



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

ELECTRICAL WORKERS REGISTRATION BOARD
ELECTRICAL SERVICE TECHNICIAN “B” EXAMINATION
17 September 2005
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 may 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 and the Electricity Amendment Regulations 2003.
- AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, 3 and A); 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) Explain how the resistance of an electrical jug element can be determined from the voltage and power rating printed on the nameplate.

(2 marks)

- (b) When replacing an HRC fuse which has blown, the replacement must have characteristics the same as the original. State **TWO** electrical characteristics to be checked for similarity.

(2 marks)

(1) _____

(2) _____

- (c) 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)

- (d) Refer to the Electricity Regulations, and state what is meant by the term **electrically safe**?

(2 marks)

Ref:

(turn over)

Question 1 continued

- (e) (i) What is the frequency of the New Zealand low voltage a.c. supply. (1 mark)

- (ii) What is the usual operating voltage of a low voltage domestic electrical installation? (1 mark)

(turn over)

Question 2

- (a) Electric motors must have a means of isolation that disconnects all voltage when the isolator is operated. What additional precaution must be taken when isolating a three-phase motor sub-circuit if the isolator is not located adjacent to the motor?

(2 marks)

- (b) State **TWO** technical advantages which HRC fuses have over rewirable fuses.

(2 marks)

(1) _____

(2) _____

- (c) 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.

(2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 2 continued

- (d) A trainee may assist in prescribed electrical work subject to supervision. Briefly state the requirements of the Electricity Regulations for **ONE** category of person who can provide this supervision.

(2 marks)

Ref:

- (e) 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)

Ref:

(turn over)

Question 3

(a) (i) Sketch and label a circuit diagram of a single-phase capacitor start motor.

(2 marks)

(ii) Describe how the direction of rotation can be reversed for the motor in (a)(i) above

(2 marks)

(b) Describe how the direction of rotation can be reversed for a Universal (series) motor

(2 marks)

(turn over)

Question 3 continued

(c) (i) Sketch and label a circuit diagram of a single-phase split-phase motor.

(2 marks)

(ii) Describe how the direction of rotation can be reversed for the motor in (c)(i) above

(2 marks)

(turn over)

Question 4 continued

- (d) 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) _____

(turn over)

Question 5

- (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. (4 marks)

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

- (b) State the main characteristic of a flexible cord determines the maximum current the cord can carry safely without overheating. (2 marks)

- (c) When selecting a flexible cord for fitting to a single phase electrical appliance it is necessary to consider its length and cross-sectional area - and the effect these will have on the heating and voltage drop in the cord.

List **FOUR** other physical factors that may need to be considered in selecting the cord. (4 marks)

- (1) _____

- (2) _____

- (3) _____

- (4) _____

(turn over)

Question 6

A three-phase fixed-wired induction motor running an industrial refrigeration plant requires new bearings. The motor is controlled by wall mounted isolating switch that is protected by HRC fuses mounted on a switchboard. The isolating switch has a broken operating handle and cannot be used.

You have been requested to:

- Remove the three-phase motor, by disconnecting the cable at the motor
- Replace the isolating switch.

You do not need to contact the Supervisor before starting the work or after finishing.

Warning: If any part of your answer is dangerous or hazardous, you will get no marks for this question.

(a) Describe how you would safely isolate the motor and its isolating switch.

(5 marks)

(1) _____

(2) _____

(3) _____

(4) _____

(turn over)

Question 6 continued

(b) Describe the work you have been requested to do.

(2 marks)

(1) _____

(2) _____

(c) List the steps necessary to leave the site safe.

(3 marks)

(1) _____

(2) _____

(turn over)

Question 7

(a) With reference to AS/NZS 3000, what is a damp situation?

(2 marks)

Ref:

(b) Electrical equipment designed for use in damp situations has an IP rating. What is an IP rating?

(2 marks)

Ref:

(c) An IP rating has the letters IP followed by two numbers.

(i) Explain what the first number indicates?

(2 marks)

Ref:

(turn over)

Question 7 continued

(ii) Explain what the second number indicates?

(2 mark)

Ref:

(d) Briefly state the protection afforded by a fitting that is labelled IP44.

(2 marks)

Ref:

(turn over)

Question 8

(a) Sketch and label a simple circuit diagram showing three-phase, 4 wire, MEN distribution lines supplying:

- A single-phase consumer installation.
- A three-phase consumer installation.

You need to show for each installation, the main switch, neutral and earth bar connections, MEN link and earth electrode

You do not need to show metering, water heating control and fuses and subcircuit conductors.

(6 marks)

(turn over)

Question 8 continued

- (b) State **TWO** reasons why a neutral conductor is required in the cable supplying a three-phase electrical appliance which has heating loads that draw different values of current on each of the phases.

(4 marks)

(1) _____

(2) _____

(turn over)

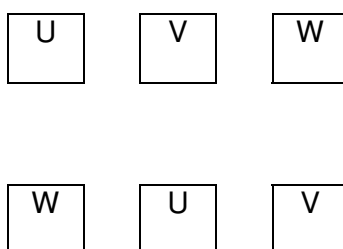
Question 9

A three-phase induction motor is operated by a star-delta starter. The starter is controlled by a 230 volt control circuit.

- (a) The diagrams in (i), (ii) and (iii) below represent the terminal block for the motor. The three individual stator windings are connected internally between terminals: U–U, V–V, W–W.

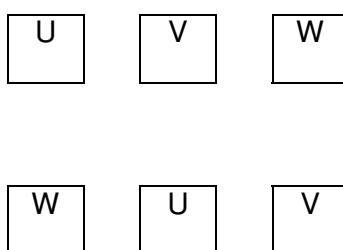
- (i) On the terminal block show both the incoming supply lines and the six terminals wired to achieve a **star** connection.

(2 marks)



- (ii) On the terminal block show both the incoming supply lines and the six terminals wired to achieve a **delta** connection.

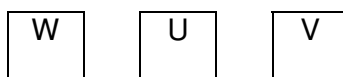
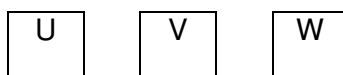
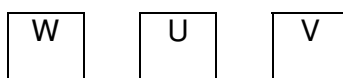
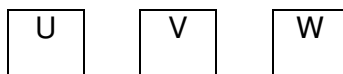
(2 marks)



(turn over)

Question 9 continued

- (iii) On the terminal blocks show how the direction of rotation can be changed on a **delta** connected three-phase induction motor. Label one diagram showing the **clockwise rotation** and other diagram to show a **counter clockwise rotation**.
(4 marks)



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

(2 marks)

(turn over)

Question 10

(a) Circuit breakers are available in a number of different operational types. Describe the operating principle of the following types of circuit breakers, and state how each is caused to trip when an overload occurs.

(i) Thermal type.

(2 marks)

(ii) Magnetic type.

(2 marks)

(iii) A combined thermal/magnetic type.

(3 marks)

(turn over)

Question 10 continued

(b) What is meant by the term **current rating** of a fuse?

(2 marks)

(c) A final sub-circuit is protected by an under-rated fuse. State **ONE** effect this could have on the operation of the circuit.

(1 mark)

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	
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		