



<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**  
**27 November 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 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); NZS 3019 (Int):2002; 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 400V three-phase motor has been repaired and is to be reconnected to a three core neutral-screened, fixed wired cable. Briefly describe **TWO** aspects of the construction of a three-core neutral screened cable.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

- (b) Explain how an overload relay in a three phase motor starter would offer protection to the motor.

(2 marks)

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\_\_\_\_\_

- (c) An electric heater is rated at 2 kW and 230V. Calculate the power output in watts when supplied at 245V

(2 marks)

\_\_\_\_\_

\_\_\_\_\_

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**(turn over)**

**Question 1 continued**

(d) An electrical fitting is labelled IP56. Refer to AS 1939 and specify:

(i) The level of protection is offered by the number 5. (1 mark)

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(ii) The level of protection is offered by the number 6. (1 mark)

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Ref: .....

(e) State **TWO** precautions which must be taken to ensure the safety of persons, animals and property after you have isolated, safety tagged and disconnected the conductors supplying a fixed-wired electrical appliance. (2 marks)

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

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

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**(turn over)**

**Question 2**

- (a) Refer to AS/NZS 3000 and state the colours that apply to the fixed wiring conductors in a three-phase MEN installation, by completing the table. (2 marks)

Function	Identifying colours	
	Recommended	Alternative
Earth/bonding	Green/Yellow	Green
Neutral		
Active		

- (b) A handheld electrical appliance used on a building or structure under construction must be used in conjunction with an appropriate safeguard. Refer to the Electricity Regulations and state **TWO** such safeguards.

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

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

Ref: .....

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

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

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

**(turn over)**

**Question 2 continued**

- (d) Refer to the Electricity Regulations and state the lowest acceptable voltage between the phase and neutral at the supply terminals of any standard low voltage fixed wired appliance.

(2 marks)

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Ref: .....

- (e) Refer to the Electricity Act and state the minimum experience required for an Electrical Service Technician to be classed as a Supervisor of Electrical Work?

(2 marks)

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Ref: .....

**(turn over)**

### Question 3

A two core Mineral-Insulated Metal-Sheathed (MIMS) permanently installed supply cable has been carefully disconnected from a single phase fuel pump motor on an oil fired furnace.

List **FIVE** important **mechanical** precautions that must be observed when reconnecting this particular cable to the motor. Against each answer mention why the precaution is necessary.

(10 marks)

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

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

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

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(5) \_\_\_\_\_

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(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
- Thermal overload contacts
- Hold-in contacts
- 400V coil

(5 marks)

(turn over)

**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) Explain why the **prove test prove** safety rule should be observed when testing a circuit for isolation.

(4 marks)

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- (b) Explain how the **prove test prove** procedure is carried out.

(6 marks)

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(turn over)



**Question 7**

(a) Explain how the direction of rotation can be reversed for the following types of single-phase electric motors.

(i) Capacitor start induction motor. (2 marks)

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(ii) Universal (series) motor (2 marks)

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(b) State **TWO** typical applications for each of the following single-phase motors.

(i) Split phase. (2 marks)

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**Question 7 continued**

(ii) Shaded pole.

(2 marks)

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(iii) Capacitor start/capacitor run.

(2 marks)

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**(turn over)**

## Question 8

An HRC fuse protects a 20A circuit consisting of two plug sockets supplying various electrical appliances in an office. The fuse has blown. When the fuse is replaced, it blows again when the supply is restored to the circuit.

- (a) State the three possible causes of the HRC fuse blowing the second time. (3 marks)

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

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

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

- (b) For each of the possible causes you have written in (a), state:

- What action you would take to establish that this is the cause.
- The remedial action you would take or recommend to the manager of the office.

(7 marks)

- (i) Possible cause No. 1

Action taken to establish that this is the cause.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Remedial action taken or recommended

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**(turn over)**

**Question 8 continued**

(ii) Possible cause No. 2

Action taken to establish that this is the cause.

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Remedial action taken or recommended

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(iii) Possible cause No. 3

Action taken to establish that this is the cause.

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Remedial action taken or recommended

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**(turn over)**

**Question 9**

- (a) State **THREE** reasons why it is important to thread the fuse wire from terminal to terminal through the tortuous path in the fuse carrier, when reloading a rewirable fuse.

(3 marks)

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

- (b) When selecting a replacement cartridge for a blown HRC fuse, it is necessary to consider its Utilisation category (fusing factor).

- (i) What is meant by Utilisation category (fusing factor)?

(3 marks)

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\_\_\_\_\_

**(turn over)**

## Question 9 continued

- (ii) How does the Utilisation category (fusing factor) influence the fuse operation?

(2 marks)

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- (iii) Why, when selecting a fuse link is it important to ensure that the correct rupturing capacity is chosen?

(2 marks)

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## Question 10

(a) A 400V three-phase motor has been repaired and is to be reconnected to a three core neutral screened, fixed wired cable.

(i) Describe how to check the effectiveness of the earthing of the frame of the motor. State the type of instrument used.

(3 marks)

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(ii) State the maximum acceptable protective earthing conductor resistance value to comply with regulatory requirements and provide the reference source for your answer.

(2 marks)

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(iii) State **TWO** reasons why the protective earth conductor resistance of the motor must not exceed the specified value.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

(turn over)

**Question 10 continued**

- (b) State **THREE** other checks or tests that you could carry out to ensure that the motor in (a) above is electrically safe.

(3 marks)

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

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

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

**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>		