



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

ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION

30 June 2007

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. Show all working to THREE significant 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 reprinted as at 19 August 2005.
- The Electricity Regulations 1997 reprinted as at 5 September 2005
- AS 60529 or AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, A and 3); 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

Each part in this question is worth 2 marks

- (a) Explain how the direction of rotation can be reversed for a three phase squirrel cage induction motor that is controlled by a star/delta starter?

- (b) State one reason why an HRC fuse is used in a circuit supplying a motor in addition to thermal overloads.

- (c) State the main effect the resistance of the conductors has on the operation of a two-core flexible cord.

- (d) State **TWO** checks or tests that you would carry out to ensure that a Class I electrical appliance is electrically safe.

(1) _____

(2) _____

- (e) State **ONE** reason why the **prove-test-prove** safety rule should be observed when testing a circuit for isolation.

(turn over)

Question 1 continued

- (f) Refer to the Electricity Regulations and state what is meant by the term "isolated".

- (g) The New Zealand Multiple Earth Neutral system of single/three phase standard low voltage distribution requires the use of four conductors. List the standard nominal voltages that exist between each of the four conductors, and between each conductor and earth.

- (h) When testing for isolation, it is found that there are live conductors at the terminals of a fixed-wired electrical appliance after the isolating switch is turned to the off position. State **TWO** circumstances that may cause such a situation to occur.

(1) _____

(2) _____

- (i) Briefly explain the internal operation of an energy controller (Simmerstat) when it controls a heating load.

(turn over)

Question 1 continued

- (j) An HRC fuse with a Utilisation category (fusing factor) of 1.5 has a rating of 20 amps. Calculate the fusing current of this fuse.

(2 marks)

(turn over)

Question 2

- (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 single-phase capacitor start motor.

(1 mark)

- (iii) Describe the purpose of the capacitor.

(2 marks)

(turn over)

Question 2 continued

(b) A small electric motor has a nameplate that reads:-

Voltage	230
Phases	1
Horsepower	0.75
Speed	1425 r.p.m.

Calculate the rated output power (in watts) of the motor.

(1 mark)

(c) A single-phase capacitor start motor is being tested on a test bench prior to being put into service. When the supply is connected it hums but fails to rotate. It reaches full load speed when the rotor is assisted by hand spinning. State **TWO** possible causes for this fault.

(2 marks)

(1) _____

(2) _____

(d) A single-phase split-phase motor has been running normally for 1 hour but then starts to slow. Once it slows down, it starts again. It keeps slowing down, then starting again until it is switched off. State the cause of the fault.

(2 marks)

(turn over)

Question 3

(a) What is meant by the term "current rating" of a fuse? (2 marks)

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

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

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

(c) For each of the following protective devices state:

- The type of fault it provides protection against
- What happens when the fault is detected.

(i) A phase failure relay? (2 marks)

(ii) A phase reversal relay? (2 marks)

(turn over)

Question 3 continued

- (d) A rewirable fuse is being reloaded with new fuse wire. State **TWO** reasons why it is important to thread the fuse wire from terminal to terminal through the tortuous path in the fuse carrier.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 4

(a) Refer to AS/NZS 3760 and state the **TWO** tests, using test instruments that are required to be carried out on a Class I, plug-in, electrical appliance. Include in your answer:

- The type of instrument required.
- The acceptable value for the test result.
- Whether the test result is a minimum or maximum value.

(6 marks)

Test No. 1

Test _____

Instrument: _____

Test result: _____

Ref:

Test No. 2

Test _____

Instrument: _____

Test result: _____

Ref:

(turn over)

Question 4 continued

- (b) A polarity test should be carried out on a Class I, plug in, electrical appliance after a replacement flexible cord has been fitted. The appliance is controlled by a single-pole switch. State the **FOUR** important points that the polarity test will confirm?

(4 marks)

- (1) _____

- (2) _____

- (3) _____

- (4) _____

(turn over)

Question 5

(a) Electrical equipment designed for use in damp situations has an IP rating. An **IP rating** consists of the initials IP followed by two numbers. Refer to AS/NZS 3000 or AS1939 - supplement 1 - 1990 or AS 60529 and answer the following:

(i) What is an IP rating?

(2 marks)

Ref:

(ii) What does the first number after the letters IP indicate?

(1 mark)

Ref:

(iii) What does the second number after the letters indicate?

(1 mark)

Ref:

(turn over)

Question 5 continued

- (b) Refer to AS1939 - supplement 1 – 1990 or AS 60529 and describe the level of protection offered by fittings rated at **IP56**.

(4 marks)

5 _____

6 _____

Ref:

- (c) You have been requested to replace a 230V heated towel rail and adjacent control switch in a domestic bathroom. The towel rail and switch are in Zone 2 but neither have markings on them.

The replacement towel rail and adjacent control switch can be installed in Zone 2, but both must have the required degree of protection.

Refer to AS/NZS 3000 and state:

- (i) The minimum IP rating of the heated towel rail. (1 mark)

Ref:

- (ii) The minimum IP rating of the control switch. (1 mark)

Ref:

(turn over)

Question 6 continued

- (b) Why does the cylinder operate on one element with two fuses blown? Give a reason for your answer.

(1 mark)

- (c) (i) State the type of test you would carry out to determine the location of the faults.

(½ mark)

- (ii) Describe how and where you would carry out the test on the hot water cylinder.

(2 marks)

(turn over)

Question 6 continued

(iii) Describe the likely causes of the faults.

(2 marks)

(turn over)

Question 7

- (a) Refer to the Electricity Regulations and state what is meant by the term "MEN system"

(2 marks)

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

(2 marks)

(1) _____

(2) _____

(turn over)

Question 7 continued

(c) 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

- (a) Explain the purpose of a phase failure relay in a three phase motor starter.
(2 marks)

- (b) State **TWO** likely causes for each of the following faults.

- (i) A three-phase induction motor hums noisily, but fails to rotate when started.
(2 marks)

(1) _____

(2) _____

- (ii) A lightly loaded three-phase induction motor runs noisily and then starts to overheat.
(2 marks)

(1) _____

(2) _____

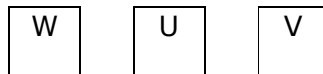
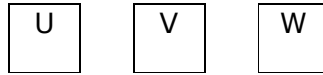
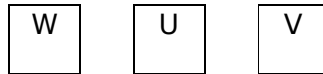
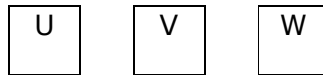
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Question 8 continued

- (c) The diagrams below represent the terminal block for the motor. The three individual stator windings are connected internally between terminals: U-U, V-V, W-W.

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)



(turn over)

Question 9 continued

(c) Why should an RCD be operationally tested?

(1 mark)

(d) Refer to NZS 3019 and state:

(i) The maximum time in which an RCD used for personal protection must operate at its rated residual current.

(1 mark)

Ref:

(ii) The maximum time in which an RCD used for personal protection must operate at five times its rated residual current.

(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

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Questions Answered	Marks	
1		
2		
3		
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7		
8		
9		
TOTAL		