higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

SPECIALISED ELECTRICAL INSTALLATION CODES

(Second Paper)

(8080644)

1 August 2019 (X-Paper)
09:00–12:00

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

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
SPECIALISED ELECTRICAL INSTALLATION CODES
(Second Paper)
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.

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QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY ACT, ACT 85 OF 1993- ELECTRICAL INSTALLATION REGULATIONS

1.1 Complete the following sentences by writing only the missing words or phrases next to the question number (1.1.1–1.1.13) in the ANSWER BOOK.

1.1.1 … means the South African National Accreditation System (SANAS).

1.1.2 … means a person or body approved by the chief inspector in terms of Regulation 5 to carry out inspections, tests and investigations of electrical installations.

1.1.3 … means a certificate, with a unique number obtainable from the chief inspector, in the form of ANNEXURE 4 and issued by a registered person in respect of an electrical installation or part of an electrical installation or a Certificate of Compliance issued under the Electrical Installation Regulations, 1992.

1.1.4 … means a person, who undertakes to perform electrical installation work on behalf of any other person, but excludes an employee of such first mentioned person.

1.1.5 … means a person who has been registered as an electrical tester for single phase in terms of Regulation 13 and who has been approved by the chief inspector for the verification and certification of the construction, testing and inspection of electrical installations supplied by a single-phase electricity supply, excluding specialised electrical installations.

1.1.6 ... includes the instruction, guidance and supervision of a registered person over electrical installation work that is being carried out.

1.1.7 … means the installation, extension, modification, repair of or the inspection, testing and verification of electrical installations, including the connection of machinery at the supply terminals of such machinery.

1.1.8 … means a person registered in terms of Regulation 13 as an electrical tester for single phase, an installation electrician or a master installation electrician, as the case may be.

1.1.9 … means the point at which electricity is supplied to any premises by a supplier.

1.1.10 … means any termination of an electrical installation which has been provided for connecting any electrical machinery without the use of tools.

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1.1.11 … means the point at which the electrical installation on or in any premises can be switched off by a user or lessor from the electricity supplied from the point of supply, or the point at which part of the installation on the premises can be switched off where different users occupy different parts of such premises.

1.1.12 … means any point of outlet or the supply terminals of machinery which is not connected to a point of outlet and which converts electrical energy to another form of energy, provided that in the case of machinery which has been installed for any specific purpose as a complete unit, the point of consumption shall be the supply terminals which have been provided on the unit of machinery for that purpose.

1.1.13 … in relation to a particular electrical installation, means anybody or person who supplies or contracts or agrees to supply electricity to that electrical installation.

(13 × 1) (13)

1.2 Section 22 of the Act states that certain articles/substances may not be sold.

Why does it state this and what is the exception? (3)

1.3 In Section 10 the Act places certain responsibilities on persons that erect and or install any article for use at work on or in any premises.

Name these responsibilities. (2)

[18]

QUESTION 2: SANS 60079-10: CLASSIFICATION OF HAZARDOUS AREAS

DEGREE OF VENTILATION

The effectiveness of the ventilation in controlling dispersion and persistence of the explosive gas atmosphere will depend upon the degree and availability of ventilation and the design of the system. An example is that ventilation may not be sufficient to prevent the formation of an explosive gas atmosphere but may be sufficient to avoid its persistence.

Name and explain the THREE degrees of ventilation that are recognised. (3 × 2) **[6]**

QUESTION 3: SANS 10142 PART 1, 2017: THE WIRING OF PREMISES (LOW-VOLTAGE INSTALLATIONS)

CERTIFICATE OF COMPLIANCE (CoC)

3.1 You are required to conduct electrical inspections on new, existing and temporary installations before testing, in order to issue certificates of compliance.

Explain what the inspections should entail. (12)

3.2 Name THREE tests that you would conduct before issuing a certificate of competency. (3)

[15]

QUESTION 4: SANS 60079 PART 17: ELECTRICAL INSTALLATIONS INSPECTION AND MAINTENANCE IN HAZARDOUS LOCATIONS AND SANS 60079 PART 19: REPAIR AND OVERHAUL FOR APPARATUS USED IN EXPLOSIVE ATMOSPHERES (OTHER THAN MINES OR EXPLOSIVES)

4.1 Choose the correct option that makes up the original text from the options given in brackets. Write only the answer next to the question number (4.1.1–4.1.4) in the ANSWER BOOK.

4.1.1 (Portable/Fixed) electrical equipment shall be submitted to a close inspection at least every 4.1.2 (12 months/2 months). Enclosures which are 4.1.3 (frequently/rarely) opened, such as battery housings shall be given a detailed inspection. In addition, the apparatus shall be 4.1.4 (visually/thoroughly) checked by the user before use, to ensure that the apparatus is not obviously damaged. (4)

4.2 REPAIR AND OVERHAUL – ENCLOSURES

While it is preferable to obtain new parts from the manufacturer, in principle a damaged part may be repaired or replaced with another, given that, when compared with the original, it meets or complies with certain standards or criteria.

State SIX criteria or standards that must be met. (6)

4.3 TESTING AFTER REPAIR OF WINDINGS

After complete or partial repair, windings (of motors, transformers, et cetera) should be subjected to tests, with the apparatus assembled, as far as reasonably practicable.

Discuss the tests that should be conducted. (6)

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4.4 State how the following types of inspections are conducted:

4.4.1 Visual inspection (2)

4.4.2 Closed inspection (2)

4.4.3 Detailed inspection (3)

[23]



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

Explain each of the following terms:

5.1 Flameproof apparatus (Ex d apparatus) (3)

5.2 Increased safety electrical apparatus (Ex e apparatus) (3)

5.3 Intrinsically safe circuit (Ex i circuit) (3)

5.4 Intrinsically safe electrical apparatus (Ex i apparatus) (2)

5.5 Intrinsically safe system (Ex i system) (3)



5.6 Non-sparking electrical apparatus (Ex n apparatus) (2)

5.7 Powder-filled or sand-filled electrical apparatus (Ex q apparatus) (2)

[18]

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QUESTION 6: SANS 10123: THE CONTROL OF UNDESIRABLE STATIC ELECTRICITY

The following is an extract from the standard SANS 10123. Choose the correct item from those given in brackets. Write only the word or words next to the question number (6.1–6.12) in the ANSWER BOOK.

Static electricity is generated when electric charges are 6.1 (separated/combined) into equal quantities of 6.2 (similar/opposite) polarity by 6.3 (combining/separation) or relative movement between contacting surfaces of 6.4 (different/similar) physical and/or chemical structures.

The surfaces may be of solids or liquids, or of one solid and one liquid. Generation of static charge 6.5 (can/cannot) occur between two substances that are apparently identical but have differing surface properties due to the presence of solid or liquid contaminants.

Generation of static charge 6.6 (can/cannot) occur within one liquid or mass of dust undergoing internal movement due to agitation.

Under these conditions, equal quantities of charges of 6.7 (opposite/similar) polarity may be physically separated and can give rise to internal static generation 6.8 (within/on the surface of) the liquid or dust.

When TWO electrostatically charged bodies are separated, an electrical stress (expressed in terms of field strength or potential gradient) is 6.9 (destroyed/created) that tends to 6.10 (separate/reunite) the charges and opposes further separation.

Energy has therefore been applied to the system to bring about this 6.11 (combining/separation) and part of the energy is contained in the electric stress so formed.

When the electric stress exceeds the breakdown strength of the medium between the separated bodies, a static 6.12 (charge/discharge) will occur. (12 × 1) **[12]**

QUESTION 7: APPLICATION IS LOOPS

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

	Ex FIELD DEVICE		BARRIER	
7.1	V_{max}	22 Volt AC	V_{ac}	26 volt AC
7.2	I_{max}	160 mA	I_{sc}	172 mA
7.3	C_A	0,02 µF	C_a	0,12 µF
7.4	L_i	0,00 mH	L_a	3,2 mH

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

- A capacitance of 30 pF per metre
- Inductance is negligible

Calculate whether the parameters of the barrier and the field device will meet the requirements for an intrinsically safe system. Show calculations. Evaluate whether each parameter is 'Suitable' or 'Not-suitable'.

Write the calculations and SUITABLE or NOT-SUITABLE next to the question number (7.1–7.4) in the ANSWER BOOK. (4 × 2) **[8]**

TOTAL: 100

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INFORMATION SHEET 1 ***SANS 10142-1***

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 2

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 3

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

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	18	18			15		
4	11	11			9,5		
6	7,3	7,3			6,4		
10	4,4	4,4			3,8		
16	2,8	2,8			2,4		
		r	x	z	r	x	Z
25	1,75	1,75	0,170	1,75	1,50	0,145	1,50
35	1,25	1,25	0,165	1,25	1,10	0,145	1,10
50	0,93	0,93	0,165	0,94	0,80	0,140	0,81
70	0,63	0,63	0,160	0,65	0,55	0,140	0,57
95	0,46	0,47	0,155	0,50	0,41	0,135	0,43
120	0,36	0,38	0,155	0,41	0,33	0,135	0,35
150	0,29	0,30	0,155	0,34	0,26	0,130	0,29
185	0,23	0,25	0,150	0,29	0,21	0,130	0,25
240	0,180	0,190	0,150	0,24	0,165	0,130	0,21
300	0,105	0,155	0,145	0,21	0,135	0,130	0,185
400	0,145	0,115	0,145	0,185	0,100	0,125	0,160

‡ In the case of single-phase circuits, the return path has been accounted for in the values given.

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