higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T890**(E)**(A1)T

NON-NATIONAL CERTIFICATE

INSTALLATION RULES
(Second Paper)

(11040432)

1 August 2019 (X-Paper)
09:00–12:00

This question paper consists of 6 pages and 6 information sheets.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NON-NATIONAL CERTIFICATE
INSTALLATION RULES
(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. Even though NOT explicitly stated in a question, ALL answers must comply with the relevant codes and/or requirements of the SANS publications (latest edition) and the Occupational Health and Safety Act regulations.

5. The answers need NOT be word-perfect in all aspects according to the publications but they must show that the candidate fully understands the context of the relevant questions.

6. The necessary tables are supplied.

7. The candidates must pass PAPER 1 and PAPER 2 with 50% each. Both examination papers may be written during the same examination period. However, candidates need not pass both examinations during the same trimester, but the second examination must be passed within 12 months of the first, otherwise both examinations must be rewritten. If a candidate obtains 75 of 100 marks in ANY ONE of the examinations, he/she will be permanently exempted from rewriting that examination. An appropriate statement will be issued. For accreditation purposes ALL candidates must meet the requirements prescribed by the Department of Labour.

8. NO condonations will be considered.

9. Start each question on a NEW page.

10. Write neatly and legibly.

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QUESTION 1: SANS 10142-1 OF 2017: ANNEXURE K: EARTHING ARRANGEMENTS AND EQUIPOTENTIAL BONDING OF INFORMATION TECHNOLOGY INSTALLATIONS FOR FUNCTIONAL PURPOSES

Carefully study FIGURE K.1 on INFORMATION SHEET 2 (attached) and name the following:

1.1 B

1.2 M

1.3 T

1.4 T1

1.5 T2

1.6 1

1.7 2

1.8 4

1.9 5

1.10 8

(10 × 1) **[10]**

QUESTION 2: SANS 10142–1 OF 2017: ANNEXURE L: CLASSIFICATION OF SAFETY SERVICES NECESSARY FOR MEDICAL LOCATIONS

TABLE L.2 gives guidelines of the example for the allocation of the medical location group and the classification of the classes of safety services.

Name TEN locations in which security of supply must be within a short break of time, i.e. be available within 0,5 sec. **[10]**

QUESTION 3: SANS 10142-1 OF 2017: VERIFICATION AND CERTIFICATION

3.1 INFORMATION SHEET 1 (attached) gives details of a 3-phase transformer. You are given a 50 mm² × 4-core armoured copper cable to feed an electrical installation that is 35 metres away from this transformer.

Calculate the PSCC at the main switch of this installation. (8)

3.2 Name FOUR alternative ways to obtain information on the three-phase PSCC mentioned in QUESTION 3.1. (2)

[10]

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QUESTION 4: SANS 10142-1 OF 2017: VERIFICATION AND CERTIFICATION

4.1 Name the TWO reports, in addition to the test report, for specialised locations. (2)

4.2 Which result/s will be recorded on the test report when multiple tests are required? (1)

4.3 What needs to be done in case of a failure in any test? (2)

4.4 How accurate must the measuring instruments be? (1)

4.5 Name the FOUR items to pay attention to when an inspection is done to check if conductors are of the correct rating and current-carrying capacity for the protective device and connected load. (4)

[10]

QUESTION 5: SANS 10142-1 OF 2017: VERIFICATION AND CERTIFICATION

5.1 Use TABLE 8.1 on INFORMATION SHEET 3 (attached) to answer the following questions:

5.1.1 What will be the maximum resistance of the earth continuity path on points when the circuit is supplied by a 15 A circuit breaker?

5.1.2 What will be the maximum resistance of the earth continuity path in a geyser if it is supplied by a 30 A 2-pole circuit breaker?

5.1.3 What will be the maximum resistance of the earth continuity path on a stove circuit if it is supplied by a 40 A circuit breaker?

5.1.4 What will be the maximum resistance of the earth continuity path for the water pipes for the geyser mentioned in QUESTION 5.1.2?

(4 × 1) (4)

5.2 How is an earth-continuity test performed on socket outlets? (2)

5.3 How will the earth-loop impedance affect the operation of the main protective device/main switch? (2)

5.4 What must be done if the following elevated voltage on the supply neutral is obtained?

5.4.1 ≥ 25 V

5.1.2 ≥ 50 V

(2 × 1) (2)

[10]

QUESTION 6: SANS10142-1 OF 2017: WIREWAYS

Complete the following sentences by writing only the missing phrases next to the question number (6.1–6.10) in the ANSWER BOOK.

When a wireway is installed:

6.1 The wireway shall be installed such that … is ensured.

6.2 Joints other than … as the wireway itself.

6.3 Where flammable material is used for its construction, … or onto the wireway shall be protected by non-flammable material.

6.4 Expansion joints shall … at least as well as the rest of the wireway does.

6.5 All inspection joints and … even if they are above the ceiling or below the floor boards.

6.6 All boxes and expansion joints that … that prevent the liquid from entering the wireway.

6.7 Any cable, … installation, may be installed in the wireway except in the case of 6.4.1 (b).

6.8 Metal doors, covers or hinged panels shall … to such doors, covers or panels.

6.9 Where it is accessible to the public, … with either the standard jointed test finger or the 2,5 mm diameter × 100 mm long rod.

6.10 Cable entry points, exit points and internal surfaces … the insulation of cables installed.

(10 × 1) **[10]**

QUESTION 7: SANS 10142-1 OF 2017: DISTRIBUTION BOARDS

State the requirements of the following items with regard to distribution boards:

7.1 Electrical equipment used (1)

7.2 Environmental conditions (1)

7.3 Maximum mounting (1)

7.4 Switch disconnector in case the maximum mounting is exceeded (1)

7.5 Minimum mounting for indoor (1)

7.6 Minimum mounting for outdoor (1)

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7.7 Mounting bathroom (1)

7.8 Mounting above a fixed cooking appliance (1)

7.9 In case of use of conductors exceeding 4 mm² in a cross-sectional area (2)
[10]

QUESTION 8: SANS 10142-1 OF 2017: LIGHTING

8.1 In a lighting circuit, a luminaire that is in a false ceiling or in a roof space 4 m above the floor where there is no ceiling or in a floor cavity or in a wall cavity or in a similar position, may be fed from a socket outlet which may be unswitched and not protected by an earth-leakage protection.

State FOUR conditions/requirements for sockets outlets. (4)

8.2 What are the requirements regarding a suspended luminaire that is likely to be exposed to wind? (2)

8.3 State FOUR conditions when a lamp holder does not have to be shrouded in insulating material or be earthed. (4)
[10]

QUESTION 9: SANS 10142-1 OF 2017: SOCKET OUTLETS

Single-phase circuits that only supply socket outlets rated at not more than 16 A, shall, if the circuit protection is rated at more than 20 A, use only protected socket outlets with as far as is practicable, discrimination between the protective devices for the circuit and the protective devices associated with the socket outlet.

State SEVEN conditions to which the protective device of a protected socket outlet shall comply. **[10]**

QUESTION 10: SANS 10142-1 OF 2017: ANNEXURE D: CALCULATION OF VOLTAGE DROP

An existing factory needs to expand its operations. It currently has a three-phase 30 kW power source and only uses 95% of this source. The new expansion will be a three-phase 35 kW load. The municipal supply is a three-phase 100 kVA/400 V AC transformer with a power factor of 09 and is 20 m away from the factory's main distribution board. The supply cable/s is/are armoured copper cables buried directly in trenches underground. A new cable will be added to the existing one in parallel.

10.1 Calculate the minimum size of the existing cable and give a reason for your answer. (3)

10.2 Calculate the size of the new cable to be added and give a reason for your answer. (5)

10.3 Calculate the total expected voltage drop for the installation after the new load is added and give a reason for your answer. (2)
[10]

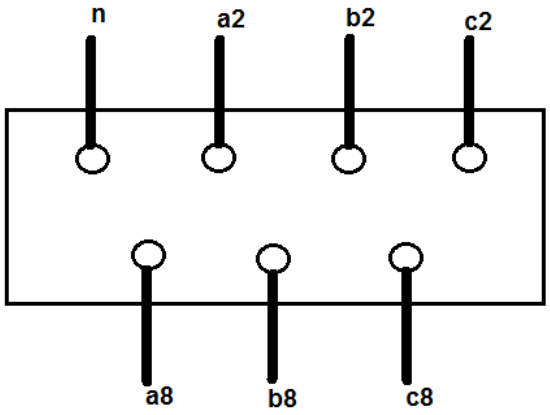
TOTAL: 100

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INFORMATION SHEET 1

TRANSFORMER

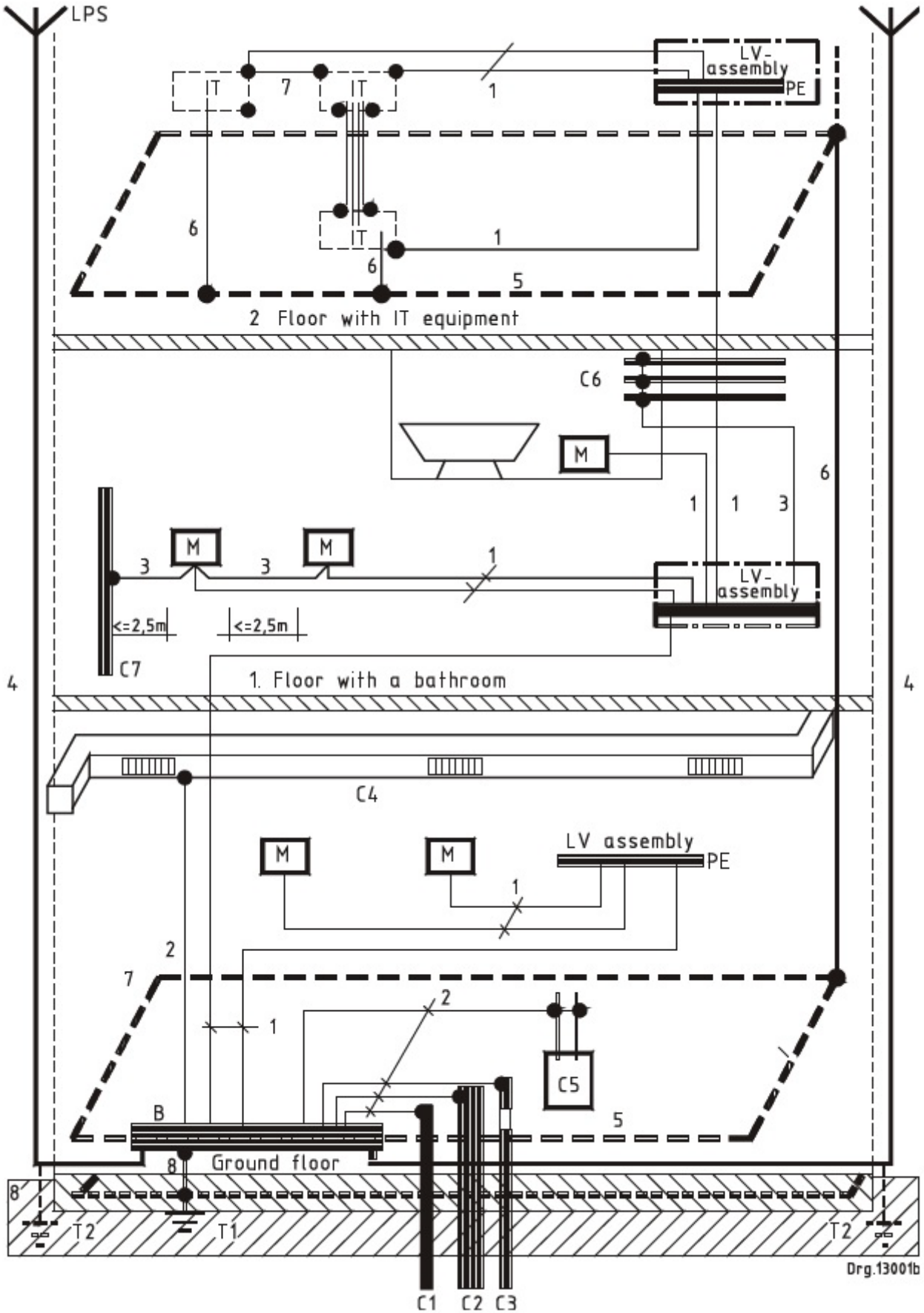
TRANSFORMER	IDB-100-11	TYPE OF COOLING	ONAN
KVA	100	FREQUANCY	50 HZ
VOLTS	11000 HV	IMPEDANCE	4 %
NO LOAD	415 LV	OIL SPECS	IEC-60296
AMPERES	5.25 HV	WEIGHT OF OIL	112 KGS
	139.1 LV	LIFTABLE ASSY.	301.5 KGS
PHASES	3 HV	TOTAL WEIGHT	600 KGS
	3 LV	YEAR OF MANUFACTURING	2010
DIAGRAM DRG NO.	S -1760	MAKERS S.NO.	1200451
VECTOR SYMBOL	Dyn - 11	P.O NO.	15048



H.T VOLTS	SWITCH POSITION
11275	1
11000	2
10725	3
10450	4
10175	5

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INFORMATION SHEET 2: FIGURE K.1



INFORMATION SHEET 3

Table 8.1 — Maximum resistance of earth continuity conductor

1	2
Rated current of protective device	**Maximum resistance of earth continuity path**
A	Ω
6,3	1,7
10	1,1
16	0,70
20	0,55
25	0,53
32	0,41
40	0,33
50	0,26
63	0,24
80	0,19
100	0,14
125	0,12
160	0,096
200	0,077
250	0,062
315	0,049

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INFORMATION SHEET 4

Table D.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 a.c. circuits Ω/km		Conductor reactance *X* for a.c. circuits Ω/km		Conductor resistance *R* for d.c. 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 5

Soil temperature: 25 °C
Maximum conductor temperature: 70 °C

1	2	3	4	5
Nominal conductor size mm²	**Standard rating[a] — Copper cables** A			
	Cables buried in the ground		**Cables in pipes or ducts buried in the ground**	
	Two-core	**Three-core or four-core**	**Two-core**	**Three-core or four-core**
	Cu	**Cu**	**Cu**	**Cu**
1,5	29	24	23	20
2,5	37	32	31	26
4	50	42	41	34
6	62	53	51	43
10	83	70	68	58
16	107	91	88	75
25	142	119	116	96
35	171	143	139	116
50	203	169	165	138
70	249	210	203	171
95	299	251	244	205
120	339	285	278	234
150	380	320	311	263
185	430	361	354	298
240	496	416	410	344
300	554	465	459	385
400	624	522	517	441

NOTE See table 6.4(b) for voltage drop.

[a] Standard conditions of installation:
Depth of burial 0,5 m;
Thermal resistivity of soil 1,2 K m/W; and
Each cable is thermally independent.

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INFORMATION SHEET 6

Table 6.4(b) — Multicore PVC insulated 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 d.c.**[a] mV/A/m	**Two-core cable, single-phase a.c.**[a] mV/A/m			**Three-core or four-core cable, three-phase a.c.** mV/A/m		
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	0,145	0,155	0,145	0,21	0,135	0,130	0,185
400	0,105	0,115	0,145	0,185	0,100	0,125	0,160

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

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