



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

ELECTRICIAN'S REGULATIONS EXAMINATION

25 November 2006

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 TWO decimal places.

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

Answer all parts of this question. Each part is worth 2 marks.

- (a) (i) A registered electrician finds that dangerous work has been carried out by another registered electrician, and wishes to lodge a complaint against that person. Refer to the Electricity Act and state what action should be taken to lodge the complaint.

(1 mark)

Ref:

- (ii) The registered electrician who did the dangerous work has been found guilty of a disciplinary offence. Refer to the Electricity Act and state, briefly, **TWO** of the disciplinary actions that can be imposed by the Board.

(1 mark)

(1) _____

(2) _____

Ref:

- (b) For an electrical installation operating at standard low voltage, the Electricity Regulations permit the voltage to fluctuate at the point of supply. Refer to the Electricity Regulations state:

- (i) The maximum percentage fluctuation permitted above standard low voltage.

(1 mark)

- (ii) The maximum percentage fluctuation permitted below standard low voltage.

(1 mark)

Ref:

(turn over)

Question 1 continued

(c) Refer to the Electricity Regulations and state **TWO** methods of personal protection that can be used where a person using a handheld appliance is partly immersed in a conductive substance.

(1) _____

(2) _____

Ref:

(d) Refer to the Electricity Regulations and state **TWO** details of an electrical accident that must included in a report to the Secretary.

(1) _____

(2) _____

Ref:

(e) Refer to AS/NZS 3000 and state the protection method for a wiring system that is located less than 50 mm from the underside of a roof and:

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

Ref:

(turn over)

Question 1 continued

(f) Refer to AS/NZS 3000 and list **FOUR** types of equipment, fittings or conductors that form part of a MEN earthing system.

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(g) Refer to AS/NZS 3000 and state the **TWO** methods of protection prohibited in areas where general hosing down operations are carried out.

(1) _____

(2) _____

Ref:

(h) Each extra-low voltage circuit must have overcurrent protection. Refer to AS/NZS 3000 and state where overcurrent protection is required to be installed in an extra-low voltage supply that is earthed at the point of supply

Ref:

(turn over)

Question 1 continued

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

- (i) An earth fault loop impedance test gave a reading of 1.1 ohms. If the circuit is to be protected by a type D MCB, what would be the maximum current rating of that MCB?

(1 mark)

Ref:

- (ii) An earth fault loop impedance test gave a reading of 1.84 ohms. If the circuit is to be protected by a HRC fuse with a maximum operating time of 0.4s, what would be the maximum current rating of that fuse?

(1 mark)

Ref:

(j) Refer to AS/NZS 3000 and state what is meant by the term "Type A" in respect to an RCD.

Ref:

(turn over)

Question 2

You are wiring a low voltage electrical installation that comprises a main (MEN) switchboard which in turn supplies a distribution board. Final subcircuits originate at the MEN switchboard and the distribution board. Refer to AS/NZS 3000 and answer the following:

(a) The installation is supplied by a 16 mm² copper, twin TPS cable. State:

(i) The type and minimum permissible size for the main earthing conductor

(1 mark)

Ref:

(ii) The minimum permissible size for equipotential bonding conductors.

(1 mark)

Ref:

(b) State **TWO** types of pipes that shall not be used as a protective earthing conductor in the electrical installation.

(2 marks)

(1) _____

(2) _____

Ref:

(c) State the situation where metallic piping systems (e.g., gas or hot water pipes) in the electrical installation need to be connected to an equipotential bonding conductor.

(2 marks)

Ref:

(turn over)

Question 2 continued

(d) State the reason why equipotential bonding is carried out in the electrical installation.

(2 marks)

Ref:

(e) State the main reason why the overall impedance of the (earth) fault loop in the installation must be low.

(1 mark)

Ref:

(f) State **ONE** restriction on a protective earthing conductor that originates at the distribution board in the electrical installation.

(1 mark)

Ref:

(turn over)

Question 3

You have been asked to install a 4-core neutral screened copper cable at a metal crushing plant from an outdoor 400 V, three-phase distribution panel to a motor control centre. There are two possible routes for the cable one buried direct, the other mounted on the surface (touching) of the structure. The information for each method is as follows:

Buried direct	Surface mounted (touching)
<ul style="list-style-type: none"> The cable run length is 45 m. The maximum half-hour demand of the new motor load is 103.2A. The ambient soil temperature is 15 °C. The voltage at the switchboard is 400 V. The voltage drop from the switchboard to the motor control centre must not exceed 10 volts. The conductor temperature is assumed to be 75 °C 	<ul style="list-style-type: none"> The cable run length is 45 m. The maximum half-hour demand of the new motor load is 103.2A. The ambient air temperature is 35 °C. The voltage at the switchboard is 400 V. The voltage drop from the switchboard to the motor control centre must not exceed 10 volts. The conductor temperature is assumed to be 75 °C

Using this information and the information in the following tables answer the following:

- (a) Calculate the minimum cable size for each installation method based on the maximum half-hour demand. (3 marks)

Buried direct	Surface mounted (touching)

(turn over)

Question 3 continued

- (b) Calculate the cable size for each installation method that will meet the volt drop requirements.

(6½ marks)

Buried direct	Surface mounted (touching)

- (c) From the cable sizes you have determined in (a) and (b) state the suitable size of the cable and installation method for this job (ignore the installation cost).

(½ mark)

(turn over)

Question 3 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
Conduct 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					
	mm ²	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	13	100	120	95	100	76	101	76	90	71	60	47	160	127	127	98
35	16	125	148	114	120	89	120	89	105	82	74	58	198	154	154	121
0																

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

(turn over)

Question 3 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 3 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 4

(a) Refer to AS/NZS 3000 and state **THREE** reasons why testing for polarity is necessary.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(b) List the equipment and test instrument you would use to test the polarity of the mains in a **live** single-phase low voltage electrical installation.

(3 marks)

(turn over)

Question 5

A 400V/230V motor control centre is being installed in a factory. The control centre will provide individual circuits to a number of single-phase and three-phase motors. All motors are permanently connected and the smallest motor is rated at 0.3kW. Refer to AS/NZS 3000 and answer the following:

- (a) Does the motor supply circuit to each motor require an isolating switch? Give a reason for your answer.

(2 marks)

Ref:

- (b) Most motors require protection against overload. State the minimum motor rating where protection against overload must be provided.

(1 mark)

Ref:

- (c) (i) State the minimum motor rating where over-temperature protection must be provided for a motor that is attended.

(1 mark)

Ref:

- (ii) State the **TWO** situations where over temperature protection must not be provided for a motor.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 5 continued

- (d) Some of the three-phase motors have power factor correction capacitors permanently connected in the supply circuit conductors. State the requirement relating to the current rating of the circuit conductors. (2 marks)

Ref:

- (e) State **TWO** features of isolating switches used for the isolation of the motors. (2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 6

It is proposed to install wiring in a small engineering workshop. Refer to AS/NZS 3000 and answer the following.

- (a) State **FOUR** aspects that must be considered when making connections between conductors and electrical equipment.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

- (b) State the **FOUR** locations in which it is deemed that wiring systems are likely to be disturbed.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 6 continued

(c) State the requirements for the changing of wiring enclosures.

(2 marks)

Ref:

(turn over)

Question 7

Wiring systems shall be installed so that they:

- Are safe
- Do not cause any detrimental effect to other wiring systems or non-electrical service
- Are not affected by other wiring systems and non-electrical services.

Refer to AS/NZS 3000 and answer the following:

- (a) An underground cable has been installed to comply with Category B requirements. State **FOUR** methods of mechanical protection.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

- (b) State the **THREE** methods of segregating extra-low voltage cables and low voltage cables installed in the same wiring system.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 7 continued

(c) State **THREE** requirements for cable trunking installations. (3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 8

(a) You are carrying out work at a hotel complex that involves wiring a 10 room extension. This comprises lights and socket outlets in each room and in the common hall way

(i) On what type of circuits are Residual Current Devices (RCDs) required to be installed?

(1 mark)

Ref:

(ii) State **THREE** situations where RCDs are not required to be installed.
(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 8 continued

(b) If Residual Current-operated Circuit Breakers (RCCBs) are installed, what other type of electrical protection is also required to be installed? Give a reason for your answer.

(2 marks)

(c) Refer to AS/NZS 3000 and state **FOUR** situations where RCD protection is **not** required to be installed on socket outlet circuits that are altered or repaired in an existing domestic electrical installation.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 9

You have carried out the following work during renovations on a low voltage electrical installation.

- Installed a new 16 mm² underground mains from the plinth on the boundary to a new meter box. This replaced a 10 mm² overhead service line and inside metering.
- Installed new 16 mm² internal mains between the new meter box and new main switchboard.
- Installed a new main switchboard in a new location to replace the existing surface mounted type.
- Replaced the existing permanently connected electric range with a range of the same rating.
- Installed a new main earthing lead and earth electrode. This replaced the bare main earth lead connected to water pipes.
- Installed new equipotential bonding conductors to the existing water pipes.
- Installed a new RCD protected socket outlet on the outside of the house.
- Installed additional lights and power points in the existing living areas.

Refer to the Electricity Regulations and answer the following:

- (a) State **SIX** items of the above work that are required to be certified on a Certificate of Compliance?

(3 marks)

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

Ref:

- (b) Which of the above work is required to be tested in accordance with section 6 of AS/NZS 3000?

(1 mark)

Ref:

(turn over)

Question 9 continued

(c) State the **THREE** items of the above work that are required to be inspected and certified by a registered electrical inspector.

(1½ marks)

(1) _____

(2) _____

(3) _____

Ref:

(d) (i) How long after the completion of the work must the Certificate of compliance be completed?

(½ mark)

Ref:

(ii) How long after the completion of the work must the Certificate of compliance be issued to the customer?

(½ mark)

Ref:

(iii) Given that you have to certify the work on a certificate of compliance and the inspector has to certify the inspection on that certificate, who is required to issue the certificate of compliance to the customer?

(½ mark)

Ref:

(e) For how long must you retain a copy of the certificate of compliance?

(1 mark)

Ref:

(turn over)

Question 9 continued

(f) What are you certifying when you have completed the Certificate of Compliance?

(2 marks)

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		
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TOTAL		