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

## **ELECTRICIAN'S REGULATIONS EXAMINATION**

**28 June 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 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 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) or AS/NZS 3000:2007; 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

- (a) A single-phase industrial hot water cylinder is located 12 metres from the MEN switchboard and the voltage at the switchboard is 230V. Refer to the Electricity Regulations and calculate the minimum voltage permitted at the terminals of the hot water cylinder.

(2 marks)

Ref: .....

- (b) You are attaching a new three-phase overhead low-voltage line to a building. Refer to the Electricity Regulations and state the insulation requirements for the active (phase) conductors.

(2 marks)

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Ref: .....

- (c) Refer to AS/NZS 3000 and state the circumstances where live parts may be exposed on an industrial switchboard.

(2 marks)

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Ref: .....

**(turn over)**

**Question 1 continued**

(d) Refer to AS/NZS 3000 and state the requirements for the minimum size of the neutral conductor in a three-phase final subcircuit cable that supplies a load of less than 100A.

(2 marks)

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Ref: .....

(e) A 25 mm<sup>2</sup> twin and earth PVC insulated, PVC sheathed cable is to be buried direct in the ground in a Category A system. Refer to AS/NZS 3000 and state the minimum depth it can be buried if:

(i) It has no further protection.

(1 mark)

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(ii) It is below 90 mm of continuous concrete.

(1 mark)

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Ref: .....

**(turn over)**

**Question 1 continued**

(f) Refer to AS/NZS 3000 and state the requirements for the installation of MIMS cables that are subject to vibration.

(2 marks)

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Ref: .....

(g) Refer to AS/NZS 3000 and state the circumstances where metallic (conductive) water piping associated with a building is required to be equipotentially bonded.

(2 marks)

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Ref: .....

(h) Refer to AS/NZS 3000 and state **TWO** requirements that apply to socket outlets installed within Zone 2 of a shower in a domestic bathroom.

(2 marks)

(1) \_\_\_\_\_

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(2) \_\_\_\_\_

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Ref: .....

**(turn over)**

## Question 1 continued

- (i) 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)

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Ref: .....

- (j) A 350 kVA, 400 V three-phase transformer has an impedance of 6%. Calculate the prospective short circuit current that would flow if a short circuit of negligible impedance occurs across the transformer output terminals.

(2 marks)

**(turn over)**

## Question 2

Automatic disconnection of supply is a permitted method of fault protection (protection against indirect contact) and overcurrent protection (to prevent injury or damage).

- (a) Refer to AS/NZS 3000 and state the **TWO** characteristics required of short-circuit protective devices. (2 marks)

(1) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

- (b) Refer to AS/NZS 3000 and state **TWO** circumstances where an overload protective device may be omitted? (2 marks)

(1) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

**(turn over)**

**Question 2 continued**

(c) 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: .....

(d) Refer to AS/NZS 3000 and state **TWO** types of devices (fittings) that can be used to provide the automatic disconnection of the supply.

(2 marks)

(1) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

(e) An air compressor motor circuit is protected by fuses labelled gM at a switchboard. Describe the main characteristic of a fuse labelled gM that distinguishes it from a fuse labelled gG.

(2 marks)

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\_\_\_\_\_

\_\_\_\_\_

**(turn over)**

### Question 3

You have completed wiring work on three buildings in a commercial development each with its own three-phase supply. Each building has its own point of supply and metering. Refer to the Electricity Regulations and answer the following:

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

(1 mark)

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Ref: .....

- (ii) For the prescribed electrical work carried out on each building state the Standard and section of that Standard that details the inspections required to be carried out.

(1 mark)

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Ref: .....

- (b) Building 1

This is a new building. You have installed all of the wiring work from the point of supply to the entire installation. Refer to the Electricity Regulations and answer the following:

- (i) For Building 1, which work is required to be certified on a Certificate of Compliance.

(½ mark)

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Ref: .....

- (ii) For Building 1, when must the Certificate of Compliance be completed?  
(½ mark)

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Ref: .....

**(turn over)**

### Question 3 continued

- (iii) For Building 1, which work is required to be inspected by a registered electrical inspector?

(1½ marks)

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Ref: .....

- (iv) For Building 1, who is required to give the Certificate of compliance to the building owner?

(½ mark)

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Ref: .....

(c) Building 2

This is an existing building. From the existing switchboard you have:

- Rewired all of the final subcircuits. All final subcircuits are now of a larger cable size or in different locations.
- Installed a new sub-main to a new distribution board

- (i) For Building 2, which work is required to be certified on a Certificate of Compliance.

(1½ marks)

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Ref: .....

- (ii) For Building 2, when must the Certificate of Compliance be given to the owner of the building?

(½ mark)

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Ref: .....

**(turn over)**

### Question 3 continued

- (iii) For Building 2, which work is required to be inspected by a registered electrical inspector?

(½ mark)

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Ref: .....

- (iv) For Building 2, who is required to give the Certificate of Compliance to the building owner?

(½ mark)

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Ref: .....

(d) Building 3

This is an existing building. You have:

- Installed new mains, and main switchboard of a larger size.
- Up-graded the main earthing system
- Installed three new final subcircuits.

- (i) For Building 3, which work is required to be certified on a Certificate of Compliance.

(½ mark)

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Ref: .....

- (ii) For Building 3, which work is required to be inspected by a registered electrical inspector?

(1 mark)

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Ref: .....

- (e) For these electrical installations, state **ONE** type of instrument test that would require the connection of the electricity supply for testing purposes.

(½ mark)

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**(turn over)**

## Question 4

A flat twin and earth TPS copper cable is to be used for a single-phase low voltage supply to a new oven in a bakery.

- (a) After completing the calculations in (b) below, state the minimum sized copper cable can be used to supply the oven.

(1 mark)

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- (b) Use the information provided and the following tables.

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

- The copper cable is clipped direct (touching)
- The voltage at the switchboard is 230V
- The load is 8 kW.
- The ambient temperature is 35 °C.
- The conductor temperature is 75 °C.

(4 marks)

**(turn over)**

## Question 4 continued

(ii) Calculate minimum conductor size of cable that could be used to supply the proposed load within the voltage drop limit.

- The cable is 20 metres in length.
- The voltage at the main switchboard is 230V
- The conductor temperature is 75 °C.
- The voltage drop is not to exceed 2.5%.

(5 marks)

**(turn over)**

## Question 4 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<br>duct<br>or<br>size | <b>Current carrying capacity A</b> |           |                 |           |                                                            |           |                                                           |           |                                                                                                   |           |                                                    |           |                      |           |                                                  |           |
|                           | <b>Unenclosed</b>                  |           |                 |           | <b>Enclosed</b>                                            |           |                                                           |           |                                                                                                   |           |                                                    |           | <b>Buried Direct</b> |           | <b>Underground non-metallic wiring enclosure</b> |           |
|                           | <b>Spaced</b>                      |           | <b>Touching</b> |           | <b>Non-metallic wiring enclosures in air – round cable</b> |           | <b>Non-metallic wiring enclosures in air – flat cable</b> |           | <b>In non-metallic wiring enclosures or unenclosed partially surrounded by thermal insulation</b> |           | <b>Completely surrounded by thermal insulation</b> |           |                      |           |                                                  |           |
|                           | <b>mm<sup>2</sup></b>              | <b>Cu</b> | <b>Al</b>       | <b>Cu</b> | <b>Al</b>                                                  | <b>Cu</b> | <b>Al</b>                                                 | <b>Cu</b> | <b>Al</b>                                                                                         | <b>Cu</b> | <b>Al</b>                                          | <b>Cu</b> | <b>Al</b>            | <b>Cu</b> | <b>Al</b>                                        | <b>Cu</b> |
| 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                        | 131                                | 100       | 120             | 95        | 100                                                        | 76        | 101                                                       | 76        | 90                                                                                                | 71        | 60                                                 | 47        | 160                  | 127       | 127                                              | 98        |
| 35                        | 160                                | 125       | 148             | 114       | 120                                                        | 89        | 120                                                       | 89        | 105                                                                                               | 82        | 74                                                 | 58        | 198                  | 154       | 154                                              | 121       |

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

**(turn over)**

## Question 4 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 <sup>2</sup>             | 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 4 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         |
|---------------------------------|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Conductor temperature °C</b> | <b>Rating Factor</b>       |           |           |           |           |           |           |
|                                 | <b>Ambient temperature</b> |           |           |           |           |           |           |
|                                 | <b>10</b>                  | <b>15</b> | <b>20</b> | <b>25</b> | <b>30</b> | <b>35</b> | <b>40</b> |
| 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**

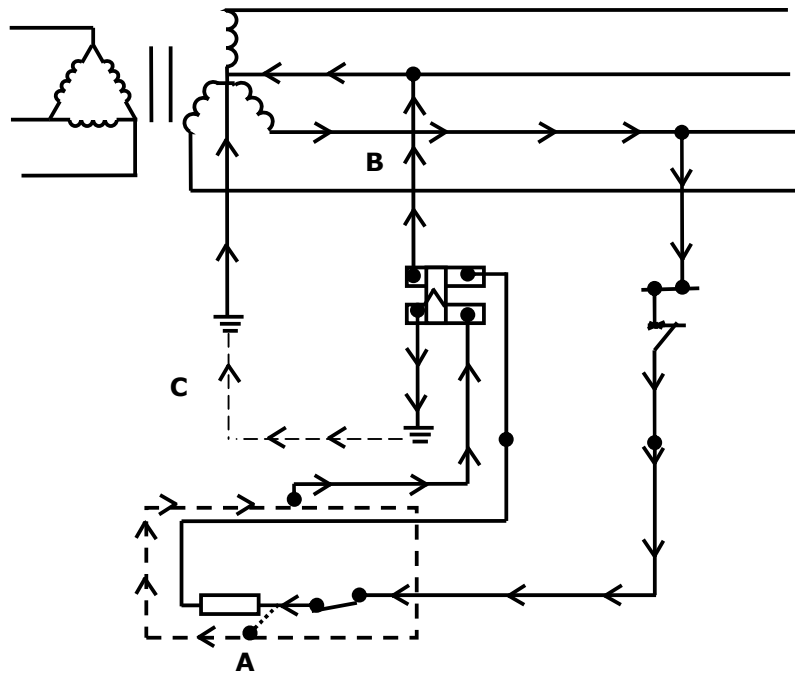
| <b>Conductor size mm<sup>2</sup></b> | <b>Three-phase voltage drop at 50 Hz, mV/A.m</b> |                 |             |                 |             |                 |             |                 |             |                 |
|--------------------------------------|--------------------------------------------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|                                      | <b>Conductor temperature, °C</b>                 |                 |             |                 |             |                 |             |                 |             |                 |
|                                      | <b>45</b>                                        |                 | <b>60</b>   |                 | <b>75</b>   |                 | <b>90</b>   |                 | <b>110</b>  |                 |
|                                      | <b>Max.</b>                                      | <b>0.8 p.f.</b> | <b>Max.</b> | <b>0.8 p.f.</b> | <b>Max.</b> | <b>0.8 p.f.</b> | <b>Max.</b> | <b>0.8 p.f.</b> | <b>Max.</b> | <b>0.8 p.f.</b> |
| 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 5

- (a) This figure represents a single-phase supply from a 230/400V MEN distribution system to a consumer's installation. A Class I electrical appliance is connected to the installation.



Class I electrical appliance

- (i) The dotted line represents the frame of the appliance. What does "A" represent? (1 mark)
- \_\_\_\_\_
- (ii) What do the paths represented by the arrows on the figure show? (2 marks)
- \_\_\_\_\_
- (iii) Why is the path from "A" through "B" considered more important than the path from "A" through "C"? (1 mark)
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**(turn over)**

**Question 5 continued**

- (b) Refer to AS/NZS 3000 and describe how a fault loop impedance test should be carried out on a live final subcircuit.

(2 marks)

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Ref: .....

- (c) You have installed a 2.5 mm<sup>2</sup> twin and earth TPS cable to a pump that draws 10A. The cable run is 73 m between the switchboard and the pump. The circuit is protected by a 20A, Type C, MCB. Refer to AS/NZS 3000 and state:

- (i) The reason why this installation does not comply with the protection requirements of AS/NZS 3000. Include the reference source for your answer.

(2 marks)

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Ref: .....

- (ii) What alteration can be made to the installation, without changing the cable size or reducing the load, to ensure the installation complies with AS/NZS 3000?

(1 mark)

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Ref: .....

- (d) Refer to AS/NZS 3000 and specify the conductor type and the minimum permissible conductor size for the main earthing conductor in a low voltage electrical installation.

(1 mark)

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Ref: .....

**(turn over)**

## Question 6

A switchboard or switchboards shall be provided in an electrical installation for the mounting or the enclosure of switchgear and protective devices.

- (a) An installation consists of an MEN switchboard and three distribution switchboards. Refer to the Electricity Regulations and state where the MEN switchboard must be placed.

(1 mark)

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Ref: .....

- (b) A multi-story apartment block consists of consists entirely of domestic electrical installations. Common services, such as the main switchboard are required for the building. Refer to AS/NZS 3000 and answer the following:

- (i) State **TWO** methods of identifying the main switchboard, if the design of the building makes it difficult to locate.

(2 marks)

(1) \_\_\_\_\_

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(2) \_\_\_\_\_

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Ref: .....

- (ii) State the **ONE** area where the main switchboard is not allowed to be installed.

(1 mark)

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Ref: .....

**(turn over)**

**Question 6 continued**

(iii) Under what circumstances can the main switchboard incorporate live conductive parts?

(2 marks)

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Ref: .....

(c) There are restricted locations for switchboards. In some locations switchboards can be installed provided certain conditions - relating either to the switchboard or the location itself - are met. In other locations any type of switchboard is totally prohibited.

Refer to AS/NZS 3000 and state **FOUR** areas where locating any type of switchboard is totally prohibited.

(4 marks)

(1) \_\_\_\_\_

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(2) \_\_\_\_\_

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(3) \_\_\_\_\_

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(4) \_\_\_\_\_

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Ref: .....

**(turn over)**

## Question 7

You are required to wire three buildings in a storage complex. All buildings will be supplied from the main building.

(a) For Building 1 and Building 2, the requirement is that both will be supplied by hard-drawn **aerial** neutral screen cables with copper conductors. Refer to AS/NZS 3000 and answer the following:

(i) Building 1 is used solely for storage and the loading is very low. What are the minimum size and type requirements for the neutral screened cable?

(1 mark)

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Ref: .....

(ii) Building 2 is used for refrigerated storage and a 16mm<sup>2</sup> neutral screened cable is required to be used. Can this cable be used to span the distance of 50m between the buildings? State a reason and the reference with your answer.

(1½ marks)

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Ref: .....

(iii) For Building 2, you have two, 30 metre lengths of the 16mm<sup>2</sup> neutral screened cables. Can these cables be jointed and used? State a reason and the reference with your answer.

(1½ marks)

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Ref: .....

**(turn over)**

**Question 7 continued**

(iv) (1) The neutral screened cable to Building 1 crosses an area used by vehicles. What is the minimum clearance above ground for this cable?

(½ mark)

\_\_\_\_\_

(2) The neutral screened cable to Building 1 crosses an area not used by vehicles. What is the minimum clearance above ground for this cable?

(½ mark)

\_\_\_\_\_

Ref: .....

(b) Building 3 will be supplied by a 4mm<sup>2</sup> two core neutral-screened cable with the sheath marked "underground". It is to be buried direct (unenclosed) in the ground in an unpaved area. Refer to AS/NZS 3000 and state:

(i) **One** method for indicating the position of the buried cable.

(1 mark)

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

(ii) **ONE** method of marking or recording that a cable enters or leaves a building.

(1 mark)

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

(iii) The minimum depth to which the cable must be buried.

(1 mark)

\_\_\_\_\_

Ref: .....

**(turn over)**

**Question 7 continued**

(iv) The requirements for bedding the cable in the ground.

(2 marks)

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Ref: .....

**(turn over)**

## Question 8

The Electricity Regulations requires that electrical work on low voltage electrical installations be tested and verified in accordance with AS/NZS 3000.

(a) AS/NZS 3000 states the types of testing and verification that are carried out. The Standard details two tests that need to be carried out with the electrical installation live. Refer to AS/NZS 3000 and answer the following:

(i) Operation of RCDS

(A) State the **TWO** methods either of which can be used to verify the function of an RCD.

(4 marks)

(1) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

(B) State the reason why verification is carried out on each final subcircuit protected by an RCD.

(1 mark)

\_\_\_\_\_

\_\_\_\_\_

Ref: .....

**(turn over)**

## Question 8 continued

(ii) Earth Fault Loop Impedance

State **ONE** reason why an Earth Fault Loop Impedance test is carried out on a socket outlet final subcircuit not protected by an RCD.

(2 marks)

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Ref: .....

(b) A newly wired, three-phase, 230/400 volt cowshed gives an insulation resistance test of 500,000 ohms. The installation includes two, 3 kilowatt water heating cylinders. Explain whether this installation can be certificated and connected to the supply, in accordance with AS/NZ 3000.

(3 marks)

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Ref: .....

**(turn over)**

## Question 9

You are wiring a new three-phase, 400 V, factory complex and need to determine the size of the mains.

Refer to AS/NZS 3000 and calculate maximum demand of the installation in kW. Assume a unity power factor and that the loads stated are for the input power.  
(10 marks)

| Equipment                           | Load Group | Calculation | Load (KW) |           |
|-------------------------------------|------------|-------------|-----------|-----------|
| 10 x 40W Fluorescent fittings       |            |             |           | (1 mark)  |
| 35 x 75W, fluorescent lights        |            |             |           | (1 mark)  |
| 18 x 1ph, 10A Socket outlets        |            |             |           | (1 mark)  |
| 10 x 1 ph, 15A socket outlets       |            |             |           | (1 mark)  |
| 2 x 3ph, 9 kW Motors                |            |             |           | (1 mark)  |
| 2 x 5 kW Chillers motors            |            |             |           | (1 mark)  |
| 1 x 15 kW pottery kiln              |            |             |           | (1 mark)  |
| 3 x 4kW instantaneous water heaters |            |             |           | (1 mark)  |
| <b>Total</b>                        |            |             |           | (2 marks) |

### 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 |  |
| <b>1</b>                |       |  |
| <b>2</b>                |       |  |
| <b>3</b>                |       |  |
| <b>4</b>                |       |  |
| <b>5</b>                |       |  |
| <b>6</b>                |       |  |
| <b>7</b>                |       |  |
| <b>8</b>                |       |  |
| <b>9</b>                |       |  |
|                         |       |  |
| <b>TOTAL</b>            |       |  |