



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

ELECTRICAL WORKERS REGISTRATION BOARD

ELECTRICIAN'S REGULATIONS EXAMINATION

27 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; 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)

SECTION 1

Answer all questions in this section. Each is worth 2 marks.

Question 1

Refer to the Electricity Regulations and state briefly what is meant by each of the following terms.

(a) Earthed

(1 mark)

(b) Isolated

(1 mark)

Ref:

Question 2

Refer to the Electricity Regulations and state **TWO** items that must be included in the main earthing system of an MEN electrical installation.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 3

Refer to the Electricity Regulations and calculate the maximum **voltage drop** allowed between the point of supply and any fixed-wired electrical appliance or socket outlet within an electrical installation operating at:

(2 marks)

- (a) Standard Low Voltage Single Phase

- (b) Standard Low Voltage Multiple Phase.

Ref:

Question 4

Refer to AS/NZS 3000 and state **TWO** situations where the protection disconnection time for a final subcircuit must not exceed 0.4 seconds.

(2 marks)

- (1) _____

- (2) _____

Ref:

Question 5

A PVC cable wiring system is to be installed in a concrete floor at a depth of 25 mm from the surface of the concrete. Refer to AS/NZS 3000 and state **TWO** acceptable **protection methods** that can be used for the cable.

(2 marks)

- (1) _____

- (2) _____

Ref:

(turn over)

Question 6

Refer to AS/NZS 3000 and state **TWO** locations in which wiring systems are installed and where those wiring systems are deemed likely to be disturbed.

(2 marks)

(1) _____

(2) _____

Ref:

Question 7

A 4mm² two core neutral-screened submain cable is to be run between two buildings. It is to be buried direct (unenclosed) in the ground in an unpaved area. Refer to AS/NZS 3000 and state the **TWO** requirements for indicating the position of the buried cable.

(2 marks)

(1) _____

(2) _____

Ref:

Question 8

Refer to AS/NZS 3000 and state the safety requirement for the prevention of injury to persons or damage to property that must be met in the event of complete power failure to an electric motor.

(2 marks)

Ref:

(turn over)

Question 9

Refer to AS/NZS 3000 and state the minimum size of protective earthing conductor that would **generally** be required for a twin and earth 4 mm² copper TPS cable

(2 marks)

Ref:

Question 10

Refer to AS/NZS 3000 and state **TWO** types of metallic non-electrical service pipes that shall not be used as a protective earthing conductor.

(2 marks)

(1) _____

(2) _____

Ref:

Question 11

Refer to AS/NZS 3000 and state the requirement for a switch, other than a main switch, in an extra-low voltage system that is not earthed at the point of supply.

(2 marks)

Ref:

Question 12

Refer to AS/NZS 3000 and state where fuses or circuit-breakers shall be connected for overcurrent protection in an extra-low voltage system that is earthed at the point of supply.

(2 marks)

Ref:

(turn over)

Question 13

Refer to AS/NZS 3001 and state:

- (a) The rating of an RCD used for personal protection for a socket outlet in a caravan park area.

(1 mark)

Ref:

- (b) The **TWO** ratings for the overload protection for socket outlets used in a caravan park area.

(1 mark)

Ref:

Question 14

Refer to AS/NZS 3001 and state **TWO** of the required characteristics of cables or cords that form part of the fixed-wiring of a caravan (relocatable premises).

(2 marks)

(1) _____

(2) _____

Ref:

Question 15

Refer to AS/NZS 3001 and state the maximum length of a 2.5 mm² supply lead for a caravan (relocatable premises).

(2 marks)

Ref:

(turn over)

Question 16

When inspecting a portable electrical appliance for defects a **visual** check should be carried out in addition to the prescribed electrical tests. Refer to AS/NZS 3760 and briefly describe **TWO** of the specific checks that should be carried out visually.

(2 marks)

(1) _____

(2) _____

Ref:

Question 17

AS/NZS 3760 requires that two electrical tests using instruments must be carried out on an electrical appliance following the completion of repairs. Refer to that Standard and state the name of each test and the required minimum or maximum value of the result for that test.

(2 marks)

(a) Test _____

Value _____

(b) Test _____

Value _____

Ref:

(turn over)

Section 2

Answer **ALL** questions in this section. Each question is worth 6 marks.

Question 18

It is proposed to install a 35 mm² four-core copper neutral-screened cable to supply a three-phase commercial development.

- The cable will be buried direct.
- The load is 170 amps per phase.
- The distance between the property boundary and the main switchboard is 37 metres.
- The ambient temperature is 20° C.
- The maximum permitted voltage drop is 3%.

Assume the conductor temperature to be 75° C

Using this information and the tables on the following pages, answer the following.

- (a) Determine by calculation whether the cable meets the voltage drop requirements. (3 marks)

- (b) Determine by calculation whether the cable meets the load requirements. (3 marks)

(turn over)

Question 18 continued

The following are extracts from AS/NZS 3008.1.2.

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	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

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 18 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 19

A fundamental principal of AS/NZS 3000 is that persons and livestock shall be protected against dangers that may arise from contact with parts which are live in normal service (direct contact) or exposed conductive parts which may become live under fault conditions (indirect contact).

Refer to AS/NZS 3000 and answer the following:

- (a) State the **FOUR** permitted methods of protection against direct contact. (2 marks)

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

Ref:

- (b) State the **TWO** minimum degrees of protection permitted when providing protection against direct contact by barriers or enclosures. (1 mark)

- (1) _____

(2) _____

Ref:

(turn over)

Question 19 continued

(c) Barriers or enclosures are required to be constructed so that they cannot be opened or removed unless certain conditions apply. State **THREE** alternative conditions that can be used regarding the opening or removal of barriers or enclosures.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

(turn over)

Question 20

Refer to AS/NZS 3000 and state:

- (a) State **TWO** methods of identifying main switches controlling fire and smoke control equipment, evacuation equipment and lifts.

(2 marks)

(1) _____

(2) _____

Ref:

- (b) The **TWO** items that are deemed to be included within evacuation equipment.

(2 marks)

(1) _____

(2) _____

Ref:

- (c) The **TWO** general connection arrangements for main switches supplying fire and smoke control equipment, evacuation equipment and lifts

(2 marks)

(1) _____

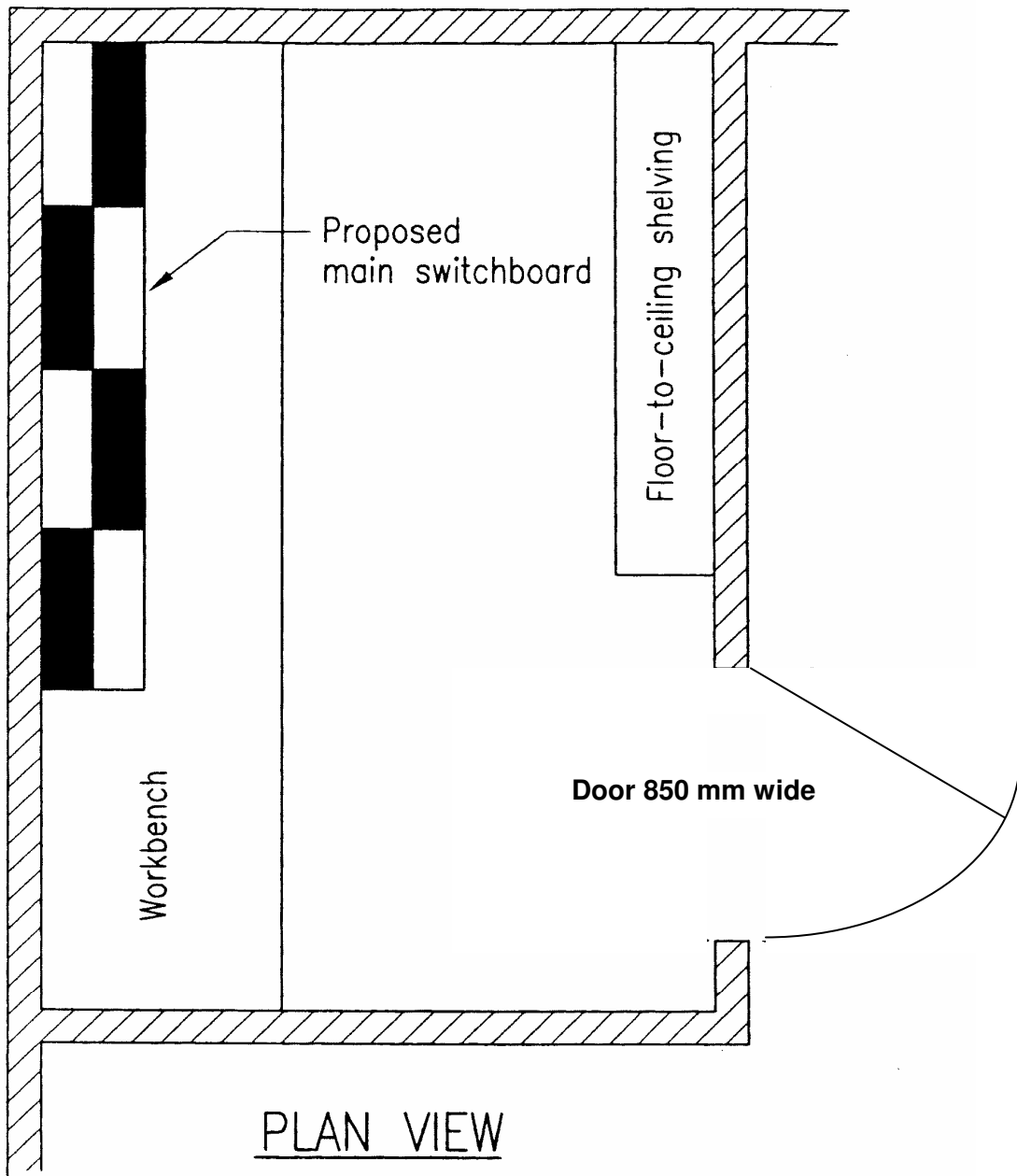
(2) _____

Ref:

(turn over)

Question 21

A small storage cupboard in a commercial complex is to house a new main switchboard. The cupboard is located in the centre of the complex and the existing workbench and lockable door is to be retained. Below is the floor plan of the storage cupboard.



(turn over)

Question 21 continued

Refer to AS/NZS 3000 and answer the following:

- (a) State the **TWO** requirements for installing a switchboard in a storage cupboard. (2 marks)

(1) _____

(2) _____

Ref:

- (b) The switchboard incorporates exposed live parts. State the **TWO** alternative requirements relating to exposed live parts. (2 marks)

(1) _____

(2) _____

Ref:

- (c) From the outside of the complex it is not obvious where the main switchboard is located. State the requirement for identifying the location of the main switchboard. (1 mark)

Ref:

- (d) State the permitted minimum dimensions of the doorway. (1 mark)

Ref:

(turn over)

Question 22

The figure on the following page shows a plan bathroom layout that includes a bath, shower (without a fixed partition) and hand basin. Refer to AS/NZS 3000 and:

- (a) Draw and label on the figure, the lines and dimensions (where applicable) of Zones 0, 1, 2 and 3 for the shower

(4 marks)

Ref:

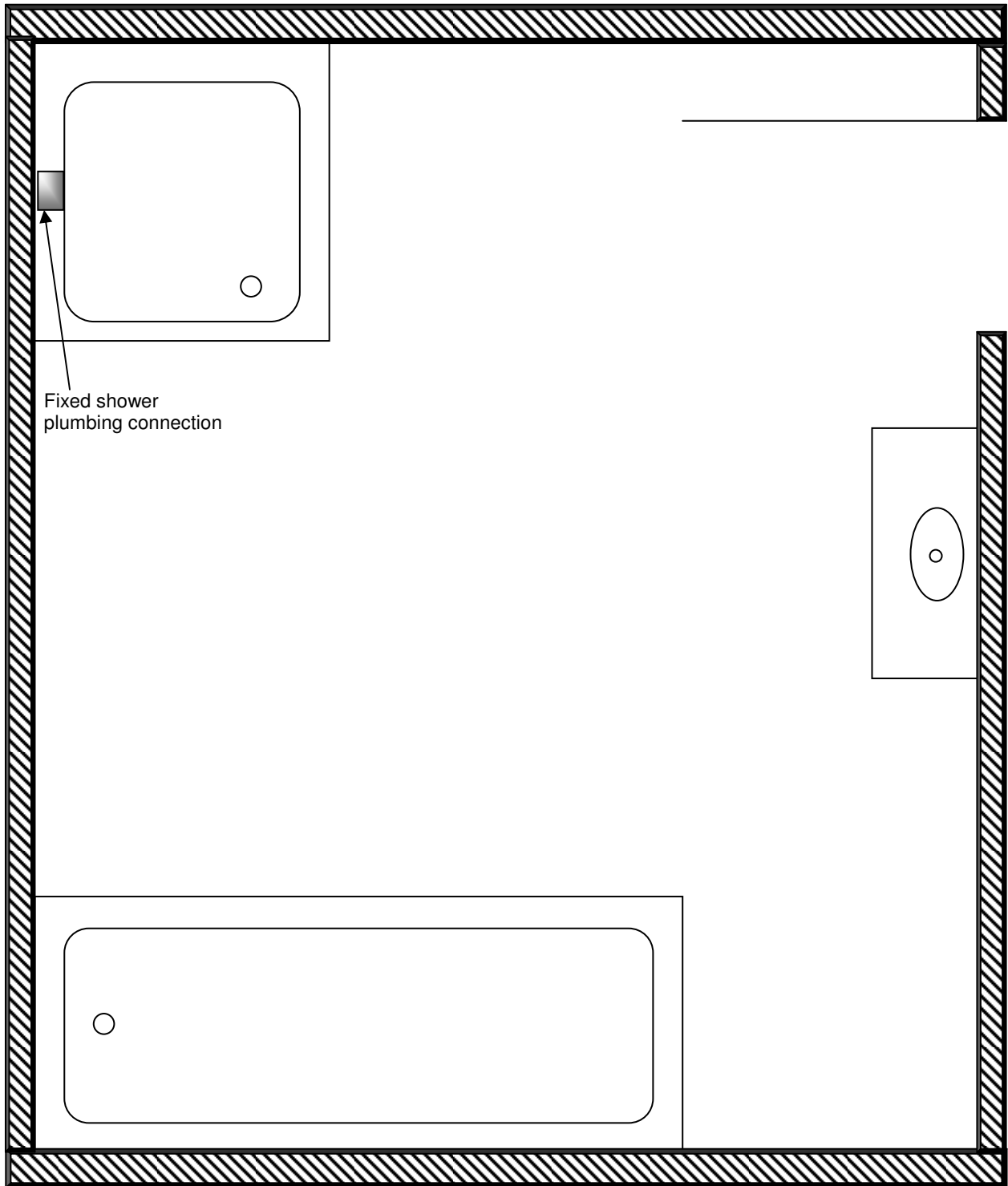
- (b) State the requirements for installing electrical equipment with an IPX7 degree of protection in Zone 0 for the bath.

(2 marks)

Ref:

(turn over)

Question 22 continued



(turn over)

Question 23

You are wiring a new domestic residence.

Refer to AS/NZS 3000 and answer the following.

- (a) Table 3.4 details the recommended minimum cable size for certain final sub-circuits. State the **THREE** factors that need to be taken into account if you want to reduce the size of a cable stated in that table.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref:

- (b) State the requirements for the minimum size of the neutral conductor in single-phase mains cables.

(2 marks)

Ref:

- (c) State **ONE** requirement for installing conductors that are connected in parallel.

(1 mark)

Ref:

(turn over)

Question 24

It is proposed to install the fixed wiring in a fruit-packing plant. The wiring comprises both cables and flexible cords and will be installed in cable trunking and flexible and metallic steel conduit. Refer to AS/NZS 3000 and answer the following.

- (a) State **FOUR** requirements relating to the installation of the cable trunking. (2 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

- (b) State the requirements for the changing of wiring enclosures. (2 marks)

Ref:

- (c) State the **TWO** types of flexible cords that are required to be used as fixed wiring. (2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 25

The figure on the following page represents a cross-sectional view of a three-phase submain from a house to an adjacent workshop. The conductors are four separate stranded PVC insulated aluminium cables with a plastic sheath stamped 'underground'. The cables are buried direct in the ground beneath a concrete driveway using a category "B" system.

Refer to AS/NZS 3000 and answer the following:

(a) Sketch on the figure the minimum requirements for such underground wiring including:

- Identification requirements.
- Mechanical protection
- Depth
- Bedding requirements.

Show items with simple representations only, and include a brief description of each, with distances or depths marked.

(4 marks)

Ref:

(b) State **TWO** requirements relating to the spacing between underground wiring systems and other underground wiring systems or services.

(2 marks)

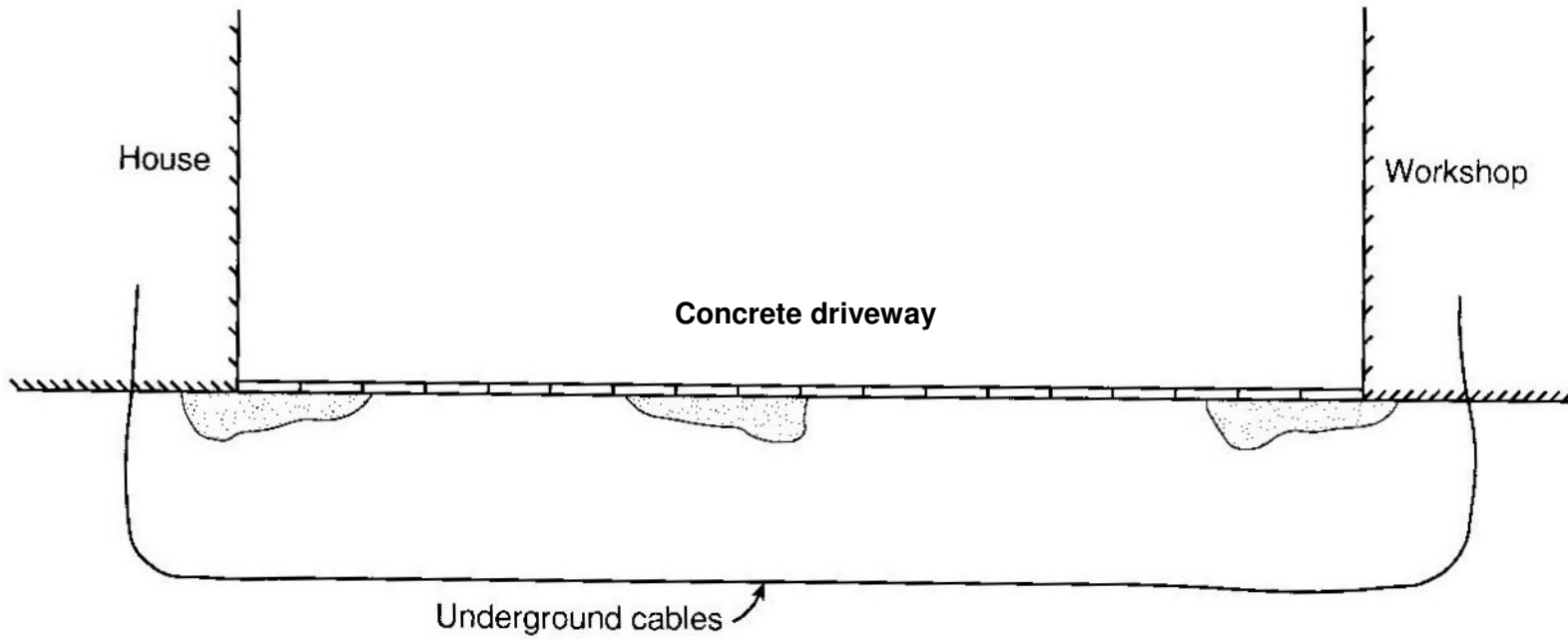
(1) _____

(2) _____

Ref:

(turn over)

Question 25 continued



(turn over)

Question 26

A registered electrician has carried out the following work during renovations on a low voltage electrical installation.

- The meter box on the south side of the house has been relocated to the north side. All existing fittings in the meter box were re-used.
- New internal mains (same size of the existing mains) have been installed and connected to the relocated meter box.
- The old 30 amp metal-clad main switch on the switchboard is replaced with a new plastic 60 amp version.
- Several old rewirable fuses were replaced with appropriate circuit breakers.
- The bare copper main earth lead was replaced and upgraded in size.
- New neutral and earth bars are installed.
- A new RCD protected socket outlet has been installed on the outside of the house.
- Additional lights and power points have been installed in the existing living areas.
- The existing heat-light and permanently connected heated towel rail in the new bathroom have been replaced with newer versions.
- The five outside ball fitting lights were replaced with new ball fittings.
- An element was replaced on the electric range.

Refer to the Electricity Regulations and answer the following:

- (a) State **SIX** items of the above work that are to 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?

(½ mark)

Ref:

(turn over)

Question 26 continued

- (c) How long after the completion of the work must the Certificate of Compliance be issued to the customer.

(1/2 mark)

Ref:

- (d) What does the electrician certify when she/he has completed the Certificate of Compliance?

(2 marks)

Ref:

(turn over)

Question 28

A three-phase motor is installed to operate a large saw-blade in a timber mill. The motor is manually controlled. Refer to AS/NZS 3000 and answer the following:

- (a) State the **FOUR** requirements relating to devices for the isolation and switching of rotating machines (motors).

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

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

(1 mark)

Ref:

- (c) State **ONE** situation where over temperature protection must not be provided for a motor

(1 mark)

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	
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