



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

ELECTRICIAN'S REGULATIONS EXAMINATION

24 November 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.

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 some of 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

(a) The Electricity Act states that no registered person shall be entitled, by virtue of their registration, to do any prescribed electrical work for payment or reward, unless that person is the holder of a practising licence.

(i) On what date does a practising licence expire?

(1 mark)

Ref:

(ii) To whom must application be made for the licence?

(1 mark)

Ref:

(b) Refer to the Electricity Regulations and state the type of protection 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:

(turn over)

Question 1 continued

(c) Refer to the Electricity Regulations and state **TWO** situations where "fittings" are deemed not to be electrically safe (that is they do not comply with Regulation 69(1)).

(2 marks)

(1) _____

(2) _____

Ref:

(d) Refer AS/NZS 3000 and state **TWO** of the methods of providing protection against indirect contact.

(2 marks)

(1) _____

(2) _____

Ref:

(e) Refer to AS/NZS 3000 and state the **TWO** situations where RCD protection is required in a new domestic electrical installation

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

- (f) Refer to AS/NZS 3000 and state the requirements for flexible cords used as fixed wiring.

(2 marks)

Ref:

- (g) The radius of a cable bend must not be less than that recommended by the cable manufacturer. Refer to AS/NZS 3000 and state the minimum internal radii of the following cables where no manufacturer’s recommendation is available:

- (i) Unarmoured sheathed cables.

(1 mark)

- (ii) Armoured sheathed cables.

(1 mark)

Ref:

(turn over)

Question 1 continued

(h) A three-phase low voltage industrial electrical installation is supplied by a 70mm² neutral screen aluminium cable. State the minimum permissible cable size and conductor type for the:

(i) Main earthing conductor (1 mark)

Ref:

(ii) Equipotential bonding conductors. (1 mark)

Ref:

(i) Refer to AS/NZS 3000 and specify the conductor type and the minimum permissible conductor size for the main earthing conductor for a three-phase low voltage electrical installation. (2 marks)

Ref:

(j) Refer to AS/NZS 3000 and state the reason why equipotential bonding is carried out in an electrical installation. (2 marks)

Ref:

(turn over)

Question 2

(a) The staff room of a college has THREE room heaters connected by fixed wiring and has a single entry door. Refer to AS/NZS 3000 and answer the following questions in relation to the position of functional switches and isolation switches for the heaters.

(i) State **THREE** general requirements in relation to the functional and isolation switches for the heaters.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(ii) State **TWO** positions where an isolating switch or isolating switches can be located.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 2 continued

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

(i) **THREE** features that an isolating device must have.

- Note:
1. Isolation is the only function of the device.
 2. Features must relate to the device itself, not how it is installed.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(ii) **TWO** features a functional switch must have.

- Note:
- Features must relate to the switch itself, not how it is installed.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 3

(a) You have been engaged to wire a new house that is to be constructed near a 33kV pole line. The supply to the house will be a 16mm² two core PVC underground cable. It is to be buried with Category B protection in an unpaved area.

(i) Refer to NZECP 34 and answer the following:

You need to excavate a 600 mm deep trench parallel to and 3 metres from power poles.

(1) Is it necessary to obtain consent from the owner of the line to do this work? Give a reason for your answer.

(1 mark)

Ref:

(2) What is the maximum depth this trench may be excavated without obtaining the written consent?

(1 mark)

Ref:

(3) What reason, other than the depth of the trench or the distance from the poles, would require you to obtain the written consent of the line owner?

(1 mark)

Ref:

(turn over)

Question 3 continued

(4) What restriction is placed on the positioning of the excavated material?

(1 mark)

Ref:

(ii) Refer to AS/NZS 3000 and answer the following:

(1) State the requirement for indicating the position of the buried cable.

(1 mark)

Ref:

(2) State the minimum depth to which the cable must be buried.

(1 mark)

Ref:

(3) State the requirements for bedding the cable in the ground.

(2 marks)

Ref:

(turn over)

Question 3 continued

- (b) Refer to AS/NZS 3000 and state the **TWO** types of cable that require no additional protection when buried, that could replace the type of cable mentioned in the preamble above.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 4

(a) A new laundry has been built that incorporates a washing machine. The accessory that connects the washing machine to the fixed wiring is in Zone 2 of the laundry tub. The accessory can be a socket outlet or a permanent connection unit. Refer to AS/NZS 3000 and state the requirements that relate to:

(i) The socket outlet.

(3 marks)

Ref:

(ii) The permanent connection unit.

(1 mark)

Ref:

(b) AS/NZS 3000 requires that RCDs be installed:

- On socket outlet and lighting final subcircuits in domestic installations.
- On socket outlet final subcircuits in other residential type installations.

However, RCDs are also required in other electrical installations.

Refer to AS/NZS 3000 and state **TWO** areas in commercial and industrial electrical installations where you consider additional personal protection should be provided by using an RCD for the protection of users of electrical appliances and equipment.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 4 continued

- (c) You have been requested to carry out work in an existing kitchen that is being renovated.

There is one existing final subcircuit supplying 4 socket outlets. This circuit is not RCD protected. Two existing socket outlets are in the kitchen and are the last two on the circuit. The other two socket outlets are in a bedroom adjacent to the kitchen.

You have been requested to install three additional new socket outlets in the kitchen and ensure that all socket outlets in the kitchen are RCD protected.

You have determined that:

- The existing final subcircuit in the kitchen has the capacity to supply all seven socket outlets.
- The method of construction of the house means that it would be extremely difficult and expensive to install a cable to an RCD protected circuit or to run a new circuit back to the switchboard.
- No alterations can be made to or near the switchboard

State **TWO** solutions either of which will enable you to ensure that all socket outlets are protected by an RCD.

(4 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 5

There are two electrical installations side-by-side each with its own point of supply. One building is a new electrical installation. The other building is an existing electrical installation that has been disconnected for 7 months.

(a) Refer to the Electricity Regulations and answer the following:

- (i) You have wired the new installation and carried out additions to the existing installation and now need to test the work carried out. State the **THREE** general requirements that relate to the testing of prescribed electrical work.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

- (ii) State the person who is required to carry out the inspection of the some of the prescribed electrical work on the new installation. State a reference source with your answer.

(1 mark)

Ref:

(turn over)

Question 5 continued

- (iii) List the **TWO** types of documents the person who connects both installations to the electricity supply must sight before doing the reconnections.

(2 marks)

(1) _____

(2) _____

Ref:

- (b) Refer to AS/NZS 3000 and state **FOUR** of the mandatory tests and checks you must carry out on the new electrical installation.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 6

A low rise development contains 12, 230v domestic electrical installations. The development has 4 units per phase.

- (a) Refer to AS/NZS 3000 and determine the maximum demand in amperes of one domestic electrical installation with the following loads:

32	Lighting points	1	Electric oven – 2.5kW
4	Double socket outlets (10A)	1	Storage water heater – 2kW
10	Single socket outlets (10A)	1	Air-conditioning unit – 4kW

(7 marks)

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

Ref:

(turn over)

Question 6 continued

- (b) You have been requested to install a copper mains cable to the unit for which you have calculated the maximum demand in part (a) above.

Calculate the size of the cable required based on the following information and the information contained in the Tables that follow Question 9:

- The cable will be buried direct.
- The load is the maximum demand calculated in part (a) above.
- The ambient soil temperature is 20° C
- The conductor temperature to be 75° C

Note: Voltage drop is not an issue as it is a short length of cable run.
(3 marks)

(turn over)

Question 7

You have completed wiring work on three buildings in a commercial development each with its own three-phase supply. Each building has its own point of supply and metering.

The work you have carried out is as follows:

<u>Building 1</u>	<u>Building 2</u>	<u>Building 3</u>
<p>This is a new building. You have installed all of the wiring work from the point of supply to the entire installation.</p>	<p>This is an existing building. From the existing switchboard you have:</p> <ul style="list-style-type: none"> • Rewired all of the final subcircuits with conductors of the same size. • Installed a new sub-main to a new outbuilding. • Installed a new distribution board and final subcircuits in the outbuilding. 	<p>This is an existing building. You have:</p> <ul style="list-style-type: none"> • Installed new mains, and main switchboard of a larger size. • Up-graded the main earthing system • Installed three new final subcircuits.

Refer to the Electricity Regulations and answer the following:

- (a) For the prescribed electrical work detailed in the preamble above, state the document and section of that document that details the types of testing required to be carried out.

(1 mark)

Ref:

- (b) For the prescribed electrical work detailed in the preamble above, state the document and section of that document that details the types of inspections required to be carried out.

(1 mark)

Ref:

(turn over)

Question 7 continued

- (c) For each building stated in the preamble above, state which work is required to be certified on a Certificate of Compliance.

(1½ marks)

Building 1

Building 2

Building 3

Ref:

- (d) A Certificate of Compliance will be issued for each building stated in the preamble above.

- (i) In each case, when must the Certificate be completed?

(1 mark)

Ref:

- (ii) In each case, when must the Certificate be given to the owner of each building?

(1 mark)

Ref:

(turn over)

Question 7 continued

- (e) For each building stated in the preamble above, state which work is required to be inspected by a registered electrical inspector?

(3 marks)

Building 1

Building 2

Building 3

Ref:

- (f) State **THREE** types of instrument tests that would require the connection of the electricity supply for testing purposes.

(1½ marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 8

- (a) A 5000 litre in-ground swimming pool is being installed in a domestic residence. A block wall will run along one side of and 1.5 metres from the internal rim of the pool. All equipment external to the pool operates at 230V.

Refer to AS/NZS 3000 and answer the following:

- (i) Can a socket outlet to be used for the connection of pool equipment be attached to the block wall? Give a reason for your answer.

(1 mark)

Ref:

- (ii) Can a socket outlet to be used for general purposes be attached to the block wall? Give a reason for your answer.

(1 mark)

Ref:

- (iii) If a socket outlet is to be installed in Zone 1 of the swimming pool, state **TWO** methods that can be used to supply the socket outlet.

(3 marks)

(1) _____

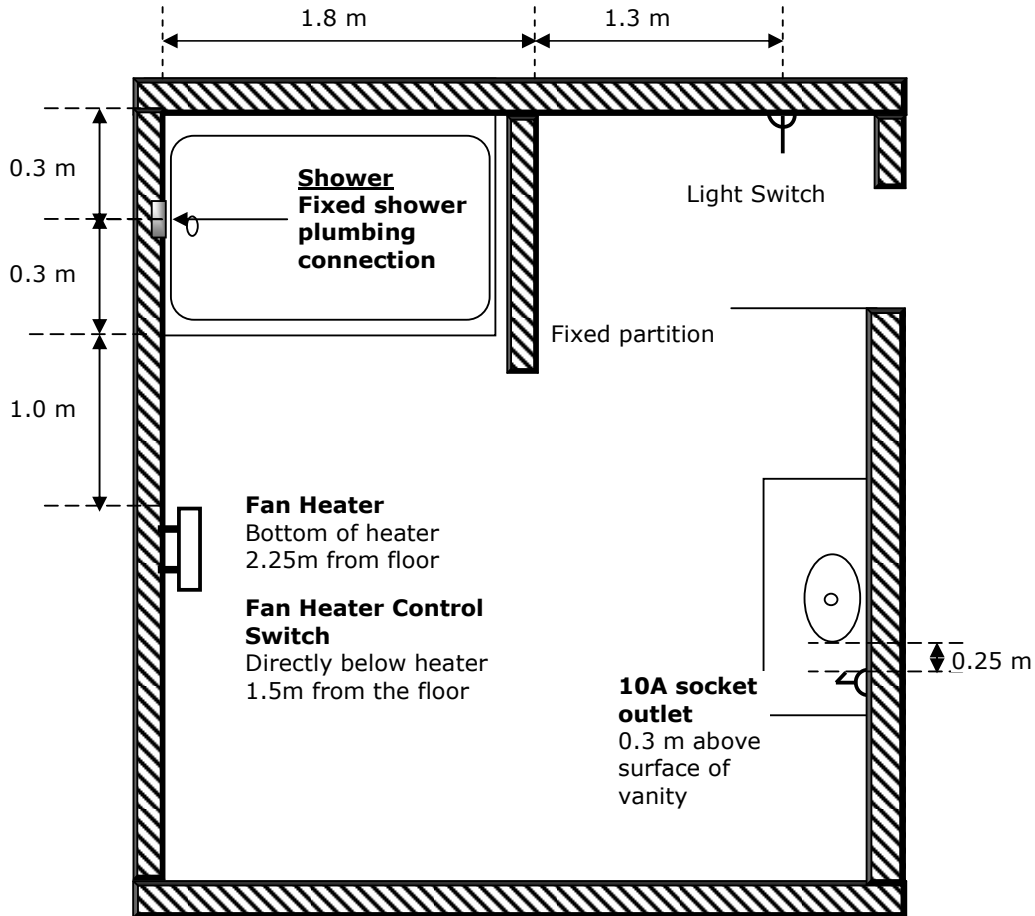
(2) _____

(turn over)

Question 8 continued

(b) The following figure shows an en-suite bathroom floor plan (not to scale) for a new domestic residence. Note that:

- The bathroom is 3 metres square.
- The basin has a capacity of 30 litres.
- All electrical cables and fittings operate at 230V.



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

(i) In which Zone of which plumbing fixture is the fan heater and control switch situated?

(1 mark)

Ref:

(turn over)

Question 8 continued

- (ii) What degree of protection is required for the fan heater and control switch?

(1 mark)

Ref:

- (iii) In which Zone of which plumbing fixture is the socket outlet situated?

(1 mark)

Ref:

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

(1 mark)

Ref:

- (v) In which Zone of which plumbing fixture is the light switch?

(1 mark)

(turn over)

Question 9

You have been engaged to lay a 4-core neutral screened **copper** cable at in a commercial development from an indoor 400 V, three-phase distribution board to an outdoor metering location in an area of the development.

- The cable run length is 20 m.
- The maximum half-hour demand of the new load is 70 kVA.
- The cable will be surface mounted (touching).
- The ambient air temperature is 20 °C.
- The voltage at the switchboard is 400 V.
- The voltage drop from the switchboard to the metering station must not exceed 3.5 volts.
- An allowance of 10% must be made for future growth.
- The conductor temperature is assumed to be 75 °C

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

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

(5½ marks)

(turn over)

Question 9 continued

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

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

(turn over)

Question 9 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 9 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
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 9 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 mm²	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

For Candidate's Use

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	
1		
2		
3		
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6		
7		
8		
9		
TOTAL		