feed water.

(10 × 1) (10)

1.2 Draw a labelled circuit diagram of an indirect dry cooling system. (6)

1.3 List FOUR types of insulators used on medium voltage overhead networks. (4)

[20]

QUESTION 2

2.1 Draw the IEC symbols for the following components:

2.1.1 Three-phase contactor

2.1.2 Normally closed thermal switch

2.1.3 Potentiometer

2.1.4 Variable inductor

2.1.5 Step down transformer

2.1.6 Normally open limit switch

(6 × 1) (6)

2.2 Wiring or schematic diagrams are normally used with motor control.

Explain what you understand by a wiring diagram. (4)

2.3 Discuss the importance of barricading the worksite with the following signage:



(2)

2.4 At the completion of any electrical installation a signed certificate of compliance (CoC) must be issued as per the Occupational Health and Safety Act.

2.4.1 Who must sign the CoC? (1)

2.4.2 Name TWO important functions, that the person listed in QUESTION 2.4.1 above, must perform before signing off the CoC. (2)

[15]

QUESTION 3

3.1 Name and explain the statutory requirements regarding the following:

3.1.1 Safety of workers in a workplace

3.1.2 Medium power grids (wires) in provinces

(3 × 2) (6)

3.2 With regards to overhead lines, explain how the height of the poles affect their spacing. (2)

3.3 Commissioning is a very important activity concerning electrical installations.

3.3.1 Explain why commissioning tests are done.

3.3.2 State what happens after the commissioning tests are done.

(2 × 2) (4)

Copyright reserved

3.4 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–D) next to the question number (3.4.1–3.4.3) in the ANSWER BOOK.

COLUMN A		COLUMN B
3.4.1	Soils are dry and loose cohesionless soils, or very soft to soft cohesive soils.	A Type 1 soils
3.4.2	Soil that is permanently under the water table and to permeable soils in low-lying areas.	B Type 2 soils C Type 3 soils D Type 4 soils
3.4.3	Soils which are quite dense and consistent in terms of strength and toughness.	

(3 x 1) (3)

[15]

QUESTION 4

4.1 An electrical floor plan is a kind of architectural plan showing the location and type of electrical devices. Name FOUR such devices. (4)

4.2 Wireways are used during the wiring of an installation.

4.2.1 Explain according to SANS 10142-1 what you understand by a wireway.

4.2.2 List THREE different forms of wireways.

(3 × 2) (6)

4.3 Complete the following table by writing only the answer next to the question number (4.3.1 – 4.3.5) in the ANSWER BOOK.

CLASSIFICATION	VOLTAGE RANGE [V]
Ultra-high voltage	4.3.1
4.3.2	Between 230 kV and 800 kV
4.3.3	Below 1000 V
High voltage	4.3.4
Medium voltage	4.3.5

(5 × 1) (5)

4.4 Explain the purpose of risk analysis. (1)

4.5 A common approach to risk analysis involves certain steps.

List the FOUR basic steps. (4)

[20]

Copyright reserved

QUESTION 5

5.1 Maintenance is an ongoing process which includes the gathering of information on how maintenance itself is working.

List FIVE aspects that you or your employer will include in the maintenance record book. (5)

5.2 Maintaining three-phase systems requires that planning procedures be followed and one of them is that observation must take place regularly.

List FOUR aspects that one should check for during observation. (4)

5.3 List TWO visible signs that will indicate a burnt-out motor. (2)

5.4 Explain high series resistance with respect to a defective splice on a cable. (3)

5.5 Different tools and techniques are used to locate underground cable faults.

State ONE advantage of using the *thumper test* on fault-tracing. (1)

[15]

QUESTION 6

6.1 A training centre wants to determine their estimated monthly bill. Study the table of the electricity usage given below, and answer the question that follows:

APPLIANCE	QUANTITY	POWER USAGE	HOURS IN USE PER DAY
Lights	8	20 W per light	8
Computers	4	150 W per computer	8
CNC machines	6	1500 W per machine	6

Calculate:

6.1.1 The number of units of energy consumed by each load per day. (3)

6.1.2 The total number of units of energy consumed by all loads per day. (1)

6.1.3 The cost of electrical energy consumed per month if a unit of energy costs R2,80 and there are 30 days in the month. (2)

6.2 Explain the following terms regarding the sizing of batteries in a solar system:

6.2.1 Electrical usage

6.2.2 BDD

6.2.3 Days of autonomy

(3 × 1) (3)

Copyright reserved

6.3 Shadows and dirt affect solar array performance.

6.3.1 Briefly explain how shadows and dirt affect the functioning of solar panels.

6.3.2 What is the function of the bypassing diodes in solar panels?

(2 × 2) (4)

6.4 There are system losses present in solar and wind powered electrical systems, which include component losses, stray losses, and copper losses.

Name any TWO components that contribute to component losses. (2)

[15]

TOTAL: 100

Copyright reserved