



IT 16

Candidate Code No.		Version of AS/NZS 3000 used	
For Board Use Only		(tick <u>ONE</u> Box)	
Result		2000	
Date		2007	
Int			

ELECTRICAL WORKERS REGISTRATION BOARD
ELECTRICAL INSPECTOR EXAMINATION
15 November 2008
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 and version of AS/NZS 3000 in the boxes 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 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 or AS/NZS 3000:2007; 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

(a) State the **TWO** safety precautions specified in the Electricity Regulations which can be used in a low voltage installation to safeguard against unintentional re-livening after isolation.

(2 marks)

(1) _____

(2) _____

Ref:

(b) 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** types of prescribed electrical work that are not required to be certified.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

(c) Refer to the Electricity Regulations and state:

- (i) The intervals at which safety checks must be carried out on medical-electrical locations.

(1 mark)

- (ii) To which Standard must the safety checks be carried out on medical-electrical appliances?

(1 mark)

Ref:

(d) Refer to the Electricity Regulations and state:

- (i) The intervals at which safety checks must be carried out on a carnival or fairground.

(1 mark)

- (ii) Who must carry out the safety checks on a carnival or fairground.

(1 mark)

Ref:

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

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

(f) The removal of barriers that provide basic protection against direct contact is not permitted unless one of three conditions apply. Refer to AS/NZS 3000 and state **TWO** of those conditions.

(2 marks)

(1) _____

(2) _____

Ref:

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

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 1 continued

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

(2 marks)

(1) _____

(2) _____

Ref:

(i) Refer to AS/NZS 3000 and state the **TWO** methods of protection against electric shock that are prohibited in refrigeration rooms.

(2 marks)

(1) _____

(2) _____

Ref:

(j) State **TWO** reasons why an earth fault loop impedance test is carried out on an electrical installation

(2 marks)

(1) _____

(2) _____

(turn over)

Question 2 continued

- (b) State the main reason why an installation supplied by a 35 mm² copper mains cable requires a larger main earthing lead than an installation supplied by a 16 mm² copper mains cable.

(2 marks)

- (c) Why is the earth fault loop path - via the consumers main neutral - between the earth and neutral bars and MEN link and the transformer star point considered more important than the path - via the mass of earth - between the earth and neutral bars and MEN link and the transformer star point.

(½ mark)

- (d) There are two points of supply to a building. Each point of supply is controlled by a main switch. Refer to AS/NZS 3000 and state the identification requirements for the main switches.

(2 marks)

Ref:

(turn over)

Question 3

- (a) Refer to the Electricity Regulations and state the maximum voltage drop permitted on a three-phase final subcircuit (between the point of supply and the end of the final subcircuit) supplied from a low voltage three-phase main switchboard.

(½ mark)

Ref:

- (b) Refer to AS/NZS 3000 and state the **THREE** options permitted for determining the value of the current used for the calculation of voltage drop.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 3 continued

(c) It is proposed to install two additional single phase electric ovens in an existing bakery. The rating of the resistive elements in each oven is 6 kilowatts each.

- The main switchboard is able to supply the additional loading without upgrading.
- The supply voltage at the main switchboard is 230 volts.
- A twin and earth TPS copper cable fixed direct (touching) is to be used to supply each new oven.
- The ambient temperature is up to 35°C.
- The conductor temperature is 75°C.
- The cable run length to each oven from the main switchboard is 15 metres.

Using this information and the information in the following tables, calculate the minimum cable size that can be used for the supply to each new oven to ensure that the voltage drop does not exceed 2.5% of the standard low voltage supply.

(6½ marks)

(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
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					
	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	12	97	97	75
25	131	100	12	95	10	76	10	76	90	71	60	47	16	12	127	98
35	160	125	0	11	0	89	12	89	10	82	74	58	0	7	154	121
			8	4	0		0		5				8	4		

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
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					
	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	10	83	81	64
25	111	86	10	81	90	68	95	72	82	64	52	40	13	10	106	83
35	137	106	12	99	10	80	10	80	96	74	64	49	8	7	127	100
			5		5		5						6			
													16	12		
													5	7		

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

(turn over)

Question 3 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 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

(turn over)

Question 3 continued

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 the **FOUR** situations where RCD protection is **not** required to be installed on socket outlet circuits or lighting final subcircuits that are altered or repaired in existing motel units.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

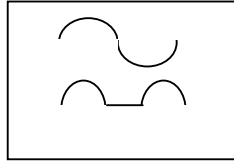
Ref:

(turn over)

Question 4 continued

- (b) RCDs for personal protection must be of a certain type.

An RCD marked with the following symbols is a type permitted to be installed for personal protection:



- (i) What type of RCD is identified by these symbols?

(1 mark)

Ref:

- (ii) Refer to AS/NZS 3000 and describe the operating characteristics of the RCD.

(2 marks)

Ref:

(turn over)

Question 4 continued

- (c) Describe the operation of an RCD when there is an active (phase) to earth fault on the circuit the device protects.

(3 marks)

(turn over)

Question 5

Wiring work has been completed on three buildings in a commercial development each with its own three-phase supply from the local MEN power supply system. Each building has its own point of supply and metering. You are required to carry out any required inspections and connect each building to the electricity supply.

- (a) (i) Refer to the Electricity Regulations and state the Standard and section of that Standard that details the testing required to be carried out on the prescribed electrical work.

(1 mark)

Ref:

- (ii) Refer to the Electricity Regulations and state the Standard and section of that Standard that details the inspections required to be carried out on the prescribed electrical work.

(1 mark)

Ref:

- (b) Refer to the Electricity Regulations and state the **FIVE** actions you must take for each building at the time of making the connection to the electricity power supply.

(2½ marks)

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

Ref:

(turn over)

Question 5 continued

(c) Building 1

Building 1 is a completely new electrical installation. Refer to the Electricity Regulations and state:

- (i) The work the electrician is required to certify on a Certificate of Compliance.

(1/2 mark)

Ref:

- (ii) When the electrician is required to complete the Certificate of Compliance?

(1/2 mark)

Ref:

- (iii) The work that you are required to inspect?

(1 1/2 marks)

Ref:

- (iv) Who is required to give the Certificate of Compliance to the building owner?

(1/2 mark)

Ref:

(turn over)

Question 5 continued

(d) Building 2

Building 2 is an existing electrical installation. From the existing switchboard the electrician has:

- Rewired some final subcircuits with a larger cable size or move them to different locations.
- Installed a new sub-main to a new distribution board
- Replaced all TRS cables with TPS cables of the same size

Refer to the Electricity Regulations and state which work is required to be certified on a Certificate of Compliance.

(1½ marks)

Ref:

(e) Building 3

Building 3 is an existing building and the electrician has:

- 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 state which work you are required to inspect.

(1 mark)

Ref:

(turn over)

Question 6

A three-phase three-wire 11 000V supply is available for the primary connection of the delta connected transformer to a commercial site.

You have taken the current measurements at the three-phase, four-wire secondary side of the transformer and have recorded the following maximum demands:

- Red = 145A
- White = 130A
- Blue = 120A

The line voltage on the secondary side is 400V.

(a) Using the information above, determine:

- (i) The load in kVA of the heaviest loaded phase.

(4 marks)

- (ii) The minimum sized kVA rating of the three phase distribution transformer required to supply load for this site.

(1½ marks)

(turn over)

Question 6 continued

- (b) Using the information given above and from your calculations in (a), determine the maximum line current in the three-phase 11 000V system
(4½ marks)

(turn over)

Question 7

(a) You have been requested by a landlord to carry out an inspection of an existing domestic electrical installation that the landlord owns. No prescribed electrical work has been carried out and the installation has not been disconnected from the electricity supply.

(i) In accordance with which Standard would you carry out the inspection? Include in your answer the relevant sections of that Standard you would use.

(1 mark)

(ii) Refer to the Standard you have stated in (a)(i) above and state the **FIVE** inspections you would carry out on the fixed-wired appliances in the installation.

(2½ marks)

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

Ref:

(turn over)

Question 7 continued

(iii) Refer to the Standard you have stated in (a)(i) above and state the **FOUR** inspections you would carry out on the MEN earthing system. (2 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(iv) Refer to the Standard you have stated in (a)(i) above and state the **FOUR** tests using test instruments you would carry out on the electrical installation. (2 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(v) Refer to the Standard you have stated in (a)(i) above and state the type of document you would issue to the landlord at the completion of the inspection. (½ mark)

Ref:

(turn over)

Question 7 continued

(b) An existing three-phase motor has now been fitted with power factor correction capacitors connected across the motor terminals.

(i) What will change when the power factor correction capacitors are connected.

(1 mark)

(ii) What adjustments, if any, should be made to the motor protection.

(1 mark)

(turn over)

Question 8

You have been requested to give advice on the size of a transformer for a 400V, three-phase new bakery and shop complex. You need to determine the **kVA** capacity. The loads are:

10	250W Metal Halide lamps	1	7.5 kW Chiller
15	75W, fluorescent lights	5	1 ph, 15A socket outlets
2	6 kW Dough Machine Motors	20	1ph, 10A Socket outlets

All loads have a 0.90 power factor.

The transformer sizes available are 25 kVA, 50 kVA and 100 KVA

- (a) Refer to AS/NZS 3000 and determine the maximum demand in KVA
(9 marks)

Load Group	Calculation	Load
<u>Group</u>		
<u>Group</u>		
<u>Group</u>		
	Total	

Ref:

(turn over)

Question 8

(b) State the transformer size that can supply the load.

(1 mark)

(turn over)

Question 9

- (a) There are two terms relating to “current rating” that are used with distribution switchgear. For each term, state the name and describe what it means.

(5 marks)

(1) _____

(2) _____

- (b) Refer to AS/NZS 3000 and state the **TWO** characteristics required of short-circuit protective devices.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 9 continued

- (c) In low voltage, MEN a.c. systems protection devices are required to operate when touch voltages exceed a pre-determined level. Refer to AS/NZS 3000 and state the maximum touch voltage permitted before a protective device is required to operate.

(1 mark)

Ref:

- (d) In low voltage, MEN a.c. systems protection devices that protect 230 volt circuits and final sub circuits must operate within maximum disconnection times. Refer to AS/NZS 3000 and state the **FOUR** types of 230V circuits and the maximum disconnection time for each.

(2 marks)

(1) _____

(2) _____

(3) _____

(4) _____

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		