higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

SPECIALISED ELECTRICAL INSTALLATION CODES

(Second Paper)

(8080644)

21 November 2019 (X-paper)
09:00–12:00

This question paper consists of 8 pages and 3 information sheets.

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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. Start each section on a new page.
5. Use only a blue or black pen.
6. Write neatly and legibly.

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QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY ACT (ACT 85 OF 1993)

1.1 Define the following terms with regard to the above act:

1.1.1 Plant

1.1.2 Premises

1.1.3 Safe

1.1.4 Hazard

1.1.5 Health and safety equipment

(5 × 1) (5)

1.2 Discuss the general duties of manufacturers and others regarding articles and substances for use at work. (5)

1.3 Briefly state general duties of employers and the self-employed towards persons other than their employees. (4)

1.4 Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his/her employees.

State FOUR matters which those duties refer to in particular. (4)

1.5 What role does the approved inspection authority play according to the OHS Act regarding electrical installations? (3)

[21]

QUESTION 2: GENERAL

2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (2.1.1–2.1.2) in the ANSWER BOOK.

2.1.1 A certificate of compliance cannot be issued for an electrical installation in potentially hazardous locations which has not yet been zoned (classified).

2.1.2 Any change or alteration to the production process that influences the classification of the hazardous location also affects the electrical certificate of compliance for the particular installation.

(2 × 1) (2)

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2.2 You are requested to find medical locations at the local hospital that may have hazardous conditions.

In which areas of medical installations will these locations be found and what type of activities will usually take place there? (2)

2.3 Explain the meaning of the area classification marking *CLASS 1 DIV 1A,* that you might come across in existing installations. (4)

2.4 In the event where there are no other signatures on the document can a registered person still issue the certificate of compliance for the installation? State 'Yes' or 'No' and explain the answer. (2)

[10]

QUESTION 3: SANS 10142 PART 1: THE WIRING OF PREMISES (LOW-VOLTAGE INSTALLATIONS)

CERTIFICATE OF COMPLIANCE (CoC)

3.1 Single-phase installation:

Complete TABLE 1 by writing the missing words or phrases next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

TYPE OF INSTALLATION	MAY BE INSTALLED BY	CERTIFICATE OF COMPLIANCE MAY BE ISSUED ONLY BY
Single-phase	3.1.1	3.1.3
	3.1.2	3.1.4
		3.1.5

TABLE 1 (5 × 1) (5)

3.2 Is a new certificate of compliance required when repairs are done on an existing domestic electrical installation for which a certificate of compliance has already been issued? Discuss the answer. (4)

3.3 Discuss why it is important for a registered person to know the age of the electrical installation being inspected and tested. (4)

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3. 4 Additional Certificate of Compliance for hazardous locations:

You are required to carry out a visual inspection in a hazardous location according to the Additional Certificate of Compliance for hazardous locations, which has to be completed and attached to the Certificate of Compliance.

During your visual inspection, state what needs to be checked/verified with the checklist in the above document with regard to the following equipment:

3.4.1 Explosion protected equipment (4)

3.4.2 Cable glands (2)

3.4.3 Intrinsically safe circuits (3)

3.4.4 Explosion protected equipment and exposed and extraneous metal parts and structures (2)

3.4.5 Sleeve piping (1)

[25]

QUESTION 4: SANS 60079 PART 17: INSPECTION AND MAINTENANCE OF ELECTRICAL INSTALLATIONS IN HAZARDOUS LOCATIONS

4.1 SANS 60079-17 defines the different GRADES of inspection.

Briefly define each of the following grades of inspection and give an example of each:

4.1.1 Visual inspections (V)

4.1.2 Close inspections (C)

4.1.3 Detailed inspections (D)

(3 × 2) (6)

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4.2 Types of inspections:

Complete TABLE 2 by only writing the missing words or phrases next to the question number (4.2.1–4.2.5) in the ANSWER BOOK.

INSPECTION TYPE	EXPLANATION	PURPOSE	EXAMPLES
4.2.1	Inspection of all electrical equipment, systems and installations before they are brought into service	4.2.2	Example 1: New installation Example 2: Replacement motor
Periodic	4.2.3	Establish if the explosion protection of the item and installation is still intact.	Equipment in service and operates normally (fault free)
4.2.4	Inspection of a portion of the electrical equipment, systems and installations	4.2.5	Example 1: Check 10% of motor stop-starts for cracks on insulators and damaged seals. Example 2: Check the high-quality earth impedance for safety barriers on PT loops.

TABLE 2 (5 × 1) (5)

4.3 State NINE competencies that inspectors/operatives should possess according to SANS 60079-17 (inspection and maintenance of electrical installations in hazardous locations) in order to perform their tasks successfully. (9)

[20]

QUESTION 5: SANS 10089-2: THE PETROLEUM INDUSTRY PART 2: ELECTRICAL AND OTHER INSTALLATIONS IN THE DISTRIBUTION AND MARKETING SECTOR

5.1 Cathodic protection:

Incendiary sparking might arise under certain conditions on cathodically protected equipment such as pipelines, joints, plant, etc.

State the causes/circumstances for incendiary sparking to arise in the following cases:

5.1.1 Pipelines, joints, plant or any other associated equipment

5.1.2 Insulating flanges

5.1.3 Flexible conductive hoses to tankers, barges and railcar gantry structures and associated pipework

5.1.4 Protected structure supplied from rectifier or other direct-current (DC) source

5.1.5 Cathodic circuit, particularly with impressed current

(5 × 1) (5)

5.2 The apparatus used and circuits employed for systems in hazardous locations shall generally comply with certain requirements.

What is required to be done/complied with in the following cases:

5.2.1 Connection to structures regarding earth (1)

5.2.2 Underground cabling (1)

5.2.3 Flexible conductive hoses to tankers, barges and railcar gantry structures and associated pipework (3)

[10]

QUESTION 6: SANS IEC 60079 PART 19: REPAIR AND OVERHAUL OF APPARATUS USED IN EXPLOSIVE ATMOSPHERES (OTHER THAN UNDERGROUND MINES AND EXPLOSIVE FACTORIES)

Repair and overhaul data:

State SIX details of data that should be available to the repairer during the repair and/or overhaul of apparatus used in explosive atmospheres. **[6]**

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QUESTION 7: APPLICATION IS – LOOPS

The following information is available for equipment/components that form part of an IS loop circuit:

EX FIELD DEVICE:
- Vmax = 27 Vac
- Imax = 170 mA
- Ci = 0,04 µF
- Li = 0,00 mH

BARRIER:
- Vac = 32 Vac
- Isc = 195 mA
- Ca = 0,14 µF
- La = 3,9 mH

If these components are connected using a specific paired screened cable, 180 metres long, which has the following specifications from the manufacturer:

- A capacitance of 25 pF per metre
- Inductance is ignorable small

Calculate whether the parameters of the barrier and the field device will meet the requirements of an intrinsically safe system. Evaluate each parameter and indicate 'Suitable' or 'Unsuitable'. **[8]**

TOTAL: 100

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INFORMATION SHEET

SANS 10142
Edition 1.1

Table E.2 (a) – Maximum lengths, in metres of copper cables/circuits at a given circuit-breaker current rating for single phase (Fv = 2)

1	2	3	4	5	6	7	8	9	10
Nominal cross-sectional area mm²	Circuit-breaker current rating A								
	10	15	20	25	30	40	50	60	80
1	26	-	-	-	-	-	-	-	-
1,5	39	26	-	-	-	-	-	-	-
2,5	66	44	33	26	-	-	-	-	-
4	104	69	52	41	34	-	-	-	-
6	159	106	79	63	53	39	-	-	-
10	261	174	130	104	87	65	52	43	-
16	410	273	205	164	136	102	82	68	51

NOTE 1: Power factor is unity.
NOTE 2: Maximum permissible voltage drop between phases and neutral if full circuit-breaker loading is 5% of 230 V, i.e. 11,5 V.
NOTE 3: Only popular circuit-breaker ratings have been selected.

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INFORMATION SHEET

TABLE E.1 – Impedance of 600/1 000 V conductors that comply with SANS 1507

Ambient temperature: 30 °C
Conductor-operating temperature: 70 °C

1	2	3	4	5	6	7
Nominal cross-sectional area of conductor mm²	**Conductor resistance R for AC circuits** Ω/km		**Conductor reactance X for AC circuits** Ω/km		**Conductor resistance R for DC circuits** Ω/km	
	Material of conductor					
	Copper Cu	**Aluminium Al**	**Copper Cu**	**Aluminium Al**	**Copper Cu**	**Aluminium Al**
1	21,9	36,0	0,107	0,107	21,9	36,0
1,5	14,6	24,0	0,100	0,100	14,6	24,0
2,5	8,7	14,4	0,095	0,095	8,7	14,4
4	5,5	9,0	0,093	0,093	5,5	9,0
6	3,6	6,0	0,090	0,090	3,6	6,0
10	2,2	3,6	0,084	0,084	2,2	3,6
16	1,4	2,3	0,080	0,080	1,4	2,2
25	0,88	1,44	0,079	0,079	0,87	1,44
35	0,63	1,03	0,076	0,076	0,62	1,03
50	0,44	0,72	0,076	0,076	0,44	0,72
70	0,31	0,52	0,074	0,074	0,31	0,51
95	0,23	0,38	0,073	0,073	0,23	0,38
120	0,18	0,30	0,072	0,072	0,18	0,30
150	0,15	0,24	0,072	0,072	0,15	0,24
185	0,12	0,20	0,072	0,072	0,12	0,19
240	0,095	0,156	0,072	0,072	0,091	0,150
300	0,077	0,127	0,071	0,071	0,073	0,120
400	0,060	0,099	0,071	0,071	0,055	0,090
500	0,050	0,083	0,070	0,070	0,044	0,072
630	0,043	0,071	0,069	0,069	0,035	0,057
800	0,037	0,061	0,058	0,058	0,027	0,045
1 000	0,033	0,054	0,049	0,049	0,022	0,036

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INFORMATION SHEET

SANS 10142-1 Edition 1.5
Table 6.4 (b) – Multicore PVC isolated, armoured cables (SANS 1507)
Voltage drop (per ampere per metre) copper conductors

Conductor-operating temperature: 70 °C **Amdt 1**

1	2	3			4		
Conductor cross-sectional area mm²	**Two-core cable DC ‡ mV/A/m**	**Two-core cable, single-four-core phase AC ‡ mV/A/m**			**Three-core or four-core cable, three-phase AC mV/A/m**		
1	**2**	**3**			**4**		
1,5	29	29			25		
2,5 4 6 10 16	18 11 7,3 4,4 2,8	18 11 7,3 4,4 2,8			15 9,5 6,4 3,8 2,4		
		r	x	z	r	x	z
25 35 50 70 95	1,75 1,25 0,93 0,63 0,46	1,75 1,25 0,93 0,63 0,47	0,170 0,165 0,165 0,160 0,155	1,75 1,25 0,94 0,65 0,50	1,50 1,10 0,80 0,55 0,41	0,145 0,145 0,140 0,140 0,135	1,50 1,10 0,81 0,57 0,43
120 150 185 240 300	0,36 0,29 0,23 0,180 0,105	0,38 0,30 0,25 0,190 0,155	0,155 0,155 0,150 0,150 0,145	0,41 0,34 0,29 0,24 0,21	0,33 0,26 0,21 0,165 0,135	0,135 0,130 0,130 0,130 0,130	0,35 0,29 0,25 0,21 0,185
400	0,145	0,115	0,145	0,185	0,100	0,125	0,160

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