



<b>Candidate Code No.</b>	
<b>For Board Use Only</b>	
Result	Result
Date	Date
Int	Int

## **ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION**

### **22 November 2008**

### **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 some of 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) or AS/NZS 3000:2007; 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) Refer to the Electricity Regulations, and briefly state the essential requirements of the term "electrically safe".

(2 marks)

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Ref: .....

(b) 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 or faulty
  2. The isolating switch is not damaged or faulty
  3. There is no capacitor in the circuit.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

**(turn over)**

## Question 1 continued

- (c) A single-phase, split phase motor hums and fails to rotate on the bench when the supply is connected, yet it attains full load speed when the rotor is assisted by hand spinning. State **TWO** parts of the motor, either of which could cause the fault.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

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

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

- (e) 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 current rating and voltage rating - to be checked for similarity.

(2 marks)

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

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

**(turn over)**

## Question 1 continued

(f) Refer to the Electricity Regulations and state the meaning of the following terms:

(i) Isolated.

(1 mark)

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Ref: .....

(ii) Live.

(1 mark)

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Ref: .....

(g) The manager of a factory has asked you how often the Class I and Class II electrical appliances in the factory should be tested and inspected. Refer to AS/NZS 3760 state the inspection intervals for:

(2 marks)

Class I appliances \_\_\_\_\_

Class II appliances \_\_\_\_\_

(h) A Class II electrical appliance is supplied by a two-core flexible cord and is operating at full load. State the main electrical effect the resistance of the conductors has on the operation of the flexible cord.

(2 marks)

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**(turn over)**

**Question 1 continued**

- (i) A handheld electrical appliance used by a person who is partially immersed in a conductive substance must be used in conjunction with an appropriate safeguard. Refer to the Electricity Regulations and state **TWO** requirements when the appliance is fixed-wired.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

Ref: .....

- (j) (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) You have interchanged the connection to one winding of a motor that consists of two windings, so the motor direction can be reversed. What type of motor are you reversing?

(1 mark)

\_\_\_\_\_

**(turn over)**

## Question 2

- (a) You are replacing a faulty ammeter on refrigeration plant control panel and have accidentally connected the ammeter in parallel with the electricity supply.

Describe the **main safety issues** that arise when this situation occurs.

(2 marks)

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- (b) You are using a voltmeter to measure the voltage on an electrical appliance and have accidentally connected the voltmeter in series with that appliance.

Describe the **main safety issues** that arise when this situation occurs.

(2 marks)

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**(turn over)**

## Question 2 continued

- (c) You are connecting test instruments to measure voltage and current values of a live 230V electrical appliance. Briefly describe **FOUR** important electrical precautions relating to the test instruments that will promote your safety.

Note:     1. All the necessary safety equipment (overalls, rubber mats etc.) is available.  
          2. Set procedures are available.  
          3. All conductive items (e.g., rings) have been removed.

(4 marks)

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

- (d) State **FOUR** electrical tests using test instruments that you would carry out to ensure that a Class I electrical appliance is electrically safe.

(2 marks)

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

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

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

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

**(turn over)**

### Question 3

- (a) 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)

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

(2 marks)

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Ref: .....

**(turn over)**

### Question 3 continued

- (c) 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.

(4 marks)

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

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

- (d) (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)

\_\_\_\_\_

**(turn over)**

## Question 4

- (a) When selecting a flexible cord for fitting to a single phase electrical appliance it is necessary to consider its length and cross-sectional area. List **FOUR** other factors that may need to be considered in selecting the cord.

(4 marks)

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- (b) (i) Explain why the voltage at the load end of a flexible cord extension set supplying current to an electrical appliance is less than that at the supply end of the cord?

(1 mark)

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- (ii) State **TWO** ways in which the effect in (b)(i) above can be reduced – assuming that the same appliance remains connected.

(2 marks)

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

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

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**(turn over)**

**Question 4 continued**

(c) All flexible cords are given a "current rating". What does "current rating" mean when applied to flexible cords?

(1 mark)

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(d) A three-phase delta-connected motor is controlled by a DOL (direct-on-line) starter. It is connected to the electricity supply by means of a three-core, screened flexible cord in which each conductor is identified by means of colour. Refer to AS/NZS 3000 and state the requirements that apply to the use of colours in such a cord?

(2 marks)

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Ref: .....

**(turn over)**

## Question 5

- (a) Refer to the Electricity Regulations and state the Standard to which a 230V, Class I, plug-in electric water heater must be tested following completion of repairs?

(1 mark)

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Ref: .....

- (b) The 230V, Class I, plug-in electric water heater has an MIMS element. Refer to the Standard you have stated in (a) and complete the following table in relation to the tests required to be carried out using test instruments.

(6 marks)

**Note:** You must state whether the permitted test result is a minimum or maximum value.

Type of test	Type of instrument required	Permitted test result

(turn over)

**Question 5 continued**

- (c) Refer to the Standard you have stated in (a) above and describe **THREE** visual checks (inspections) that must be carried out on the 230V, Class I, plug-in electric water heater

(3 marks)

**Note:** The visual checks (inspections) must relate specifically to the 230V, Class I, plug-in electric water heater

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

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

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

Ref: .....

**(turn over)**

## Question 6

(a) Draw and label a diagram of a 230V control circuit for a three-phase DOL motor starter. The diagram is to include the following components.

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

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

(6 marks)

**(turn over)**

## Question 6 continued

(b) A three-phase motor is protected by a thermal overload and HRC fuses.

(i) Briefly explain how the thermal overload protects the motor.

(2 marks)

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(ii) Briefly explain how the HRC fuses protect the motor.

(2 marks)

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**(turn over)**

## Question 7

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

(2 marks)

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(b) (i) A fuse on a switchboard protects a final sub-circuit. State the reason why the fuse "blows" before the circuit has reached full-load current.

(1 mark)

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(ii) A fuse on a switchboard protects a final sub-circuit. State the reason why the circuit has been damaged under fault conditions.

(1 mark)

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(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?

(1 mark)

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(ii) A phase reversal relay?

(1 mark)

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**(turn over)**

## Question 7 continued

- (d) 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) \_\_\_\_\_

\_\_\_\_\_

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

(2 marks)

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\_\_\_\_\_

**(turn over)**

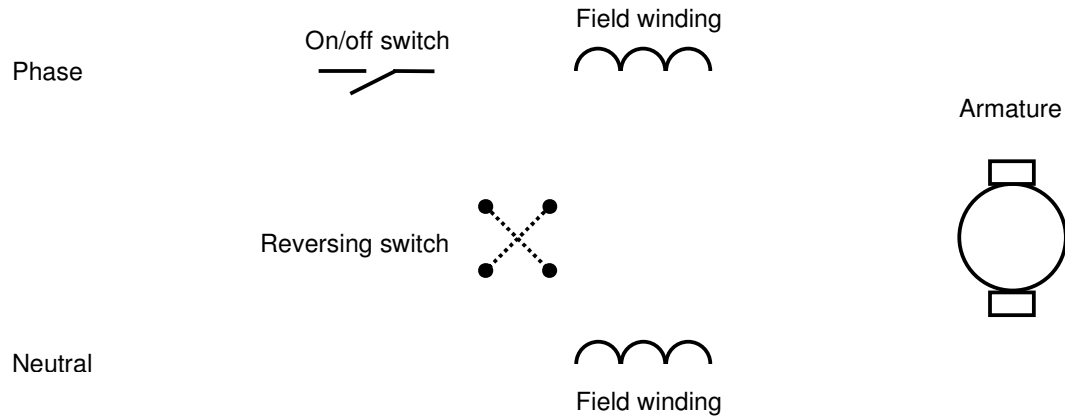




## Question 9

- (a) The diagram below shows the components of a universal (series) motor in a floor polisher. 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 9 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)

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**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>TOTAL</b>		