



Candidate Code No.	
For Board Use Only	
Result	Result
Date	Date
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ELECTRICAL WORKERS REGISTRATION BOARD ELECTRICIAN'S REGULATIONS EXAMINATION

057

27 November 2004

QUESTION AND ANSWER BOOKLET

Time Allowed: Three hours

INSTRUCTIONS – READ CAREFULLY

You have 10 minutes to read this paper but do not start writing until you are told to do so by the supervisor.

Write your Candidate Code Number in the box provided above. Your name must NOT appear anywhere in this paper.

Answer all questions.

The pass mark for this examination is 60 marks.

Use a pen for written answers. **Do not** use pencils or red pens.

Drawing instruments and pencils may be used when diagrams are required. Marks are allocated on the basis of correctness.

Do not use correcting fluid or correcting tape.

Non-programmable calculators may be used.

It is recommended that the reference source for your answers be included in the space provided if a question can be answered from the Act, Regulations, Standard or Code of Practice. However, just stating a reference only will earn no marks.

For calculation questions all workings, including formulae, must be shown to gain full marks.

Warning – You could get 0 marks for any question, or part of a question, if you show anything hazardous or dangerous in your answer.

You will need to use the following documents in this examination:

- The Electricity Act 1992 and amendments
- The Electricity Regulations 1997 and the Electricity Amendment Regulations 1999, Electricity Amendment Regulations 2002 and the Electricity Amendment Regulations 2003; or
The Electricity Regulations Compilation 2003 and the Electricity Amendment Regulations 2003; or
The Integrated Electricity Regulations 1997
- AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, 3 and A); AS/NZS 3001:2001; NZS 3019 (Int):2002; AS/NZS 3760:2001 or ; AS/NZS 3760:2003
- ECP 34, and ECP 54

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

SECTION 1

Answer all questions in this section. Each is worth 2 marks.

Question 1

Electrical wiring work consists of two types of prescribed electrical work. Refer to the Electricity Act and state these **TWO** types.

(1) _____

(2) _____

Ref:

Question 2

State **TWO** of the limitations that the Board can impose under the Electricity Act, upon the work carried out by a trainee who has been found guilty of a disciplinary offence under the Act.

(2 marks)

(1) _____

(2) _____

Ref:

Question 3

Because of renovations, an electrician is required to move an existing wall light to a new position. While in the ceiling space, he notices the cooker circuit insulation has been damaged by a nail. Repair is made using a heat shrink sleeve. He then proceeds to move the wall light. Refer to the Electricity Regulations and state which of this work requires certification.

Ref:

(turn over)

Question 4

Refer to the Electricity Regulations and list **TWO** categories of electrical workers that are permitted to certify prescribed work other than a registered electrician or inspector.

(1) _____

(2) _____

Ref:

Question 5

Refer to Electricity Regulations and state the maximum voltage drop allowed between the point of supply and any fixed wired appliance or socket outlet within any electrical installation operating at:

(a) Standard Low Voltage Single Phase _____ volts

(b) Standard Low Voltage Multiple Phase. _____ volts

Ref:

Question 6

Refer to the Electricity Regulations and list **TWO** situations where fittings or electrical are deemed not to be electrically safe.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 7

Refer to the Electricity Regulations and state **ONE** of the insulation requirements that applies to conductors, other than the neutral, when attaching an overhead low-voltage line to a building.

(2 marks)

Ref:

Question 8

Automatic disconnection of the supply is one method of preventing danger to persons where exposed conductive parts become live under fault conditions (indirect contact). Refer to AS/NZS 3000 and state the **TWO** general methods of achieving automatic disconnection.

(1) _____

(2) _____

Ref:

Question 9

Refer to AS/NZS 3000 and list **TWO** acceptable methods of limiting the maximum demand in mains and sub-mains.

AS/NZS 3000: 1.8.3.5

(1) _____

(2) _____

Ref:

(turn over)

Question 10

Refer to AS/NZS 3000 and state the requirement for a motor isolator that is located remotely from the motor.

(2 marks)

Ref:

Question 11

Refer to AS/NZS 3000 and state the safety requirement for the prevention of injury to persons or damage to property that must be met in the event of complete power failure to an electric motor.

(2 marks)

Ref:

Question 12

Refer to AS/NZS 3000 and state the minimum permissible size for the following in a low voltage electrical installation.

(a) Main earthing conductor

(1 mark)

Ref:

(b) An equipotential bonding conductor for metal water pipes

(1 mark)

Ref:

(turn over)

Question 13

One end of a main earthing conductor must be connected to the main earthing terminal in the main switchboard. Refer to AS/NZS 3000 and state **ONE** point where the other end of the main earthing conductor can be connected.

(2 marks)

Ref:

Question 14

Refer to AS/NZS 3000 and state the situation where metallic piping systems (e.g., gas or hot water pipes) need to be connected to an equipotential bonding conductor.

Ref:

Question 15

Refer to AS/NZS 3000 and state the precautions that shall be taken when testing a low voltage electrical installation?

(2 marks)

Ref:

(turn over)

Question 16

SELV circuits are required to be arranged in a certain manner. State **TWO** parts of an electrical installation that SELV circuits must not be connected to.

(2 marks)

(1) _____

(2) _____

Ref:

Question 17

Refer to AS/NZS 3000 and state **TWO** requirements for plugs and socket outlets in extra-low voltage electrical installations.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Section 2

Answer **ALL** questions in this section. Each question is worth 6 marks.

Question 18

AS/NZS 3000 requires that the selection and installation of the general earthing requirements shall ensure **THREE** operational results. State these operational results.

(6 marks)

- (1) . _____

- (2) . _____

- (3) . _____

Ref:

(turn over)

Question 19

A registered electrician has just completed the following work on a domestic electrical installation:

- Relocated the main earth electrode
- Installed a new sub-main, a switchboard, three lights and two socket outlets in a detached garage
- Repaired a damaged cable supplying the range/stove
- Replaced at the main switchboard:
 - a 10 A, 6 kA circuit-breaker with a 10 A, 4.5 kA circuit-breaker
 - the existing ironclad 80 A main switch with a new plastic 80 A switch.
- Shortened the mains cable and terminated in a new point of supply

With reference to the Electricity Regulations:

(a) Which work requires certification?

(2 marks)

Ref:

(b) Which work requires inspection?

(1 mark)

Ref:

(c) Who is permitted to inspect the work?

(2 marks)

Ref:

(turn over)

Question 19 continued

- (d) In accordance with which document must the low voltage electrical installation be tested?

(1 mark)

Ref:

(turn over)

Question 20

Refer to the Electricity Regulations and answer the following:

- (a) What protection is required to be given by a service protective fitting provided by the person who provides line function services to an electrical installation?
(2 marks)

Ref:

- (b) State **THREE** requirements for protective fittings installed in an electrical installation to protect against overcurrent, short circuiting, earth fault current, overvoltage or undervoltage?
(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

- (c) State the maximum permitted operating time for a Residual Current Device (RCD) installed for the protection of property.
(1 mark)

Ref:

(turn over)

Question 21

An electrician has been requested to install a 400 V, three-phase, 38 kVA motor in a plaster mill.

Assume that:

- The motor is to be supplied from the main switchboard, which has adequate capacity
- The supply voltage at the main switchboard is 400 V
- An XLPE multi-core cable clipped direct (touching) to the building surface is to be used
- The ambient temperature is 20 °C
- The cable run from the switchboard to the motor is 42 metres
- The maximum voltage drop permitted is 3%.
- Assume the conductor temperature to be 75⁰C

Using this information and that from the following tables:

- (a) Calculate the minimum size cable, based on current rating, which can be used to supply the motor.

(3 marks)

Ref:

(turn over)

Question 21 continued

- (b) Calculate the minimum size cable, based on voltage drop, which can be used to supply the motor.

(2 marks)

Ref:

- (c) What is the minimum size cable that can be used to supply the motor that satisfies both the loading and voltage drop requirements? State a reason for your selection.

(1 mark)

Ref:

(turn over)

Question 21 continued

Table 12

CURRENT CARRYING CAPACITIES OF THREE-CORE AND FOUR-CORE 0.6/1 kV INSULATED AND SHEATHED (INCLUDING NEUTRAL SCREENED) CABLES WITH OR WITHOUT EARTH CONDUCTOR, ARMoured OR NON-ARMoured CABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Conductor size	Current carrying capacity A															
	Unenclosed				Enclosed								Buried Direct		Underground non-metallic wiring enclosure	
	Spaced		Touching		Non-metallic wiring enclosures in air – round cable		Non-metallic wiring enclosures in air – flat cable		In non-metallic wiring enclosures or unenclosed partially surrounded by thermal insulation		Completely surrounded by thermal insulation					
mm ²	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al
1	15	--	14	--	11	9	14	10	11	8	7	-	21	-	17	-
1.5	18	-	17	-	15	11	17	13	14	11	9	-	26	-	21	-
2.5	26	-	25	-	21	16	23	17	19	15	13	-	37	-	29	-
4	35	-	33	-	27	21	30	23	25	19	17	-	48	-	37	-
6	46	-	42	-	35	27	39	30	33	25	22	-	61	-	47	-
10	52	-	58	-	48	38	52	40	44	34	29	-	81	-	63	-
16	82	64	78	60	64	49	68	52	59	46	39	30	106	83	81	64
25	111	86	104	81	90	68	95	72	82	64	52	40	138	107	106	83
35	137	106	125	99	105	80	105	80	96	74	64	49	165	127	127	100

Table 27(1)

RATING FACTORS FOR VARIATIONS IN AMBIENT TEMPERATURE FOR CABLES IN AIR OR HEATED CONCRETE SLABS AND FOR CABLES BURIED DIRECT IN THE GROUND OR IN UNDERGROUND WIRING ENCLOSURES – AIR AND CONCRETE SLAB TEMPERATURES

1	2	3	4	5	6	7	8	9	10	11
Conductor temperature °C	Rating Factor									
	Ambient temperature									
	15	20	25	30	35	40	45	50	55	60
150	1.07	1.05	1.03	1.00	0.98	0.96	0.94	0.91	0.89	0.87
110	1.08	1.06	1.03	1.00	0.97	0.93	0.90	0.87	0.83	0.79
90	1.15	1.09	1.05	1.00	0.95	0.91	0.85	0.80	0.74	0.66
80	1.17	1.12	1.06	1.00	0.95	0.89	0.82	0.75	0.68	0.59
75	1.18	1.12	1.06	1.00	0.94	0.88	0.80	0.72	0.63	0.53

Table 42

(turn over)

Question 21 continued

THREE-PHASE VOLTAGE DROP AT 50Hz OF MULTICORE CABLES WITH CIRCULAR COPPER CONDUCTORS

Conductor size mm ²	Three-phase voltage drop at 50 Hz, mV/A.m									
	Conductor temperature, °C									
	45		60		75		90		110	
	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.	Max.	0.8 p.f.
1	40.3	-	42.5	-	44.7	-	46.8	-	49.7	-
1.5	25.9	-	27.3	-	28.6	-	30.0	-	31.9	-
2.5	14.1	-	14.9	-	15.6	-	16.4	-	17.4	-
4	8.77	-	9.24	-	9.71	-	10.2	-	10.8	-
6	5.86	-	6.18	-	6.49	-	6.80	-	7.22	-
10	3.49	-	3.67	-	3.86	-	4.05	-	4.29	-
16	2.19	-	2.31	-	2.43	-	2.55	-	2.70	-
25	1.39	-	1.47	-	1.54	-	1.61	-	1.71	-
35	1.01	-	1.06	-	1.11	-	1.17	-	1.24	-

Note: To convert to single-phase values multiply the three-phase value by 1.155

(turn over)

Question 22

- (a) Paragraph 3.3(a) of NZS 3019 requires that inspections of switchboards shall include ensuring that the current ratings, fusing factors, and breaking capacities of protective devices are appropriate for the circuits that they protect.

State what is meant by the following terms.

- (i) Current rating (1 mark)

- (ii) Utilisation category (fusing factor) (1 mark)

- (iii) Breaking capacity (1 mark)

- (b) A particular fuse operates (ruptures) at 25 amps and is said to have an utilisation category of gG. What is the current rating of the fuse? (1 mark)

- (c) Refer to AS/NZS 3000 and state **TWO** situations where the protection disconnection time for a final subcircuit must not exceed 0.4 seconds.

(1) _____

(2) _____

(turn over)

Question 23

Refer to AS/NZS 3000 and answer the following:

- (a) When using colour for the identification of fixed wiring conductors, what colours may be used to identify the phase conductor of a single-phase circuit? (1 mark)

Ref:

- (b) What colours identify equipotential bonding conductors? (1 mark)

Ref:

- (c) State **FOUR** aspects that need to be taken into account when making connections between conductors or between conductors and equipment (4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 24

- (a) An overhead line structure supporting a sub-main to a woolshed is found to be close to failing, which would result in damage to the woolshed and possible injury to workers inside. Refer to the Electricity Regulations and list **TWO** actions that must be taken.

(1) _____

(2) _____

Ref:

- (b) A 10 mm² twin and earth PVC insulated cable is to be buried direct in the ground in a Category A system. Refer to AS/NZS 3000 and state the minimum depth it can be buried if:

(i) It has no further protection (1 mark)

(ii) It is below 75 mm of continuous concrete (1 mark)

Ref:

- (c) Refer to NZECP 34 and state the minimum vertical distance from the ground of a 230 volt overhead service line:

(i) That crosses a footpath used only by pedestrians (1 mark)

(ii) That crosses a driveway (1 mark)

Ref:

(turn over)

Question 25

Refer to AS/NZS 3000 and answer the following:

- (a) State the **TWO** requirements for terminating MIMS (mineral insulated metal sheathed) cables that are subject to vibration.

(2 marks)

(1) _____

(2) _____

Ref:

- (b) For Earth Sheath Return Systems (ESR) state:

- (i) The minimum size conductor permitted.

(1 mark)

Ref:

- (ii) The situation where such a system cannot be used.

(1 mark)

Ref:

(turn over)

Question 25 continued

- (iii) The system of earthing of the electrical installation where an ESR system is to be installed.

(1 mark)

Ref:

- (iv) Where in an electrical installation must an ESR system commence.

(1 mark)

Ref:

(turn over)

Question 26

With regard to switchboards, refer to AS/NZS 3000 and state:

(a) The requirement for accessibility.

(2 marks)

(b) **FOUR** situations where it is not permitted to install a switchboard.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

(turn over)

Question 27

(a) Sketch the (earth) fault loop circuit for a MEN system.

(4 marks)

Ref:

(b) State the main reason why overall impedance/resistance of an (earth) fault loop must be low.

(2 marks)

Ref:

(turn over)

Question 28

RCD protection is required to be installed:

- On socket outlet and lighting final subcircuits in domestic installations.
 - On socket outlet final subcircuits in other residential installations.
- (a) You are required to wire a new domestic residence. Two RCDs will be installed in the switchboard. One RCD will protect half of the socket outlets and half of the lights. The second RCD will protect the other socket outlets and lights.

- (i) The RCDs to be installed have no facility for terminating the neutral conductors. How many neutral busbars will be required in the switchboard?

(1 mark)

- (ii) What other electrical protection is required on the circuits protected by the RCDs

(1 mark)

- (c) Refer to AS/NZS 3000 and state:

- (i) **TWO** situations where RCDs do not need to be installed after alterations, additions or repairs have been carried out.

(2 marks)

(1) _____

(2) _____

Ref:

- (ii) The **ONE** situation where an RCD does not need to be installed on a socket outlet final subcircuit in a new installation.

(1 mark)

(turn over)

Question 28 continued

- (iii) The maximum rated residual current of an RCD installed to protect socket outlet and lighting final subcircuits in domestic installations.

(1 mark)

Ref:

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In the box, write the number of **EXTRA** sheets you have used. Write **NIL** if you have not used any

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Questions Answered	Marks	
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