



Candidate Code No.	
For Board Use Only	
Result	Result
Date	Date
Int	Int

ELECTRICIAN'S REGULATIONS EXAMINATION

23 June 2007

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. Show answers to THREE significant figures.

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 may need to use the following documents in this examination:

- The Electricity Act 1992 reprint dated 19 August 2005.
- The Electricity Regulations 1997 reprint dated 5 September 2005.
- AS 60529 or AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, 3 and A); AS/NZS 3001:2001; NZS 3019 (Int):2002 or NZS 3019:2004; 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)

Question 1

Each part of this question is worth 2 marks.

(a) Refer to the Electricity Regulations and state which of the following types of work are deemed NOT to be prescribed electrical work:

- The operation of electrical installations.
- The maintenance of electrical appliances.
- The rewinding of armatures.
- The installation of electrical conductors.

Ref:

(b) Refer to the Electricity Regulations state briefly, **TWO** types of prescribed electrical work on low voltage installations which do NOT have to be certified on a certificate of compliance.

(1) _____

(2) _____

Ref:

(c) Refer to the Electricity Regulations and state **TWO** items that must be included in the main earthing system of an MEN electrical installation.

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

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

Ref:

- (e) Refer to AS/NZS 3000 and state the requirements that apply to the colours of the conductors of four core flexible cord that supplies a three phase-induction motor controlled by a direct-on-line starter. The phase conductors are all different colours.

Ref:

- (f) Refer to AS/NZS 3000 and state the protection method for a wiring system that is located less than 50 mm from a ceiling fixing support and:

- Has no mechanical protection.
- Is not provided with an earthed metallic armouring, screen, covering or enclosure.

Ref:

(turn over)

Question 1 continued

(g) A 4mm² two core neutral-screened submain cable is to be run between two buildings. It is to be buried direct (unenclosed) in the ground in an unpaved area. Refer to AS/NZS 3000 and state the **TWO** requirements for indicating the position of the buried cable.

(1) _____

(2) _____

Ref:

(h) SELV circuits are required to be arranged in a certain manner. Refer to AS/NZS 3000 and state **TWO** parts of an electrical installation to which SELV circuits must not be connected.

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

- (i) (i) A circuit is protected by a type D MCB has an earth fault loop impedance test reading of 1.1 ohms. Refer to AS/NZS 3000 and state the maximum current rating of that MCB.

(1 mark)

Ref:

- (ii) An earth fault loop impedance test gave a reading of 1.84 ohms. The circuit is to be protected by a HRC fuse with a maximum operating time of 0.4s. Refer to AS/NZS 3000 and state the maximum current rating of that fuse.

(1 mark)

Ref:

- (j) Refer to NZECP 34 and state **TWO** means of restricting access to the conductor of an aerial sub-main to an outbuilding.

(1) _____

(2) _____

Ref:

(turn over)

Question 2

You are making additions and alterations to an existing domestic electrical installation. You are required to install:

- Additional lights in a hallway supplied from existing final subcircuits not protected by an RCD.
- One completely new final subcircuits comprising 4 socket outlets in a new bedroom.
- A new socket outlet located in Zone 2 in a bathroom, supplied from an existing final subcircuit not protected by an RCD.
- Additional socket outlets in the lounge supplied from existing final subcircuits protected by an RCD.
- A new 30A socket outlet for a new range in a different position from the existing range (the existing range and final subcircuit is to be removed).

Refer to AS/NZS 3000 and answer the following:

- (a) Which of the final subcircuits stated in the preamble above are not required to be protected by an RCD? State the reference source for each of your answers.

(2 marks)

- (b) (i) Which of the final subcircuits stated in the preamble above are required to be protected by an RCD. State the reference source for each of your answers.

(2 marks)

(turn over)

Question 3

AS/NZS 3000 states:

Persons and livestock shall be protected against dangers that may arise from contact with parts of the electrical installation which are live in normal service (direct contact).

Refer to AS/NZS 3000 and answer the following:

- (a) State the **FOUR** methods of protection permitted to protect against direct contact
(4 marks)

- (1) _____
- (2) _____
- (3) _____
- (4) _____

Ref:

- (b) The constructional requirements for barriers requires that they cannot be opened or removed by unauthorised persons. State **THREE** methods that can be used to prevent the opening or removal of a barrier by an unauthorised person.
(3 marks)

- (1) _____
- (2) _____
- (3) _____

Ref:

(turn over)

Question 3 continued

(c) Clause 1.7.3.4.1 of AS/NZS 3000 states that barriers should provide a degree of protection. If a barrier was rated IP24:

(i) State what the letters "IP" mean: (1 mark)

(ii) State type of protection provided by the first number. (1 mark)

(iii) State type of protection provided by the second number. (1 mark)

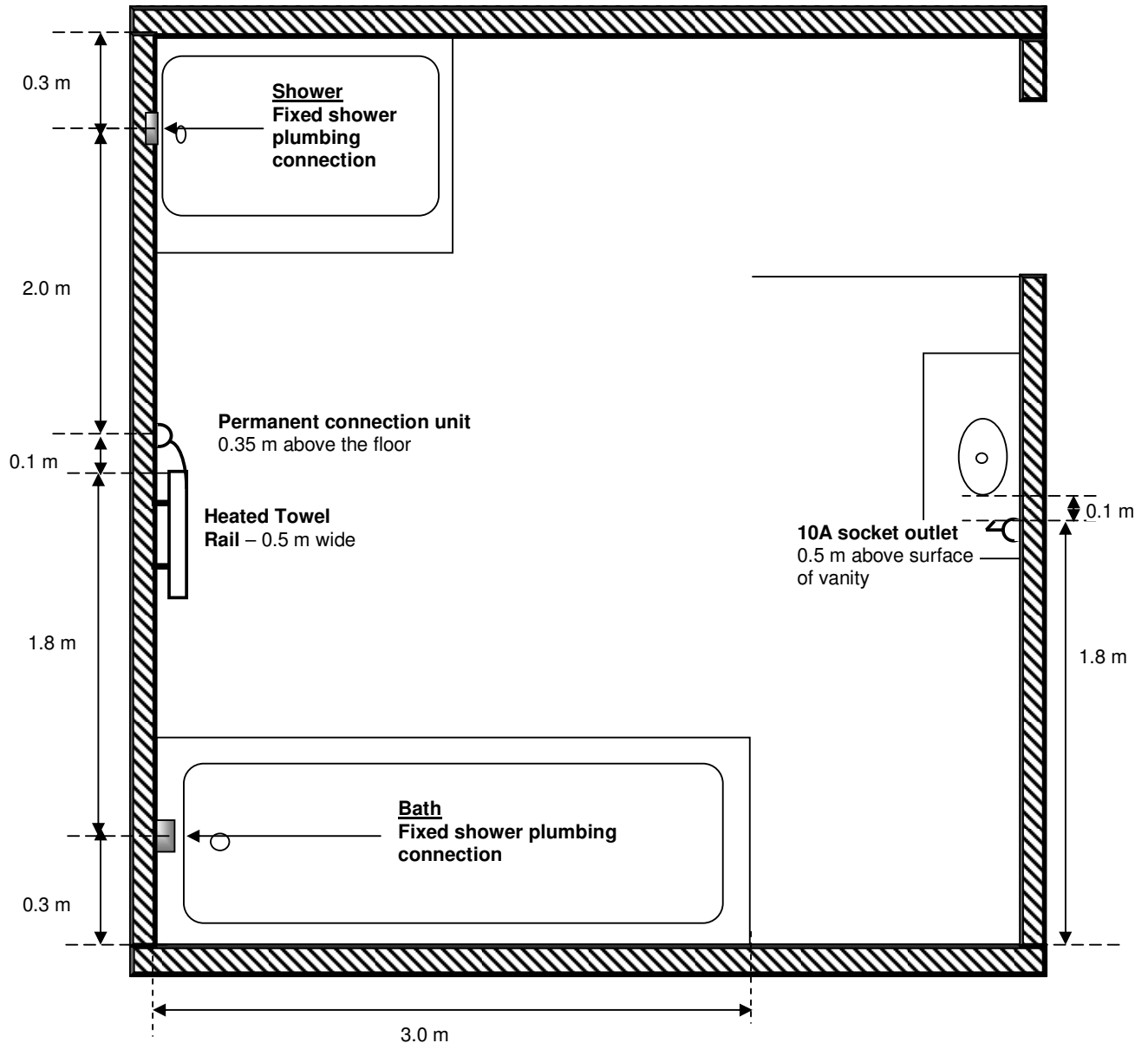
Ref:

(turn over)

Question 4

The following figure shows a bathroom floor plan (not to scale). Note that:

- The bathroom is 4.5 metres square.
- The basin has a capacity of 30 litres.
- There is no partition or barrier around the shower.
- All electrical cables and fittings operate at 230V.



(turn over)

Question 4 continued

Using the information given in the figure above, refer to AS/NZS 3000 and answer the following:

- Note:
1. Some of the electrical fittings may be in two zones. You are to apply the most stringent Zone requirement to the rating of any fitting.
 2. "Plumbing fixture" includes the bath, shower and basin.

(a) Towel rail

- (i) In which Zone or Zones is the towel rail situated? State both the Zone and the plumbing fixture to which the Zone relates.

(1 mark)

Ref:

- (ii) What is the minimum permitted IP rating for the towel rail?

(1 mark)

Ref:

(b) Towel rail permanent connection unit

- (i) In which Zone is the towel rail permanent connection unit situated? State both the Zone and the plumbing fixture to which the Zone relates.

(2 marks)

Ref:

- (ii) What is the minimum permitted IP rating for the permanent connection unit?

(1 mark)

Ref:

(turn over)

Question 4 continued

(c) The socket outlet

- (i) In which Zone is the socket outlet situated? State both the Zone and the plumbing fixture to which the Zone relates.

(2 marks)

Ref:

- (ii) What is the minimum permitted IP rating for the socket outlet?

(1 mark)

Ref:

- (iii) State the **TWO** additional requirements that apply to the socket outlet?

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 5

A customer requires a supply to a single phase oven rated at 21A using a **copper** TPS cable. The cable length is 20 metres and is to be clipped direct (touching).

- The ambient air temperature is 35 °C.
- The voltage at the switchboard is 230 V.
- The conductor temperature is 75 °C.
- An allowance of 20% for future load growth is required.
- The maximum permitted volt drop is 2.5%.

Using this information and the relevant information from the following tables determine the size of cable required for this installation. To determine the cable size you must:

- Find by calculation, the size of cable that will carry the intended load.
- Find by calculation, the size of the cable which satisfies the volt drop requirements.
- State the size of cable that will meet the requirements.

(a) The size of cable that will carry the intended load.

(3 marks)

(turn over)

Question 5 continued

(b) The size of the cable which satisfies the volt drop requirements. (6 marks)

(c) The size of cable that will meet the requirements. (1 mark)

(turn over)

Question 5 continued

The following are extracts from AS/NZS 3008.1.2.

Table 9

Current Carrying Capacities of TWO-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
Con duct or 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					
	mm²	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu
1	17	--	16	--	13	10	15	11	11	9	8	-	24	-	19	-
1.5	22	-	21	-	16	13	19	15	15	11	10	-	31	-	24	-
2.5	31	-	30	-	23	17	25	19	21	16	15	-	44	-	34	-
4	42	-	39	-	30	23	33	25	27	22	19	-	57	-	44	-
6	52	-	50	-	39	30	42	32	35	27	25	-	72	-	56	-
10	73	-	68	-	54	41	57	43	49	38	34	-	96	-	75	-
16	97	75	91	71	72	55	75	57	65	50	46	35	127	97	97	75
25	131	100	120	95	100	76	101	76	90	71	60	47	160	127	127	98
35	160	125	148	114	120	89	120	89	105	82	74	58	198	154	154	121

Note: The ratings are based on 30°C ambient air temperature and 15°C ambient soil temperature

(turn over)

Question 5 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					
	mm²	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu	Al	Cu
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

Note: The ratings are based on 30°C ambient air temperature and 15°C ambient soil temperature

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

(turn over)

Question 5 continued

Table 27(2)

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 – SOIL TEMPERATURES

1	2	3	4	5	6	7	8
Conductor temperature °C	Rating Factor						
	Ambient temperature						
	10	15	20	25	30	35	40
110	1.02	1.00	0.97	0.94	0.92	0.89	0.86
90	1.04	1.00	0.96	0.93	0.91	0.87	0.83
80	1.04	1.00	0.95	0.92	0.88	0.83	0.78
75	1.04	1.00	0.95	0.91	0.86	0.81	0.75

Table 42

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 6

The Electricity Regulations requires that electrical work on low voltage electrical installations be tested and verified in accordance with AS/NZS 3000.

- (a) Refer to AS NZS 3000 and state **FOUR** mandatory inspections and tests required to be carried out on a low voltage electrical installation. (2 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

- (b) A completed three-phase, 230/400 volt new bakery includes four 10 kilowatt ovens with MIMS elements. The insulation resistance test result for the entire installation is 500,000 ohms.

However, with the ovens disconnected, the insulation resistance test result for the installation is 100 Mohms.

Refer to AS/NZS 3000 and state the reasons why this installation complies and can be certified on a Certificate of Compliance.

(3 marks)

Ref:

(turn over)

Question 6 continued

(c) Refer to AS/NZS 3000 and state **FIVE** aspects relating to electrical equipment that should be inspected after work has been completed in a low voltage electrical installation.

(5 marks)

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

Ref:

(turn over)

Question 7

Clause 1.9.2 of AS/NZS 3000 states that all electrical equipment in an electrical installation shall:

- Be safe to use when properly assembled, installed and connected to supply; and
- Not cause a danger from electric shock, fire, high temperature or physical injury in the event of reasonably expected conditions of overload, abnormal operation, fault or external influences.

Refer to AS/NZS 3000 and answer the following:

- (a) Each electrical installation shall be provided with a switchboard or switchboards. State the requirement for an installation when the MEN system of supply is used.

(1 mark)

Ref:

- (b) Switchboards can be installed in specific locations provided their installation meets certain additional requirements.

- (i) State the requirements for installing a switchboard in a cupboard.

(3 marks)

Ref:

(turn over)

Question 7 continued

(ii) State the requirements for installing a switchboard near a shower. (2 marks)

Ref:

(iii) State the requirements for installing a switchboard near a swimming pool. (2 marks)

Ref:

(c) There are restricted locations for switchboards. State **TWO** situations where the installation of a switchboard is totally prohibited. (2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 8

The provision of protective earth connections to electrical equipment or fittings is to ensure operation of protective devices in the event of an earth fault from active to earth."

- (a) Refer to AS/NZS 3000 and state the **TWO** restrictions on a protective earthing conductor that originates at a distribution board.

(2 marks)

(1) _____

(2) _____

Ref:

- (b) Refer to AS/NZS 3000 and state the **THREE** methods of protecting earthing conductors against mechanical damage.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 8 continued

(c) A multi-phase electricity supply has active conductors are of different sizes. Refer to AS/NZS 3000 and state how is the minimum size of the earth continuity conductor is determined?

(2 marks)

Ref:

(d) Refer the Electricity Regulations and state:

(i) The **FIVE** components of the main earthing system of an MEN electrical installation operating at standard low voltage.

(2½ marks)

- (1) _____
- (2) _____
- (3) _____
- (4) _____
- (5) _____

Ref:

(ii) The wording of the warning label required near some earthing connection points.

(½ mark)

Ref:

(turn over)

Question 9

Refer to AS/NZS 3000 and determine the maximum demand in amperes of a 230 volt domestic installation with the following loads:

- 32 lighting points
- 10 double socket outlets (10 A)
- 12 single socket outlets (10 A)
- 1 gas water heater with auxiliaries supplied from a 10A permanent connection unit
- 1 electric range (12 kW)
- 3000 watts of outdoor lighting for a tennis court
- 1 6kW spa pool

(10 marks)

Load Group	Calculation	Load (A)
<u>Group</u>		
<u>Group</u>		
<u>Group</u>		
<u>Group</u>		
Total maximum demand		

Ref:

For Candidate's Use

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

For Examiner's Use Only

Questions Answered	Marks	
1		
2		
3		
4		
5		
6		
7		
8		
9		
TOTAL		