



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

ELECTRICAL WORKERS REGISTRATION BOARD
ELECTRICAL INSPECTOR THEORY EXAMINATION
20 November 2004
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 the following documents in this examination:

- The Electricity Act 1992 and amendments
- 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
- 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; 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) State **ONE** benefit to the consumer of improving the power factor of an installation.

- (b) State **ONE** benefit to the electricity supplier of improving the power factor of an installation.

- (c) Refer to AS/NZS 3000 and state the main control and protection requirements for special lifts specifically required to operate for fire fighting purposes.

Ref:

- (d) Refer to AS/NZS 3000 and state the maximum period of time permitted for any circuit breaker to carry out its protective function for a final subcircuit supplying handheld Class I equipment

Ref:

- (e) In accordance with the relevant section of the Act, who does the Registrar have to inform if a complaint has been received against a tradesperson.

Ref:

(turn over)

- (f) The Electricity Act requires the Secretary to appoint a Complaints Assessment Committee. Refer to the Act and state the minimum number of persons that make up the committee.

Ref:

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

Ref:

- (h) Refer to AS/NZS 3004:2002 and state **ONE** type of wiring system suitable for a pleasure craft berth supply.

Ref:

- (i) Refer to the Electricity Regulations and state the period of time that a copy of a certificate of compliance must be retained.

Ref:

- (j) Refer to the Electricity Regulations and state how long a warrant of electrical fitness for a caravan remains valid.

Ref:

(turn over)

- (k) Refer to the Electricity Regulations and state the level of fine that can be imposed for failing to comply with regulation 36.

Ref:

- (l) An earth loop impedance test on a single phase 230v 10A socket outlet is measured at 0.45 Ω . Determine the prospective short circuit current if a short circuit of negligible impedance occurs between the phase and the earth continuity conductors at the socket outlet.

Ref:

- (m) Refer to AS/NZS 3000 and state the maximum voltage drop permitted in an extra-low voltage electrical installation.

Ref:

- (n) Refer to the Electricity Act and state the circumstances under which certification is not required when connecting an electrical installation to the supply?

Ref:

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

(1) _____

(2) _____

Ref:

(turn over)

- (p) Refer to NZS 3019 and state the minimum insulation resistance for a socket-outlet supplied from an isolating transformer?

Ref:

- (q) Refer to the Electricity Act and list **TWO** situations where the Board may direct the Registrar to remove a name from any register or cancel the provisional licence held by any person.

(1) _____

(2) _____

Ref:

- (r) Refer to AS/NZS 3000 and state the minimum size copper earthing lead that can be used in an electrical installation operating at standard low voltage.

Ref:

- (s) Refer to the Electricity Act and state the level of fine that may be imposed on a person who interferes with the scene of an accident who has not obtained the permission of the Secretary to do so?

Ref:

- (t) Refer to AS/NZS 3000 and state the maximum demand per phase indicated for a domestic electric range with a full load rating of 9.5kW?

Ref:

(turn over)

Question 2

- (a) The single phase supply cable to a new installation has the phase and neutral conductors transposed at the mains entry point.
 - (i) Draw a circuit diagram of the installation showing the mains entry and the MEN switchboard. (Subcircuits and metering are not required to be shown)
(2 marks)

- (ii) State **TWO** hazards that will result from this phase and neutral transposition.
(2 marks)

(1) _____

(2) _____

(turn over)

Question 2 continued

- (b) Explain with the aid of a neat circuit diagram how an inspector can ensure that the polarity of the supply to a new single phase installation is correct. Your answer must include the type of test instrument and test method used.

(3 marks)

(i) Diagram

(ii) Explanation

(3 marks)

(turn over)

Question 3

- (a) You are about to inspect a new industrial switchboard adjacent to a 500kVA 3 phase 400/230V distribution transformer, and you wish to confirm the MVA fault rating of the busbars and main MCB.

To assist with the calculations, you have been advised by the power supply company that the phase to phase no load voltage is 400V and with 721A per phase flowing, the line voltage is 380V.

- (i) Calculate the required short circuit fault MVA rating of the busbars and switchgear on the new transformer. (3 marks)

- (ii) Calculate the prospective short circuit current. (3 marks)

(turn over)

Question 3 continued

(b) Define the term power factor.

(1 mark)

(c) What must be taken into account when setting the overloads for a motor with power factor correction capacitors connected across the terminals?

(3 marks)

(turn over)

Question 4

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

(i) State **THREE** circumstances where an overload protective device may be omitted?

(3 marks)

(1) _____

(2) _____

(3) _____

Ref.....

(ii) State the overload characteristics of an overcurrent protective device for circuits supplying fire pump motors.

(3 marks)

Ref.....

(turn over)

Question 4 continued

- (b) When inspecting the protective devices on a new switchboard in accordance with NZS 3019, what checks of the protective devices (other than RCDs) are required?

(4 marks)

Ref.....

(turn over)

Question 5

An electrical inspector has been requested by an electricity retailer to inspect and reconnect an electrical installation that has been disconnected for 8 months. The installation has:-

- An overhead supply,
- A driven earth electrode
- Contains TRS cables.
- Contains fixed-wired appliances

- (a) Before connecting the installation, the electrical inspector must issue a specific type of document. Refer the Electricity Regulations and state this document?
(1 mark)

Ref:

- (b) Refer to the Electricity Regulations and state the **FOUR** tests and checks that the electrical inspector is required to carry out before connecting the installation to the supply.
(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

(turn over)

Question 5 continued

(c) Refer to NZS 3019 and state what particular checking needs to be made of:

(i) The overhead supply,

(2 marks)

(ii) The driven earth electrode.

(1 mark)

(iii) The TRS cables.

(1 mark)

(iv) The fixed-wired appliances.

(1 mark)

Ref.....

(turn over)

Question 6

A PVC insulated multi-core copper cable clipped direct (touching) is to be used to supply a 70 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.

Assume the conductor temperature to be 75°C.

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

- (a) Calculate the minimum current rating of the cable.

(2 marks)

Ref:

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

(3 marks)

Ref:

(turn over)

Question 6 continued

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

(3 marks)

Ref:

- (d) Calculate whether the volt drop calculated in (b) complies with maximum voltage drop permissible under the Electricity Regulations? State the reference in your answer.

(1 mark)

Ref:

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

(1 mark)

(turn over)

Question 6 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	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

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 6continued

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 7

(a) For each of the **FIVE** situations outlined below, indicate with: -

- E** if the work requires certification by a registered electrician, or
- I** if the work requires inspection and certification by a registered electrical inspector or,
- R** if the work does not require certification or inspection, but must be carried out by a person with appropriate registration.

In each case state the reference source of your answer – if (no reference is stated, no marks will be awarded).

(5 marks)

- (i) A domestic installation mains cable is to be replaced to facilitate a new point of entry.

Ref:

- (ii) An element is to be replaced on an electric water heater.

Ref:

- (iii) A Warrant of Electrical Fitness for a pleasure vessel.

Ref:

- (iv) The installation of a sub-main, a linked-busbar switchboard, lights and socket-outlets in a workshop.

Ref:

- (v) The replacement of a damaged switched socket-outlet in a domestic installation for hire or reward.

Ref:

(turn over)

Question 7 continued

- (b) Certificates of Compliance may be issued by registered electricians, electrical inspectors, and line mechanics. Refer to the Electricity Regulations and list **THREE** other persons who may issue such a certificate.

(3 marks)

(1) _____

(2) _____

(3) _____

- (c) Refer to the Electricity Regulations and list **TWO** conditions that must be met before a certificate of compliance is issued for prescribed electrical work.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 8

(a) Consider a fault of negligible impedance from a phase or live conductor to any adjacent earthed exposed metal on a final subcircuit.

(i) What minimum fault current must be able to flow in the earthing conductor to operate?

(1) A 20 amp fuse with a gG utilisation category? (1 mark)

(2) A 20 amp circuit breaker with a gG utilisation category? (1 mark)

(ii) State **TWO** reasons these minimum values of fault current are necessary? (2 marks)

(1) _____

(2) _____

(b) Fuses and circuit breakers are labelled with some or all of the expressions set out below. Briefly describe the meaning of each expression, and indicate the type of protective device on which it would be found.

(4 marks)

(i) 415 AC 80

(ii) 6kA

(turn over)

Question 8 continued

(iii) Class Q1

(iv) 63A

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

(2 marks)

(turn over)

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		