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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

SPECIALISED ELECTRICAL INSTALLATION CODES (Second paper)

(8080644)

6 April 2020 (X-paper)
09:00–12:00

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

116Q1A2006

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
SPECIALISED ELCTRICAL 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.

QUESTION 1: HEALTH AND SAFETY ACT, ACT 85 OF 1993

1.1 Define the following terms as per the above act.

1.1.1 Occupational hygiene (2)

1.1.2 Occupational medicine (1)

1.1.3 Organism (1)

1.1.4 Risk (1)

1.1.5 Medical surveillance (2)

1.1.6 Machinery (3)

1.2 State TWO general duties of employers and self-employed persons other than their employees (2)

1.3 The following is an excerpt from the Electrical Installation Regulations as found in the Occupational Health and Safety Act (Act 85 of 1993).

Complete the following sentences by writing only the missing word or words next to the question number (1.3.1– 1.3.3) in the ANSWER BOOK.

'Every user or (1.3.1) … of an electrical installation as the case may be shall on request produce the certificate of compliance for that installation to an inspector or the (1.3.2) … Subregulation 1 shall not apply to electrical installations existing prior to the coming into force of this regulation: (23 October 1992) provided that if any (1.3.3) … or alterations are effected to such an installation…' (3 × 1) (3)

1.4 The construction regulations in the abovementioned act contain certain requirements which specifically deal with electrical installations and more specifically temporary installations on construction sites.

State FIVE of these requirements. (5)

[20]

QUESTION 2: SANS 10086-3: THE INSTALLATION, INSPECTION AND MAINTENANCE OF EQUIPMENT USED IN EXPLOSIVE ATMOSPHERES PART 3: REPAIR AND OVERHAUL OF APPARATUS USED IN EXPLOSIVE ATMOSPHERES.

TABLE 1 below displays the relevant standards with which a master installation electrician should be familiar in order to assess the compliance of specialised electrical installations in hazardous locations.

Complete the TABLE by choosing an industrial description or a standard from the list below. Write only the industrial description or standard next to the question number (2.1–2.10) in the ANSWER BOOK.

- SANS 10108 and SANS 60079-10-1
- SANS 10142-1
- Inspection and maintenance of surface installations.
- Ex Equipment certification requirements
- SANS 10086-1, SANS 60079-14
- Wiring of premises
- Installations in underground mines
- SANS 10086-3, ARP 0108, SANS 10108 and SANS 60079-19
- Classification of surface dust areas
- SANS 10108 and SANS 60079-14

1	2	3
INDUSTRIAL CLASSIFICATION	**INDUSTRIAL DESCRIPTION**	**STANDARDS**
AREA CLASSIFICATION	Classification of surface gas areas	2.6
	2.1	SANS 10108 and SANS 60079-10-2
EQUIPMENT SELECTION	Equipment selection	2.3
	2.8	SANS 10108 and ARP 0108
INSTALLATION (ERECTION)	Surface installations including surface installations on mines	2.10
	2.7	SANS 10086-2
Inspection and maintenance	2.2	SANS 10086-1 and SANS 60079-17
2.9	Low-voltage installations	2.4
Repair	Repair of equipment used in explosive atmospheres	2.5

(10 × 1) **[10]**

TABLE 1

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

CERTIFICATE OF COMPLIANCE (CoC)

3.1 Two-phase, three-phase and DC Installations:

Complete TABLE 2 by filling in the missing word or words. Write only the word or words 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
Two-phase, three-phase and DC	3.1.1	3.1.4
	3.1.2	3.1.5
	3.1.3	

(5 × 1) (5)

TABLE 2

3.2 Name at least THREE documents which must be added to the certificate of compliance for a specialised electrical installation. (3)

3.3 State whether the following statements regarding additional inspection and test document for a hazardous location are TRUE or FALSE. Write only 'True' or 'False' next to the question number (3.3.1–3.3.3) in the ANSWER BOOK.

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

3.3.2 Any change or alteration to the production process that influences the classification of the hazardous location will not affect the electrical certificate of compliance for the particular installation.

3.3.3 Any person suitably qualified or a person deemed competent enough by the owner or user of the installation or a hazardous location classification committee may classify areas containing flammable atmospheres into different zones.

(3 × 1) (3)

[11]

QUESTION 4: SANS 60079–0: ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES PART 0: GENERAL REQUIREMENTS

4.1 Define each of the following terms:

4.1.1 Inherently safe (ihs) cell (or battery) (2)

4.1.2 Maximum open-circuit voltage (of a cell or battery) (2)

4.1.3 Sealed gas-tight cell or battery (2)

4.1.4 Continuous operating temperature (COT) (1)

4.1.5 Maximum surface temperature (2)

4.1.6 Explosive test mixture (1)

4.2 Avoidance of a build-up of electrostatic charge:

Electrical apparatus shall be so designed that under normal conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges shall be avoided.

State THREE ways that the above statement may be satisfied. (3)
[13]

QUESTION 5: SANS 10086 – PART 1 THE INSTALLATION, INSPECTION AND MAINTENANCE OF EQUIPMENT USED IN EXPLOSIVE ATMOSPHERES

5.1 As a master installation electrician you are tasked with the selection of appropriate apparatus for hazardous areas in the industry. In order to select the appropriate apparatus for the hazardous areas important information is first required.

State FOUR important factors that should be considered. (4)

5.2 Read the following statements and answer the questions:

5.2.1 In the design of electrical installations, allowance shall be made for the dissipation of static electricity in such a way that incentive sparking is prevented. Consideration shall also be given to mechanical equipment and processes that can generate high static charges.

State FOUR such mechanical equipment and processes likely to be found in an industrial production environment. (4)

5.2.2 Rotating electrical machinery shall, in addition, be protected against overcurrent unless it can continuously withstand the starting current at rated voltage and frequency or, in the case of generators, the short-circuit current, without inadmissible heating.

State THREE examples of protective devices and their function that apply to the above machinery. (3 × 2) (6)
[14]

QUESTION 6: SANS 10089 – 2: THE PETROLEUM INDUSTRY PART 2: ELECTRICAL INSTALLATIONS IN THE DISTRIBUTION AND MARKETING SECTOR

6.1 Define each of the following terms.

6.1.1 Encapsulated electrical apparatus (2)

6.1.2 Enclosed premises (1)

6.1.3 Hydraulic housing (1)

6.1.4 Flameproof apparatus (2)

6.1.5 Primary release (2)

6.1.6 Secondary release (2)

6.2 Briefly explain the principle of the cathode protection method which is widely used in the petro-chemical industry. (4)
[14]

QUESTION 7: SANS 60079 PART 19: REPAIR AND OVERHAUL OF APPARATUS USED IN EXPLOSIVE ATMOSPHERES (OTHER THAN UNDERGROUND MINES AND EXPLOSIVE FACTORIES)

7.1 Define each of the following terms:

7.1.1 Serviceable condition (2)

7.1.2 Maintenance (1)

7.1.3 Type of protection 'e' (2)

7.1.4 Reclamation (3)

7.2 A certificate reference number may refer to a single design or a range of apparatus of similar design.

What does *X* indicate when added to the certificate number? (2)
[10]

QUESTION 8: APPLICATION IS-loops

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

Ex FIELD DEVICE:
- Vmax= 25 Vac
- Imax = 175 mA
- Ci = 0,035 µF
- Li = 0,00 mH

BARRIER:
- Vac= 29 Vac
- Isc= 190 mA
- Ca= 0.135 µF
- La = 4.5 mH

Calculate whether the parameters of the barrier and the field device will meet the requirements for an intrinsically safe system if these components are connected using a cable 210 metres long of a specific paired screened cable which has the following specifications from the manufacturer:

- Capacitance of 25 pF per metre
- Inductance is ignorable small

[8]

TOTAL: 100

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.

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

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