



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

ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION

27 June 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) 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)

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

(1 mark)

(b) When connecting a three-phase motor to the electricity supply it is necessary to connect the three supply conductors to the motor windings. It is also necessary to **securely** connect the motor to earth by means of a protective earthing conductor. State **ONE** reason why the protective earthing conductor is required.

(2 marks)

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

(2 marks)

(turn over)

Question 1 continued

(d) 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

(2 marks)

(1) _____

(2) _____

(e) One method of identifying a double insulated appliance is the symbol of "a square within a square" on the appliance name plate. State **TWO** other methods that are used to identify a double insulated appliance.

(2 marks)

(1) _____

(2) _____

(f) A single-phase capacitor-start motor is being tested **under no-load** on a workbench.

(i) When switched on, the capacitor-start motor started but did not run. Which type of fault would cause this to happen?

(1 mark)

(ii) When switched on, the capacitor-start motor failed to start. Tests showed both the start and run windings to be continuous? Which type of fault would cause this to happen?

(1 mark)

(turn over)

Question 1 continued

(g) A switch controls two heating elements of the same resistance of an electric blanket. The switch has three positions – “low”, “medium” and “high”. The blanket is faulty because it draws current only in the “high” and “medium” positions, but not in the “low” position. The switch is not faulty.

(i) What situation would cause such a fault?

(1 mark)

(ii) Would the faulty blanket draw more current or less current or the same current in the “high” position as in the “medium” position? State a reason for your answer.

(1 mark)

(h) An HRC fuse with a current rating of 20A is gM rated. Calculate the fusing current of this fuse.

(2 marks)

(i) (i) A thermistor overload protecting a motor has operated. What has the thermistor detected that would cause it to operate?

(1 mark)

(ii) A thermal overload protecting a three-phase motor has operated. What has the thermal overload detected that would cause it to operate?

(1 mark)

(turn over)

Question 1 continued

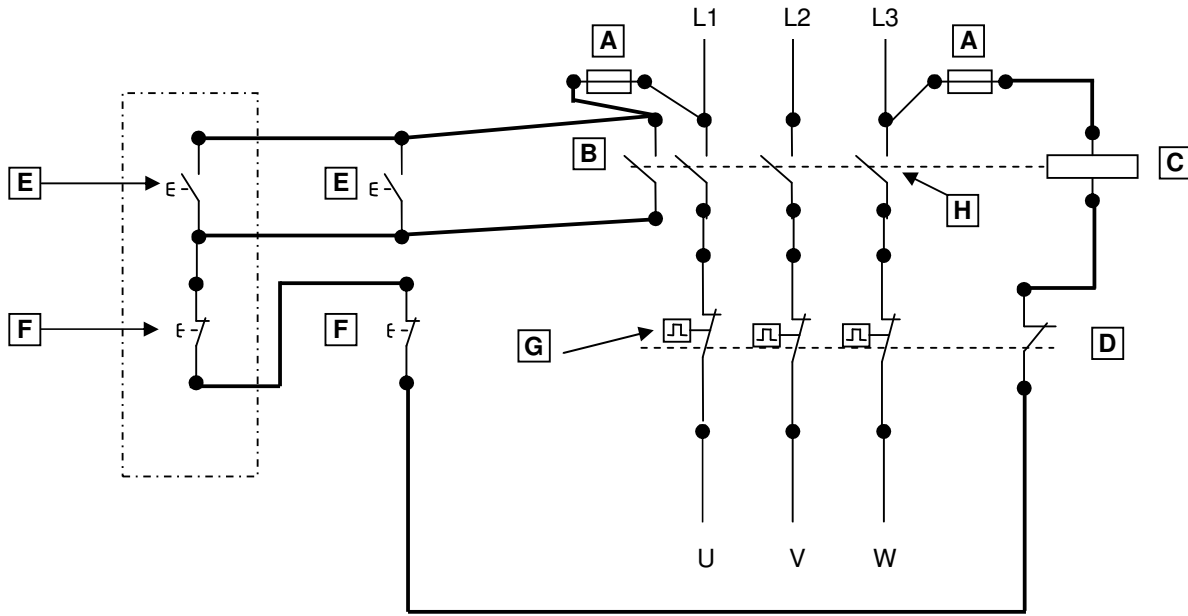
- (j) Refer to the Electricity Regulations and calculate the lowest acceptable voltage between the phase and neutral at the supply terminals of any standard low voltage fixed wired appliance if the voltage at the switchboard is 230 volts.

(2 marks)

(turn over)

Question 2

The figure below is a control circuit of a direct-on-line (DOL) starter that controls a three-phase induction motor.



(a) Name the components of the circuit.

(4 marks)

- (A) _____
- (B) _____
- (C) _____
- (D) _____
- (E) _____
- (F) _____
- (G) _____
- (H) _____

(turn over)

Question 2 continued

(b) At what voltage does the control coil operate?

(1 mark)

(c) What would be the effect on the motor if the stop button was jammed in the open position? State a reason for your answer.

(1 mark)

(d) What would be the effect on the motor if the hold-in contact was jammed in the open position? State a reason for your answer.

(2 marks)

(e) What would be the effect on the motor if the overload auxiliary contact was jammed in the open position? State a reason for your answer.

(1 mark)

(f) Which protective device would be used in place of the overload device?

(1 mark)

(turn over)

Question 3

An HRC fuse protects a 20A circuit consisting of two plug sockets supplying various electrical appliances in an office. The fuse has blown. When the fuse is replaced, it blows again when the supply is restored to the circuit.

You have established that the fuse is not faulty and is correctly rated for the circuit.

(a) State the **THREE** possible causes of the HRC fuse blowing the second time. (3 marks)

(1) _____

(2) _____

(3) _____

(b) For each of the possible causes you have written in (a), state:

- What action you would take to establish that this is the cause.
- The remedial action you would take or recommend to the manager of the office.

(7 marks)

(i) Possible cause No. 1

Action taken to establish that this is the cause.

Remedial action taken or recommended

(turn over)

Question 3 continued

(ii) Possible cause No. 2

Action taken to establish that this is the cause.

Remedial action taken or recommended

(iii) Possible cause No. 3

Action taken to establish that this is the cause.

Remedial action taken or recommended

(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 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 4 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)

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

(2 marks)

Ref:

(turn over)

Question 5

- (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)

- (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)

(turn over)

Question 5 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 6

- (a) A three-phase motor is supplied from a circuit protected by MCBs and is required to be isolated at the isolator. The motor isolator is not located adjacent to the motor. State **TWO** types of precautions relating to isolation that can be taken where an isolating switch is not located adjacent to the motor.

(2 marks)

(1) _____

(2) _____

- (b) State the **TWO** reasons why the **prove test prove** method of testing for isolation is used.

(1 mark)

(1) _____

(2) _____

- (c) Explain the **main** purpose of using a Danger Tag system.

(2 marks)

(turn over)

Question 6 continued

(d) State **TWO** circumstances where an isolating switch would carry two safety danger tags.

(2 marks)

(1) _____

(2) _____

(e) A three-phase fixed wired electrical machine is protected by MCBs. It has been proven to be isolated at the isolating switch using the prove-test-prove method. To secure the isolation, a danger tag has been attached to the isolator and the isolator has been locked.

Describe **THREE** other methods of securing the isolation of the machine.

(3 marks)

(1) _____

(2) _____

(3) _____

(turn over)

Question 7

- (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. State **FOUR** other physical factors that may need to be considered in selecting the cord.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

- (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)

- (ii) State **TWO** ways in which the effect in (b)(i) above can be reduced.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 7 continued

- (c) Refer to AS/NZS 3000 and state **ONE** set of colours that applies to the fixed wiring conductors in a three-phase MEN installation.

(3 marks)

(turn over)

Question 8

- (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 9

- (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)

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

(2 marks)

Ref:

(turn over)

Question 9 continued

- (c) 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.

(2 marks)

(1) _____

(2) _____

- (d) 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)

- (e) (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)

For Candidate's Use

In the box, write the number of **EXTRA** sheets you have used. Write **NIL** if you have not used any

For Examiner's Use Only		
Questions Answered	Marks	
1		
2		
3		
4		
5		
6		
7		
8		
9		
TOTAL		