ELECTRICAL WORKERS REGISTRATION BOARD
Safety • Competency

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

ELECTRICAL SERVICE TECHNICIAN "B" EXAMINATION

12 May 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 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 TWO decimal 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 in this question is worth 2 marks

(a) In a three-phase motor starter, which type of protection device detects loss of one phase and de-energises the coil which opens the control circuit and disconnects the motor from the supply.

_____

_____

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

- Resistance
- Colour coding
- Fusing factor
- Cross-sectional area

(1) _____

(2) _____

(c) Refer to the Electricity Regulations and list **TWO** situations where fittings or electrical appliances are deemed not to be electrically safe.

(1) _____

_____

(2) _____

_____

Ref: .....

(turn over)

Question 1 continued

(d) 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.

Ref: ……

(e) Refer to the Electricity Act, and define a supervisor of electrical work as applied to an Electrical Service Technician.

_____

_____

_____

_____

Ref: ……

(f) When testing for isolation, it is found that there are live conductors at the terminals of a fixed-wired electrical appliance after the isolating switch is turned to the off position. State **TWO** circumstances that may cause such a situation to occur.

(2 marks)

(1) _____

_____

(2) _____

_____

(turn over)

Question 1 continued

(g) A handheld electrical appliance used on a building or structure under construction must be used in conjunction with an appropriate safeguard. Refer to the Electricity Regulations and state **TWO** such safeguards.

(1) _____

_____

_____

_____

Ref: ……

(2) _____

_____

_____

_____

Ref: ……

(h) Explain how the direction of rotation can be reversed in a Universal (series) motor

_____

_____

_____

_____

(i) State **TWO** typical applications for a Universal (series) motor.

(1) _____

_____

(2) _____

_____

(turn over)

Question 1 continued

(j) A three-phase 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 means of 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?

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_____

_____

_____

Ref: .....

(turn over)

Question 2

(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 2 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) _____

_____

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_____

(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?

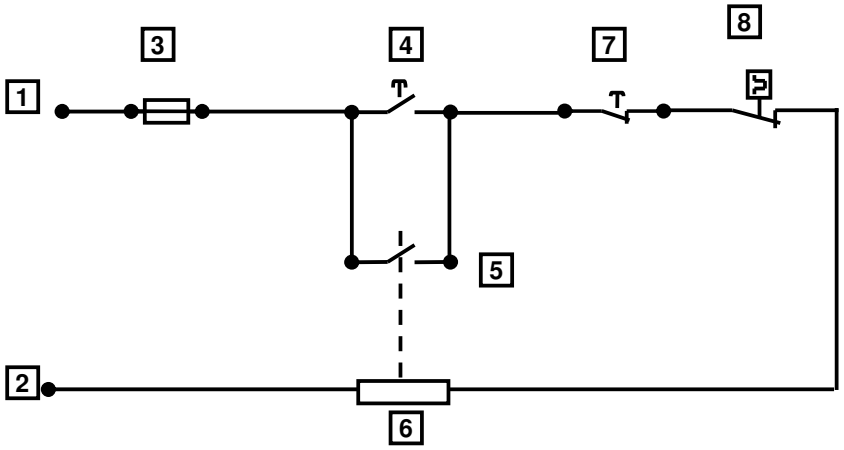
(1 mark)

_____

(turn over)

Question 3

(a) The diagram below shows the low voltage control circuit of a three-phase DOL motor starter.



(i) Name the numbered parts of the circuit.

(4 marks)

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

(ii) State **ONE** typical operating voltage for the circuit

(1 mark)

_____

(turn over)

Question 3 continued

(b) The motor can be protected either by a thermal overload or a thermistor.

(i) Briefly explain how a thermal overload would protect the motor.

(2 marks)

_____

_____

_____

_____

_____

_____

(ii) Briefly explain how a thermistor would protect the motor.

(2 marks)

_____

_____

_____

_____

_____

_____

(c) Supply lines 1 and 3 have been reversed at the output terminals of a DOL starter supplying a 3-phase induction motor when the wiring was re-connected. What will happen when this induction motor is livened?

(1 mark)

_____

_____

(turn over)

Question 4

Carefully read the entire question before answering parts (a) and (b).

You have been requested by the Supervisor to commission a new single-phase electric hot water cylinder in a small factory. The cylinder element is an MIMS type. The connection is to be made via a new flexible cord.

The cylinder circuit is supplied by an HRC fuse on a three-phase switchboard and a lockable isolating switch is located adjacent to the cylinder. The cylinder connects directly via a flexible cord to the isolating switch.

Another electrical service technician has disconnected the old cylinder from the isolating switch. The isolating switch is **not** locked nor is it tagged.

(a) Describe the **TWO** tests you will make using test instruments to ensure that the **new cylinder** is safe to connect to the power supply. The tests are to be carried out after you have connected the flexible cord to the cylinder, but before you connect it to the isolating switch. Include in your description for each test:

- The type of instrument used
- The test voltage applied - if applicable.
- The expected test result
- Whether the test result is a minimum or maximum value

(6 marks)

Test 1

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_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(turn over)

Question 4 continued

Test 2

(b) Describe the steps that you will take to ensure your own safety prior to connecting the **new cylinder** to the isolating switch.

(4 marks)

(turn over)

Question 5

(a) You are using an ammeter to measure the current drawn by an electrical appliance. Describe what would happen if you connected the ammeter in parallel with that appliance.

(3 marks)

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_____

_____

_____

_____

_____

_____

_____

(b) You are using a voltmeter to measure the voltage on an electrical appliance. Describe what would happen if you connected the voltmeter in series with that appliance.

(3 marks)

_____

_____

_____

_____

_____

_____

_____

_____

(turn over)

Question 5 continued

(c) You are connecting test instruments to measure voltage and current values of a live 230V electrical appliance. When doing this work it is important to observe set procedures to ensure personal safety. Briefly describe **FOUR** important electrical precautions relating to the test instruments that which will promote personal 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) _____

_____

_____

(turn over)

Question 6

(a) Fuses and RCDS are found on switchboards.

(i) What is the main purpose of a fuse found on a switchboard?

(2 marks)

_____

_____

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

(2 marks)

_____

_____

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

(2 marks)

_____

_____

(c) State the **TWO** reasons explaining how HRC motor-rated fuse links provide backup protection for the thermal overloads in a DOL starter supplying a three-phase electric motor in the event of a short-circuit.

(2 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(turn over)

Question 6 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 rewireable fuse.

(2 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(turn over)

Question 7

(a) A Class I, 230 V single-phase plug-in faulty washing machine was put back into service without being repaired. It was plugged into a live socket outlet and turned on and the homeowner received an electric shock.

The outlet is protected by a 15A HRC fuse with a 1.25 Utilisation category (fusing factor).

A protective earthing conductor test was carried out on the washing machine. It was found that there was a resistance of 20Ω between the earth pin of the plug and the frame of the machine.

(i) Calculate the current that would have flowed in the protective earthing conductor.

(2 marks)

(ii) Calculate the power that would have dissipated in the protective earthing conductor.

(2 marks)

(turn over)

Question 7 continued

(iii) Determine by calculation whether or not the fuse would have operated.

(2 marks)

(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 8

The circuit supplying a 230V a.c. single phase induction motor has both RCCB and MCB protection. The motor isolator has been replaced.

What would be the effect if:

(a) The phase and neutral were accidentally interchanged at the supply side of the isolating switch.

(3 marks)

(b) The neutral and earth were accidentally interchanged at the supply side of the isolating switch.

(1 mark)

(c) The phase and earth were accidentally interchanged at the supply side of the isolating switch and the RCCB failed to operate.

(4 marks)

(turn over)

Question 8 continued

(d) State **TWO** tests that would detect the interchange of the phase and earth conductors?

(2 marks)

(1) _____

(2) _____

(turn over)

Question 9

(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 - and the effect these will have on the heating and voltage drop in the cord.

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

(4 marks)

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_____

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_____

(b) A three phase <u>motor</u> is connected to the electricity supply by means of a four core flexible cord in which each conductor is identified by means of colour. There is no screen in the flexible cord. Refer to AS/NZS 3000 and state the requirements apply to the use of colours in such a cord?

(2 marks)

_____

_____

_____

_____

Ref: .....

(turn over)

Question 9 continued

(c) (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 (c)(i) above can be reduced.

(2 marks)

(1) _____

_____

(2) _____

_____

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

(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		