



<b>Candidate Code No.</b>	
<b>For Board Use Only</b>	
Result	Result
Date	Date
Int	Int

# **ELECTRICAL WORKERS REGISTRATION BOARD**

## **ELECTRICAL SERVICE TECHNICIAN “B” EXAMINATION**

**20 March 2004**

### **QUESTION AND ANSWER BOOKLET**

Time Allowed: Two Hours

#### **INSTRUCTIONS – READ CAREFULLY**

You have 10 minutes to read this paper but do not start writing until instructed to do so by the supervisor.

Write your Candidate Code Number in the space provided above. Your name must NOT appear.

**The pass mark in this examination is 60 marks.**

**Attempt all the questions** in this paper; each question is worth 10 marks.

Where applicable, your written answers may be a direct quote from the Act, Regulations, Code or Standards or you may summarise, in your own words, the key points from these documents. Wherever possible include the reference to the source of your answer in the space provided. However, stating a reference only will gain no marks

Drawing instruments may be used when diagrams are required. Marks are allocated on the basis of correctness. Approved calculators may be used.

Use a pen for writing your answer. You may use a pencil for diagrams. Do not use correcting fluid or correcting tape.

**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 1999 and 2002 Amendments or  
 The Electricity Regulations Compilation 2003  
 AS 1939 supplement 1 – 1990; AS/NZS 3000:2000; AS/NZS 3001:2001; AS/NZS  
 3004:2002; NZS 3019 (Int):2002; AS/NZS 3760:2001

**PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM**

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## Question 1

- (a) Explain how the **resistance** of an electrical jug element can be determined from the voltage and power rating printed on the nameplate. (2 marks)

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- (b) In each of the following statements, write the appropriate words or figures that would correctly complete the statements below:

- (i) Where the resistance and rated voltage of an electrical appliance is known, its power rating may be determined from the formula. (1 mark)

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- (ii) When supplied at a constant voltage, any increase in the resistance of any electrical appliance will result in a decrease in (1 mark)

\_\_\_\_\_ and in \_\_\_\_\_

- (c) In accordance with the Electricity Regulations what is meant by the term **standard low voltage** when applied to a single phase MEN system (2 marks)

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- (d) Explain how the direction of rotation can be reversed for a three phase squirrel cage induction motor (2 marks)

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- (e) The voltage drop along a two core flexible cord depends on the \_\_\_\_\_ and the \_\_\_\_\_ (2 marks)

**(turn over)**

## Question 2

- (a) In accordance with AS/NZS 3000, explain what is meant by a **Damp Situation**.  
(2 marks)

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- (b) A single-phase capacitor start motor hums and fails to rotate on the bench when the supply is connected, yet it attains full load speed when the rotor is assisted by hand spinning. State **TWO** likely causes of this fault?  
(2 marks)

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

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

- (c) List **TWO** circumstances in which 230V single phase metal clad electrical appliances must not be deliberately connected to earth.  
(2 marks)

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

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

- (d) In accordance with the Electricity Regulations 1997, what is meant by the term **hazardous area**?  
(2 marks)

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**Question 2 continued**

- (e) What type of protective control equipment is installed on 3-phase sub-circuits where the loss of one phase or reversal of phase rotation on the electricity supply may result in injury to persons?

(2 marks)

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### Question 3

- (a) In accordance with the Electricity Regulations what is meant by the term **MEN system**?

(2 marks)

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- (b) State **TWO** reasons why the neutral in the MEN system is multiple-earthed.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

(turn over)

### Question 3 continued

- (c) Sketch and label a simple circuit diagram showing a three-phase MEN supply would be connected to
- A single-phase consumer installation including main switch, and neutral and earth bar connections, MEN link and earth electrode
  - A three-phase consumer installation including main switch, and neutral and earth bar connections, MEN link and earth electrode.

Note Metering, water heating control and fuses and subcircuit conductors are not required to be shown.

(6 marks)

**(turn over)**

#### Question 4

- (a) Supply lines 1 and 3 have been reversed at the output terminals of a DOL starter supplying a 3-phase induction motor when the wiring was re-connected. What will happen when this induction motor is livened?

(1 mark)

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- (b) Name **ONE** type of reduced voltage starters that would be suitable for starting a large three-phase induction motor.

(1 mark)

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- (c) (i) Draw the 400V control circuit for a direct-on-line (DOL) starter that controls a three-phase induction motor. Your answer must include:

- Fuse protection
- Start/stop station
- Overload contacts
- Hold-in contacts
- 400V coil

(5 marks)

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**Question 4 continued**

- (ii) Explain how the control circuit protects the three-phase motor against a mechanical overload

(3 marks)

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**Question 5**

- (a) State **FOUR** precautions which must be taken to ensure the safety of persons, animals and property when disconnecting the conductors supplying a fixed-wired electrical appliance.

(4 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

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

\_\_\_\_\_

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

\_\_\_\_\_

- (b) What is the essential safety difference between switching an electrical appliance off and isolating an electrical appliance?

(3 marks)

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**Question 5 continued**

- (c) Describe **THREE** different ways of safely ensuring the continued isolation of an electrical appliance.

(3 marks)

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## Question 6

Another electrical service technician has disconnected and repaired a 230V industrial sewing machine in a leather goods factory. You are required to reconnect the machine by connecting the flexible cord to the single phase fixed wiring at a terminal box mounted on an adjacent pillar and recommission the sewing machine. There are no danger tags attached to the isolator controlling the terminal box.

Describe:

- (a) The correct sequence of actions you should take to ensure your own safety before recommissioning the sewing machine.

(2 marks)

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- (b) (i) The tests, using instruments, you should carry out to ensure the sewing machine and flexible cord are safe to reconnect to the electricity supply. Include maximum or minimum test results.

(5 marks)

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**Question 6 continued**

- (ii) The additional actions you should take to recommission the sewing machine.

(3 marks)

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## Question 7

Rewirable fuses and HRC cartridge fuses may be found on switchboards.

- (a) (i) What is the main purpose of a fuse? (2 marks)

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- (ii) Why are fuses located on switchboards? (2 marks)

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- (b) What would be the overall effect on a subcircuit when the protection device operates and the circuit is protected by:-

- (i) An under-rated fuse? (1 mark)

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- (ii) An over-rated fuse? (1 mark)

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**Question 7 continued**

(c) State **FOUR** technical advantages which HRC cartridge fuses have over rewirable fuses.

(4 marks)

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

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\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

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

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## Question 8

(a) Sketch and label a circuit diagram of an RCD used for personal protection that includes the following components:

- Sensing coil/toroid
- Block diagram of the tripping device
- Test circuit (push button and resistor)
- Phase, neutral and earth conductor.

(4 marks)

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**Question 8 continued**

(b) Describe the operation of the RCD circuit when there is:

(i) No fault

(3 marks)

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(ii) A phase to earth fault

(3 marks)

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## Question 9

The Electricity Regulations require that when an electrical appliance has been repaired inspections and tests must be carried out in accordance with a specific Standard.

(a) Name that Standard

(1 mark)

\_\_\_\_\_

(b) List the **THREE** inspections and tests that must be carried out in accordance with the Standard.

(3 marks)

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

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

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

(c) State the **TWO** tests required to be carried out with instruments and state the minimum or maximum test result that applies.

(6 marks)

(i) Test \_\_\_\_\_

Instrument \_\_\_\_\_

Test result \_\_\_\_\_

(ii) Test \_\_\_\_\_

Instrument \_\_\_\_\_

Test result \_\_\_\_\_

(turn over)

### Question 10

An isolating switch supplying a 230V a.c. single phase induction motor is to be replaced. What would be the result in terms of safety to the user and the motor's operation, if during reconnection the following conductors were accidentally interchanged at the supply side of the isolating switch: -

- (a) The phase and neutral (4 marks)

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- (b) The neutral and earth (2 marks)

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- (c) The phase and earth (3 marks)

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- (d) State **ONE** test that would detect the interchange of the phase and earth conductors? (1 mark)

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**For Candidate's Use**

In the box, write the number of **EXTRA** sheets you have used. Write **NIL** if you have not used any

<b>For Examiner's Use Only</b>		
<b>Questions Answered</b>	<b>Marks</b>	
<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>10</b>		
<b>TOTAL</b>		