



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

ELECTRICAL WORKERS REGISTRATION BOARD

ELECTRICAL INSPECTOR THEORY EXAMINATION

19 November 2005

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 and amendments or The Electricity Act 1992 reprint dated 19 August 2005.
- 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 or
The Electricity Regulations 1997 reprint dated 5 September 2005.
- AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, 3 and A); AS/NZS 3001:2001; AS/NZS 3004/2002; NZS 3019 (Int):2002 or NZS 3019 2004; AS/NZS 3760:2001 or AS/NZS 3760:2003
- ECP 34, 35, 51 and ECP 54

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

Question 1

Each part is worth 1 mark, (total 20 marks)

- (a) Refer to the Electricity Act 1992 and state what is meant by the term electrical wiring work?

Ref:

- (b) A registered person may carry out prescribed electrical work for hire or reward subject to **ONE** condition. Refer to the Electricity Act and state that condition.

Ref:

- (c) Define the term “standard low voltage” with respect to the **MEN** system only?

Ref:

- (d) State briefly **ONE** of the safety precautions specified in the Electricity Regulations which must be complied with on a low voltage installation to safeguard against unintentional re-livening after isolation.

Ref:

(turn over)

Question 1 continued

(e) The Electricity Regulations requires certain prescribed electrical work to be certified on a Certificate of Compliance before connection to a power supply. Refer to the Regulations and state **TWO** kinds of prescribed electrical work where this does not apply.

(1) _____

(2) _____

Ref:

(f) Which Standard may be used for electric security fences in accordance with the Electricity Regulations?

Ref:

(g) Refer to the Electricity Regulations and state the **TWO** requirements for earthing or bonding metal.

(1) _____

(2) _____

Ref:

(h) Under what circumstances does AS/NZS 3000 state that the earthing contact of a socket outlet need not be earthed?

Ref:

(turn over)

Question 1 continued

- (i) Refer to AS/NZS 3000 and state whether it is permissible to install a switchboard in a swimming pool or spa pool Zone. Include a reference source to support your answer.

Ref:

- (j) Refer to AS/NZS 3000 and state the **TWO** requirements that provide early warning of the presence of an underground cable?

(1) _____

(2) _____

Ref:

- (k) Refer to AS/NZS 3000 and state whether or not a neutral screen cable constructed for underground conditions and buried direct requires additional protection against mechanical damage. Include a reference source to support your answer.

Ref:

- (l) Refer to AS/NZS 3000 and state the minimum resistance required for a protective earthing conductor continuity test in an electrical installation.

Ref:

(turn over)

Question 1 continued

- (m) Refer to AS/NZS 3000 and state **TWO** components that must be included in the earthing system of a MEN electrical installation.

(1) _____

(2) _____

Ref:

- (n) Refer to AS/NZS 3000 and state **TWO** items that are not required to be earthed.

(1) _____

(2) _____

Ref:

- (o) Refer to AS/NZS 3000 and state where ordinary switches may be used in a bathroom, and under what condition?

Ref:

- (p) Refer to AS/NZS 3000 and state the maximum demand per phase for a domestic electric range in a three-phase residential block of flats containing 5 living units.

Ref:

- (q) Refer to AS/NZS 3001 and state the minimum IP rating against ingress of moisture for a low voltage socket outlet located on the exterior of a caravan.

Ref:

(turn over)

Question 1 continued

- (r) An electrical inspector has been called to inspect wiring installation work on a new house carried out by the home owner. Refer to NZS 3019 and state **TWO** categories of tests using test instruments that are required to be carried out.

(1) _____

(2) _____

Ref:

- (s) Refer to NZS 3019 and state **TWO** requirements for an RCD designed or used for personal protection.

(1) _____

(2) _____

Ref:

- (t) For what practical reason is it necessary to test all three-phase socket outlets in a new installation with a phase sequence indicator.

Ref:

(turn over)

Question 2

- (a) Refer to AS/NZS 3000 and state **TWO** circumstances where an overload protective device may be omitted?

(2 marks)

(1) _____

(2) _____

Ref:

- (b) Refer to AS/NZS 3000 and state **TWO** types of fittings that are suitable for protection against both overload and short circuit currents.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 2 continued

(c) You have recorded an earth-fault loop test of 1.6Ω for a Type C MCB protecting a final sub-circuit supplying 15A socket outlets. Refer to AS/NZS 3000 and state:

(i) The minimum disconnection time permitted for the MCB under fault conditions. Include a reference source to support your answer.

(2 marks)

(ii) The maximum Type C MCB rating that will ensure the circuit disconnects within the minimum time. Include a reference source to support your answer.

(2 marks)

(d) An earth loop impedance tester reads 0.18 ohms when connected to a 230V socket-outlet. Calculate the prospective short circuit current.

(2 marks)

(turn over)

Question 3 continued

(iii) The dishwasher and washing machine.

(1 mark)

Ref:

(b) You have also been requested by the electricity retailer to inspect and reconnect the electrical installation. Refer to the Electricity Regulations and state the **FOUR** tests and checks that you should carry out before connecting the installation to the supply.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 5

An electrician has upgraded the main switchboard in a domestic residence to cater for an increase in load. An electrical inspector is required to inspect and reconnect this low voltage electrical installation to the supply. In addition some work has been carried out by the homeowner

- (a) Refer to NZS 3019 and list the **THREE** items on the main switchboard which must be inspected and/or tested before this installation is connected to the supply. (3 marks)

(1) _____

(2) _____

(3) _____

Ref:

- (b) Refer to the Electricity Regulations and list another **FOUR** types of work similar to that stated in the preamble above, which would also require an inspection. (4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 5 continued

(c) Refer to the Electricity Regulations and state:

- (i) The work carried out by the owner of domestic premises that is required to be tested by a registered electrical inspector.

(1 mark)

Ref:

- (ii) The Standard to which the electrical inspector must carry out the testing of the work stated in (c)(i) above.

(1 mark)

Ref:

- (iii) The circumstances under which the owner of domestic premises can relocate existing switches, socket outlets and lighting outlets.

(1 mark)

Ref:

(turn over)

Question 6

- (a) In a single phase domestic installation, what hazards would occur if the phase and neutral were interchanged at the mains entry box and the fault loop on the installation was of a high impedance?

(4 marks)

(1) _____

(2) _____

(3) _____

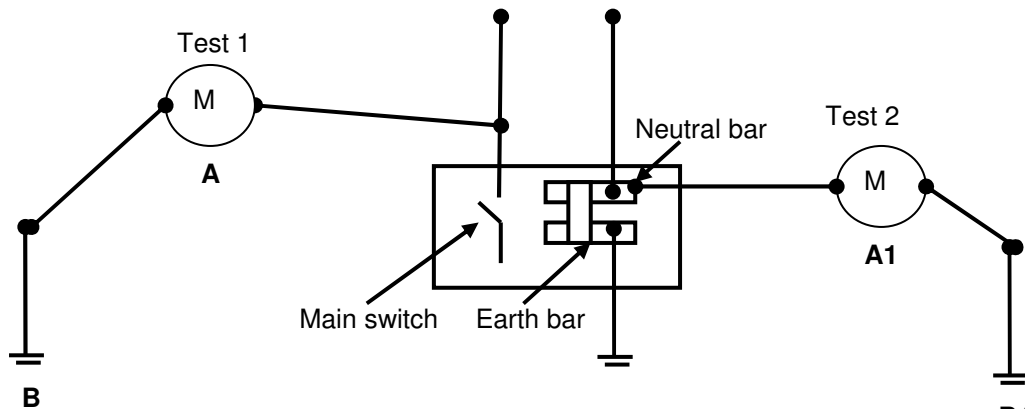
(4) _____

(turn over)

Question 6 continued

- (b) The diagram below represents a two-stage test carried out at the main switchboard of an MEN electrical installation. This test was carried out because an overhead to underground conversion had taken place on the installation and a new underground service line was connected to the existing mains entry box.

“A” and “A1” are the same meter.



- (i) What type of test is being carried out? (1 mark)

- (ii) What type of meter is “A”. (½ mark)

- (iii) What components are “B” and “B1”? (½ mark)

- (iv) Describe what is being checked in Test 1. Include the expected reading on the meter. (2 marks)

- (v) Describe what is being checked in Test 2. Include the expected reading on the meter. (2 marks)

(turn over)

Question 7

A PVC insulated multi-core copper cable clipped direct (touching) is to be used to supply an 80 kW, three-phase, 400 V load in a factory. The ambient temperature is 20°C. The distance between the switchboard and the furnace is 78 metres, and the cable is to be protected by HRC fuses. The voltage at the point-of-supply is 400V.

Assume the conductor temperature to be 75 °C.

Using this information and information from the tables following, answer the following:

- (a) Calculate the current the cable is required to carry. (2 marks)

- (b) Calculate the minimum conductor size of the cable that could be used to supply the load. (2 marks)

- (c) Calculate the voltage drop that will occur in the cable under normal load conditions. (2 marks)

(turn over)

Question 7 continued

- (d) Calculate whether the volt drop calculated in (c) complies with maximum voltage drop permissible under the Electricity Regulations, allowing for 0.5% volt drop in the mains. (2 marks)

- (e) From the cables sizes you have determined from the current rating and voltage drop calculations, state the minimum size cable for this installation. (2 marks)

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	62	-	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

(turn over)

Question 7 continued

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

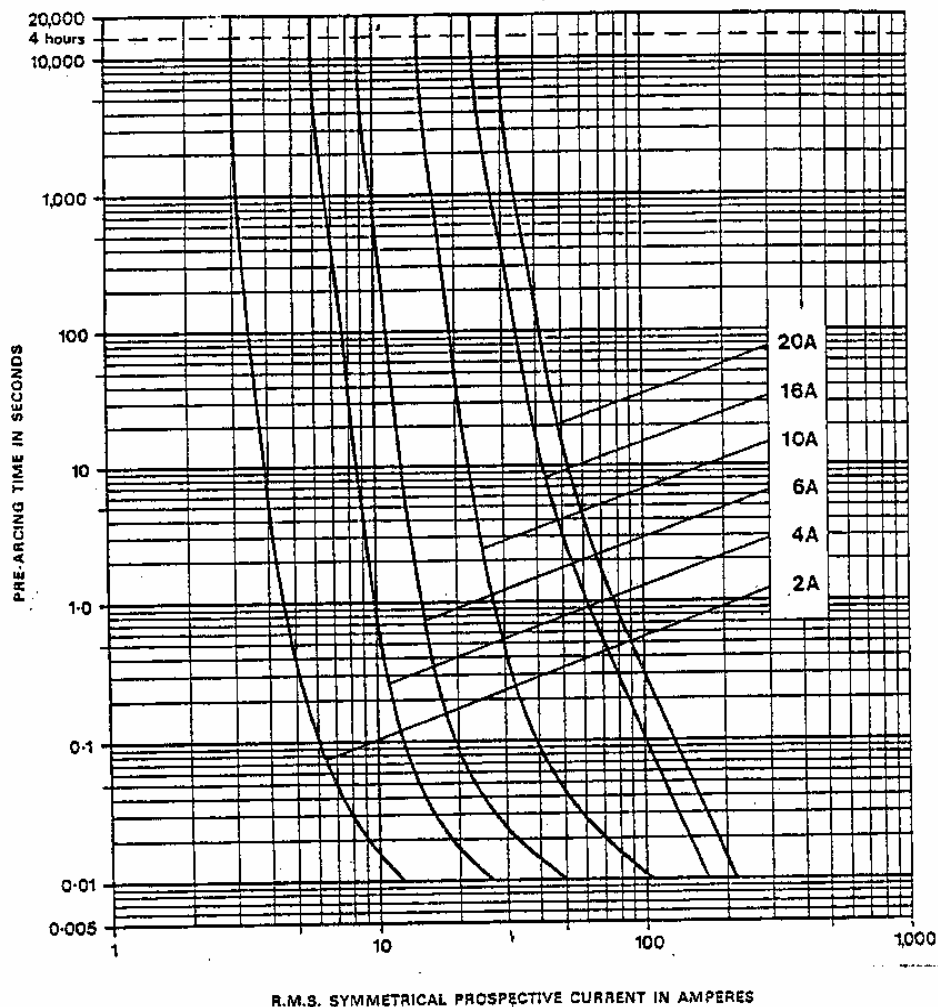
THREE-PHASE VOLTAGE DROP AT 50Hz OF MULTICORE CABLES WITH CIRCULAR COPPER CONDUCTORS

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	-

(turn over)

Question 8

- (a) Characteristic curves for HRC fuses are published by their manufacturers. The figure below shows typical characteristic curves for various fuse sizes.



- (i) What is meant by the term inverse time-current characteristic in relation to fuses and circuit breakers?

(2 marks)

(turn over)

Question 8 continued

- (ii) Refer to the characteristic curves graph above and state the time duration for a 32 Amp fuse to operate on a fault current of 100 Amperes.

(1 mark)

- (iii) Refer to the characteristic curves graph above and state the time duration for a 16 Amp fuse to operate on a fault current of 100 Amperes.

(1 mark)

- (b) Describe the operation of an RCD circuit when there is a phase to earth fault (4 marks)

- (c) A 300kVA, 11kV/400V three-phase transformer has a 5% impedance. Determine the prospective short-circuit current that would flow if a short circuit of negligible impedance occurs across the transformer output terminals.

(turn over)

Question 9

(a) Refer to the Electricity Regulations: and state:

- (i) The specific requirements that apply to fittings supplying electricity to connectable installations.

(1 mark)

Ref:

- (ii) The requirement that applies to protective fittings of socket outlets supplying electricity at standard low voltage to connectable installations.

(1 mark)

Ref:

(b) Refer to AS/NZS 3004 and state the three alternative methods of connecting a pleasure craft.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 9 continued

- (c) Refer to AS/NZS 3004 and state the configuration and rating requirements for socket outlets supplying pleasure craft.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

- (d) Refer to AS/NZS 3004 and state the two types of protective devices not permitted to be installed in a pleasure craft.

(2 marks)

(1) _____

(2) _____

Ref:

FOR CANDIDATE'S USE

In the box, write the number of **EXTRA** pages 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		