



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

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

**28 November 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, A and 3 **or** AS/NZS 3000:2007
- AS/NZS 3760:2003, 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**

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## Question 1

(a) What type of protection device is installed on three-phase final subcircuits to specifically provide protection for:

(i) The loss of one phase on the electricity supply. (1 mark)

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(ii) The reversal of phase rotation on the electricity supply. (1 mark)

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(b) Briefly explain the operation of an energy controller (Simmerstat) when it controls a heating load. (2 marks)

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(c) One method of identifying a double insulated electrical appliance is by the words "Class II" or "Class 2" on the appliance name plate. State **TWO** other methods that are used to identify a double insulated appliance. (2 marks)

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

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

(d) An electrical service technician intends to isolate a fixed-wired three-phase electric motor, but has withdrawn the wrong fuses for that motor on the factory switchboard.

State **TWO** dangerous conditions that could occur because the electrical service technician withdrew the wrong fuses. (2 marks)

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

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

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**(turn over)**

**Question 1 continued**

(e) Refer to the Electricity Regulations and calculate the lowest acceptable voltage between the phase and neutral at the supply terminals of any standard low voltage fixed wired appliance if the voltage at the switchboard is 230 volts.

(2 marks)

(f) Electrical equipment designed for use in damp situations has an **IP rating** – an International Protection rating or Ingress protection rating. An **IP rating** consists of the initials IP followed by two numbers. Refer to AS1939; AS 60529 or AS/NZS 3000 and explain:

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

(1 mark)

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Ref: .....

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

(1 mark)

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Ref: .....

**(turn over)**

## Question 1 continued

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

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

- (h) An electrical service technician notices that an electrical fitting on a machine is damaged and if used, could endanger personnel. The machine is controlled by a lockable isolator. What action should the electrical service technician take to ensure the machine is safe – aside from carrying out repairs?

(2 marks)

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- (i) An HRC fuse with a current rating of 30A is gM rated. Calculate the fusing current of this fuse.

(2 marks)

**(turn over)**

## Question 1 continued

- (j) Refer to the Electricity Regulations and state the **TWO** practical steps an employee must take when carrying out work requiring personal protective equipment.

(2 marks)

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

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\_\_\_\_\_

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

\_\_\_\_\_

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Ref: .....

**(turn over)**

## Question 2

- (a) A three-phase motor controlled by a DOL starter drives a wood planer. The thermal overload in the motor starter has tripped due to a sustained overcurrent. State **THREE** conditions that could cause a sustained overcurrent.

Note: The wood planer is not jammed.

(3 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

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

\_\_\_\_\_

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

- (i) A three-phase induction motor, controlled by a direct-on-line (DOL) starter, overheats while running, but the current in all three phases is the same as the nameplate rating.

Note: 1. The voltage level is normal.  
2. The protection is correctly rated and is not faulty.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

**(turn over)**



### Question 3

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

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

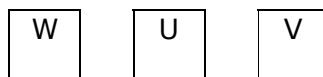
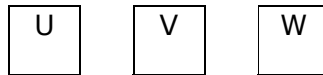
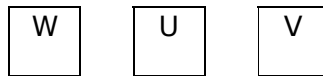
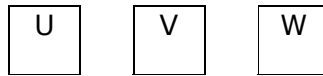
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### Question 3 continued

- (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 4

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

(2 marks)

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

(2 marks)

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

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

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**(turn over)**

## Question 4 continued

(c) Draw and label a 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 final subcircuit conductors.

(6 marks)

**(turn over)**

## Question 5

A fixed-wired small printing press, driven by a three-phase electric motor is supplied by PVC cables enclosed in a flexible steel conduit. It has been operating safely for some months, but the operator has now reported the MCB protection occasionally tripping. When reset, the MCB functions for a short period and trips again.

- The MCB is not faulty.
- The MCB is correctly rated for the circuit it protects.

You have been required to find the problem and have safety tagged the circuit and confirmed by testing, that the supply is isolated.

(a) You carried out an insulation resistance test.

(i) State the type of instrument and test voltage used.

(1 mark)

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(ii) Briefly describe how you carried out this test. Include any desired test result

(3 marks)

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(iii) State the reason why the MCB tripped if an unsatisfactory insulation resistance test result was obtained.

(2 marks)

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**(turn over)**

## Question 5 continued

- (b) (i) Describe the test you would carry out to confirm that the motor is functionally earthed. Identify the type of instrument used and any minimum or maximum test values that are applicable.

(2 marks)

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- (ii) Describe how the test described in (b)(i) contributes to the safety of the motor.

(2 marks)

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**(turn over)**

## Question 6

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

(i) Capacitor start induction motor.

(1 mark)

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(ii) Universal (series) motor

(1 mark)

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(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 6 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)

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(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)

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**(turn over)**

## Question 7

**Note: Read the entire question before commencing.**

In a bakery a three-phase oven, comprising three single-phase 6 kW elements, is faulty. The oven is controlled by a contactor. Both the oven and contactor are controlled by an adjacent isolating switch. The manager has told you that:

- Two HRC fuses have blown. When they were replaced, they blew immediately.
- One element in the oven operates.

**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 oven.

(3 marks)

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

(1 mark)

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**(turn over)**



## Question 8

(a) Refer to AS/NZS 3760 and state the **TWO** tests, using test instruments that are required to be carried out on a three-phase, 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 8 continued

(b) The three-phase appliance is supplied by a three-core and earth flexible cable.

(i) Describe how you would carry out the insulation resistance test on the appliance.

(2 marks)

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(ii) Refer to AS/NZS 3000 and state **ONE** set of colours required for the flexible cord conductors.

(2 marks)

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Ref: .....

**(turn over)**

## Question 9

(a) Refer to the Electricity Regulations and answer the following:

- (i) Name the organisation that approved the form for an application for a practising licence.

(1 mark)

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Ref: .....

- (ii) State the circumstances under which the holder of a practising licence must carry that licence.

(1 mark)

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Ref: .....

(b) An applicant for a practising licence – who has previously held a licence – must have attended a refresher course. Refer to the Electricity Regulations and state:

- (i) The period before the date of applying for a licence in which an applicant must have attended the refresher course.

(1 mark)

\_\_\_\_\_

Ref: .....

- (ii) **FOUR** of the subjects that must be covered in refresher course:  
(4 marks)

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

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

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

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

Ref: .....

**(turn over)**

## Question 9 continued

- (c) The Electricity Act lists **SEVEN** classes of person who may do, or assist in doing prescribed electrical work. Trainees are one class of person. Refer the Electricity Act and list **THREE** other of classes of person.

(3 marks)

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

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

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

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

<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>		
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<b>9</b>		
<b>TOTAL</b>		