



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

ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION

23 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 of this question is worth 2 marks.

(a) What type of protection device is installed on three-phase sub-circuits that provide protection for:

(i) The loss of one phase on the electricity supply.

(1 mark)

(ii) The reversal of phase rotation on the electricity supply.

(1 mark)

(b) A thermal overload provides protection for a three-phase motor circuit. What type of fault on the motor would cause the thermal overload to operate?

(c) Which **TWO** of the following factors will affect the voltage drop in a two core flexible cord?

- Insulation resistance
- Resistance
- Fusing factor
- Cross-sectional area

(1) _____

(2) _____

(turn over)

Question 1 continued

(d) A three phase electric motor with a flexible cord and plug attached is to be tested before being returned to service.

(i) State the minimum acceptable value for the insulation resistance between the windings of the motor.

(1 mark)

(ii) State the maximum acceptable value for the resistance of the protective earthing conductor of the motor.

(1 mark)

(e) An electric motor supplied from a circuit protected by MCBs is required to be isolated. Two precautions must be taken to secure the isolation as the motor isolator is not located adjacent to the motor. State **TWO** types of precautions that can be taken.

(1) _____

(2) _____

(f) A trainee may assist in prescribed electrical work subject to supervision. Refer to the Electricity Regulations and state **ONE** category of person who can provide this supervision.

Ref:

(turn over)

Question 1 continued

(g) For the New Zealand MEN system state:

- (i) The nominal voltage that should exist between a neutral conductor and earth

(1 mark)

- (ii) The nominal voltage that should exist between any active conductor and the neutral conductor

(1 mark)

- (h) A fuse has blown on a switchboard circuit supplying a single phase plug-in appliance. The appliance has been disconnected and taken away to be tested for faults.

When the fuse is replaced and the main switch is turned on, the fuse blows again. What is the probable cause of the fault and what action should be taken to rectify it?

- (i) State **TWO** methods of identifying a double insulated appliance.

(1) _____

(2) _____

- (j) A circuit-breaker is used as back-up protection for a motor. The circuit breaker has the rating 6 kA, 16A. Briefly explain the meaning of **ONE** of these terms.

(turn over)

Question 2

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

(i) Capacitor start induction motor.

(1 mark)

(ii) Universal (series) motor

(1 mark)

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

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

Calculate the current drawn by the motor.

(3 marks)

(turn over)

Question 2 continued

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

(ii) State **ONE** device that can be used in a single-phase capacitor start motor or split phase motor in place of a centrifugal switch?
(1 mark)

(d) A universal (series) motor is controlled by means of a reversing switch. State what would occur if attempts were made to reverse the motor while it was still running.
(2 marks)

(turn over)

Question 3

Fuses, MCBs and RCDs are found on switchboards

- (a) What is the main purpose of a fuse or an MCB found on a switchboard?
(2 marks)

- (b) What is the main purpose of a RCD found on a switchboard?
(2 marks)

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

(turn over)

Question 3 continued

(d) Circuit breakers are available in a number of different operational types.

(i) Describe how the internal mechanism of a **thermal type** circuit breaker operates when an overload occurs.

(2 marks)

(ii) Describe how the internal mechanism of a **magnetic type** circuit breaker operates when a short-circuit occurs.

(2 marks)

(turn over)

Question 4

- (a) Refer to the Electricity Regulations and state the Standard to which a portable electric water heater containing an MIMS element must be tested following completion of repairs?

(1 mark)

Ref:

- (b) Refer to the Standard stated in (a) above and complete the table by stating:

- The type of test required using test instruments
- The type of instrument required for each test,
- The value of each test result which is acceptable to comply with the Standard.
- Whether the test result is a minimum or maximum value.

(4 marks)

Test	Instrument	Test value	Maximum or minimum

Ref:

(turn over)

Question 4 continued

(c) Refer to the Standard required in (a) above and briefly describe **FIVE** of the specific checks that should be carried out visually.

Note: The tests must relate to a portable electric water heater (5 marks)

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

Ref:

(turn over)

Question 5

- (a) Refer to AS/NZS 3000 and state what is meant by the term "damp situation"?
(2 marks)

Ref:

- (b) Refer to AS/NZS 3000 or AS 60529 or AS 1939 supplement 1 – 1990 and state what is meant by the term "IP rating"?
(2 marks)

Ref:

- (c) An IP rating has the letters IP followed by two numbers. Refer to AS/NZS 3000 or AS 60529 or AS 1939 supplement 1 – 1990 and explain:

- (i) What the first number indicates.
(2 marks)

Ref:

(turn over)

Question 5 continued

- (ii) Explain what the second number indicates?

(2 marks)

Ref:

- (d) 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

- (a) A protective earthing conductor test was carried out on Class I, 230 V single-phase plug-in washing machine. It was found that a termination in the machine had a resistance of 20Ω .

The washing machine was put back into service without being repaired. It was plugged into a live socket outlet and turned on. The outlet is protected by a 15A HRC fuse with a 1.25 Utilisation category (fusing factor).

A phase to earth fault occurred on the washing machine.

- (i) Calculate the current that would flow in the protective earthing conductor.

(2 marks)

- (ii) Calculate the power that would dissipate in the protective earthing conductor.

(2 marks)

- (iii) Determine by calculation whether or not the fuse would operate.

(2 marks)

(turn over)

Question 6 continued

- (b) A 230V, Class I, plug-in electrical appliance is controlled by a single pole switch. You have disconnected the appliance and are testing it with an ohmmeter. Describe the **THREE** situations that could cause the neutral to be switched instead of the phase in the appliance.

(3 marks)

(1) _____

(2) _____

(3) _____

- (c) State **ONE** unsafe effect on the operation of an electrical appliance a phase and neutral transposition could create.

(1 mark)

(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 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 7 continued

- (c) In many installations, three-phase loads do not require nor have neutral conductors in the cables supplying three-phase subcircuits. Explain the circumstances under which a subcircuit cable that supplies a three-phase load would not require a neutral conductor.

(2 marks)

- (d) Refer to AS/NZS 3000, state the requirement for a switch that controls more than one active conductor of a circuit in an a.c. system.

(2 marks)

(turn over)

Question 8

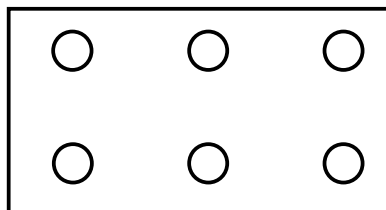
(a) The figure in (ii) below represents the terminal block on an old three-phase induction motor you are required to connect to a star-delta starter. There are no markings on the terminal block to indicate which pair of terminals are the ends of a winding.

(i) Describe the procedure you would carry out to identify the winding terminal of the motor. Include in your description the type of instrument you would use.

(2 marks)

(ii) Mark and label the position of the ends of the motor windings on the terminal block. Draw the incoming supply and connections so the motor could be started direct-on-line in delta.

(2 marks)



(turn over)

Question 8 continued

(b) List **TWO** possible causes for the following faults that may occur on three phase induction motors.

(i) The motor hums on starting but fails to rotate.

(2 marks)

(1) _____

(2) _____

(ii) The motor overheats while running on load.

(2 marks)

(1) _____

(2) _____

(iii) A three-phase induction motor overheats while running, but the current in all three phases is the same as the nameplate rating.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 9

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

- Sensing coil/toroid
- Tripping device
- Test circuit (push button and resistor)
- Active, neutral and earth conductors.
- Class I equipment load

(4 marks)

(b) 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)

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

(1 mark)

(turn over)

Question 9 continued

- (c) Briefly explain how a Residual Current Device (RCD) detects an earth fault and disconnects the supply from an electrical appliance.

(4 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

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Questions Answered	Marks	
1		
2		
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7		
8		
9		
TOTAL		