



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

ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION

9 May 2009

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 some of the following documents in this examination:

- The Electricity Act 1992 reprint dated 19 August 2005
- The Electricity Regulations 1997 reprint dated 2 September 2005
- AS 60529 **or** AS 1939 Supplement 1-1990
- AS/NZS 3000:2000 and Amendments 1, 2 and 3 **or** AS/NZS 3000:2007
- AS/NZS 3760:2003 and Amendment 1
- NZS 3019:2004 **or** AS/NZS 3019:2007
- ECP 34
- ECP 54

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

Question 1

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

- (ii) If the usual operating voltage of a low voltage domestic electrical installation is 230 V, what is the peak voltage?

(1 mark)

- (b) (i) If you reversed a motor by reversing the connections to the start winding, what type of motor would you be reversing?

(1 mark)

- (ii) If you reversed a motor by reversing the connections to the field winding, what type of motor would you be reversing?

(1 mark)

- (c) When replacing an HRC fuse which has blown, the replacement must have characteristics the same as the original. State the **TWO** electrical characteristics – other than category of duty (rupturing capacity) and voltage rating - to be checked for similarity.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 1 continued

(d) A switch controls two heating elements of the same resistance. The switch has three positions – “high”, “medium” and “low”.

(i) When the **high** position is selected:

(A) How many elements will be connected to the supply? (½ mark)

(B) How will the elements be connected to the supply? (½ mark)

(ii) When the **low** position is selected:

(A) How many elements will be connected to the supply? (½ mark)

(B) How will the elements be connected to the supply? (½ mark)

(e) An electrical service technician isolated a fixed-wired three-phase electric motor by withdrawing the fuses for the motor on the factory switchboard. She/he did not carry out any tests to prove the isolation.

The electrical service technician withdrew the wrong fuses on the factory switchboard. State **TWO** dangerous conditions that could occur because of the electrical service technician’s actions.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 1 continued

(f) 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)

(g) You have turned off an isolating switch because you want to isolate a fixed-wired electrical appliance. When you test the terminals of the appliance, they are still live. State **TWO** circumstances that may cause such a situation to occur.

- Note:
1. The circuit wiring is not damaged
 2. The isolating switch is not damaged or faulty
 3. There is no capacitor in the circuit.

(2 marks)

(1) _____

(2) _____

(h) A three-phase, delta-connected, induction motor for a lathe is connected to the electricity supply by means of a four core flexible cord in which each conductor is identified by colour. The cable runs between the direct-on-line (DOL) starter and the motor. Refer to AS/NZS 3000 and state the requirements that apply to the use of colours in the cord?

(2 marks)

(turn over)

Question 1 continued

- (i) A thermal overload protecting a three-phase motor has operated. State the **TWO** conditions, either of which would cause the thermal overload to operate?

(2 marks)

(1) _____

(2) _____

- (j) State the **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

A 400V three-phase motor has been repaired and you have to reconnect it.. The six-core neutral screened cable that is to be connected to the star/delta starter is connected to the motor.

Describe the two tests you will carry out using test instruments to ensure the motor is safe to connect to the supply.

- (a) State the order in which the two tests must be carried out. (1 mark)

- (b) State the reason why the tests you have stated in (a) are carried out in that order. (1 mark)

- (c) Describe how you will carry out each test. Your answer for each test must include:

- The test instrument.
- The test voltage (if applicable)
- How the test is carried out.
- The maximum or minimum permitted acceptable test result for that test

(8 marks)

Test 1

(turn over)

Question 2 continued

Test 2

(turn over)

Question 3

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

(2 marks)

- (b) 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.

(2 marks)

- (c) State **TWO** reasons explaining why the neutral is earthed in the New Zealand MEN system of supply.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 3 continued

- (d) In many installations, three-phase loads do not require nor have neutral conductors in the cables supplying three-phase final subcircuits. State **TWO** situations where a final subcircuit cable that supplies a three-phase load would not require a neutral conductor.

(2 marks)

(1) _____

(2) _____

- (e) State **TWO** reasons why a neutral conductor is required in the cable supplying a three-phase electrical appliance which has 230V heating loads that draw different values of current on each of the phases.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 4

(a) Draw 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 4 continued

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

(4 marks)

(turn over)

Question 5 continued

- (b) After you have done the disconnection, what would you do to ensure that the work area is safe to be left unattended?

(4 marks)

- (c) State the **TWO** tests using test instruments the other electrical service technician will have to carry out on the new hot water cylinder to ensure the cylinder is safe to connect to the supply.

(1 mark)

- (1) _____
- (2) _____

(turn over)

Question 6 continued

(b) Refer to AS/NZS 3760 and state the insulation resistance permitted between the live supply conductors and earthed exposed metal parts of a 230V, Class I, portable isolating transformer. State a reference to support your answer.

(1 mark)

Ref:

(c) A polarity test should be carried out on a 230V, Class I, plug-in electrical appliance after a replacement flexible cord has been fitted. The appliance is controlled by a single-pole switch. What **FOUR** important points will this polarity test confirm?

(4 marks)

(1) _____

(2) _____

(3) _____

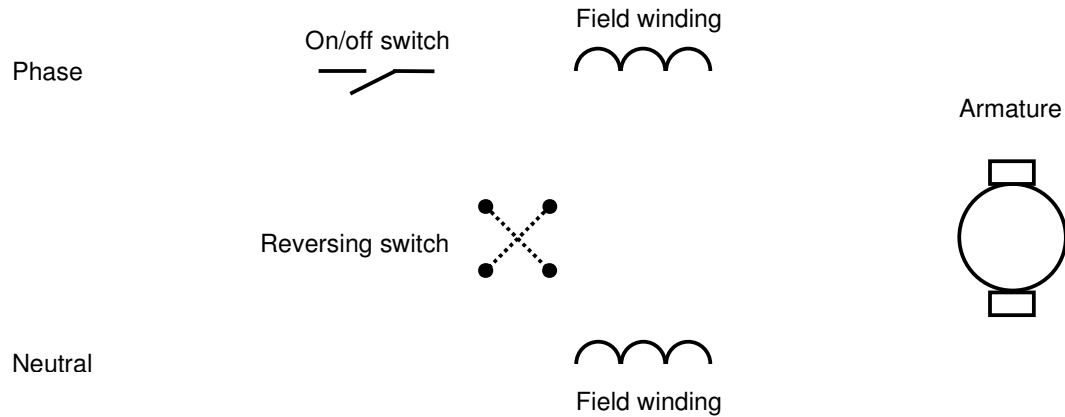
(4) _____

(turn over)

Question 7

- (a) The diagram below shows the components of a universal (series) motor. Draw the conductors on the diagram to show how the on/off switch and the reversing switch are used to control the motor.

(5 marks)



- (b) State **TWO** technical reasons why universal motors are more suitable than single-phase induction motors for use in portable power tools.

(2 marks)

- (1) _____

- (2) _____

(turn over)

Question 7 continued

- (c) (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)

(turn over)

Question 8

- (a) (i) You have interchanged two of the supply phase connections to a motor, so the motor direction can be reversed. What type of motor are you reversing?

(1 mark)

- (ii) A motor consists of two identical windings and there is a capacitor connected in series with one of those windings. To reverse the direction of the motor you have connected the capacitor in series with the other winding. What type of motor are you reversing?

(1 mark)

- (b) Draw and label a schematic diagram to show how the components listed below would be connected in the 230V control circuit of a three-phase DOL motor starter. Your diagram is to include the following components.

- a fuse
- thermal overload relay contact
- stop button
- start button
- hold in contact (maintaining contact)
- 230V coil

You do not need to show the main contacts or the motor

(5 marks)

(turn over)

Question 8 continued

- (c) Explain how the thermistor in a 230V control circuit of a DOL starter protects the three-phase motor against the effects of a mechanical overload
(3 marks)

(turn over)

Question 9

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

- (i) Describe how the internal mechanism of a thermal type circuit breaker operates to open the circuit breaker when a fault is detected.

(2 marks)

- (ii) Describe how the internal mechanism of an electro-magnetic type circuit breaker operates to open the circuit breaker when a fault is detected.

(2 marks)

(b) Fuses, MCBs and RCDS are found on switchboards.

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

(2 marks)

- (ii) What is the main purpose of a RCD found on a switchboard?

(2 marks)

(turn over)

Question 9 continued

- (c) State **TWO** 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.

(2 marks)

(1) _____

(2) _____

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		
4		
5		
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7		
8		
9		
TOTAL		