ELECTRICAL WORKERS REGISTRATION BOARD
Safety • Competency

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

ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

16 June 2007 - 019

QUESTION AND ANSWER BOOKLET

Time Allowed: 2 Hours

INSTRUCTIONS – READ CAREFULLY

You have 10 minutes to read this paper but do not start writing until instructed 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 a pencil or a red pen.

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. 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 THREE significant figures.

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 and amendments or The Electricity Act 1992 reprint dated 19 August 2005.
- The Electricity Regulations 1997 reprint dated 5 September 2005.
- AS 60529 or AS 1939 supplement 1 – 1990; AS/NZS 3000:2000 (including amendments 1, 2, A and 3); AS/NZS 3760:2001 or AS/NZS 3760:2003.

PLEASE HAND THIS PAPER TO THE SUPERVISOR BEFORE LEAVING THE ROOM

(turn over)

Question 1

Each part in this question is worth 2 marks. Write your answer for each part in the box provided

(a) An HRC fuse has a minimum fusing current of 12.5 amps and a Utilisation category (fusing factor) of 1.25. The current rating of this fuse is:

1. 25A
2. 13.75A
3. 15.625
4. 10A

(b) Select from the single core flexible cords listed below, the cord which would have the most electrical resistance.

1. 10 metres of 1.0mm² cord
2. 3 metres of 1.0mm² cord
3. 10 metres of 0.75mm² cord
4. 3 metres of 0.75mm^2 cord

(c) The maximum permitted resistance of the protective earthing conductor (earth continuity conductor) when measured between the earth pin of the supply plug and the metal framework of a Class I electrical appliance is:

1. 1 Megohm?
2. 1.25 ohms?
3. 1.5 ohms?
4. 1 ohm?

(turn over)

Question 1 continued

(d) If a 230V, Class I portable electrical appliance with a phase to framework fault and broken protective earthing conductor (earth continuity conductor) is being used outdoors, which of the following protection devices will prevent the passage of an electric current through the operator's body?

1. An HRC fuse
2. A 230/230 volt isolating transformer
3. An overload relay
4. A simmerstat switch

(e) In a parallel circuit, the section which has the lowest resistance also has the:

1. greatest voltage drop
2. highest current
3. smallest heating effect
4. smallest voltage drop

(f) Which of the following voltage ranges defines **low voltage** in accordance with the Electricity Regulations?

1. Exceeding 50V a.c. or 120V ripple-free d.c. but not exceeding 1,000V a.c. or 1,500V d.c.
2. Exceeding 120V a.c. or 32V ripple-free d.c. but not exceeding 1,000V a.c. or 1,500V d.c.
3. Exceeding 50V a.c. or 120V ripple-free d.c. but not exceeding 2,000V a.c. or 3,500V d.c.
4. Exceeding 110V a.c. or 110V ripple-free d.c. but not exceeding 1,000V a.c. or 1,500V d.c.

(turn over)

Question 1 continued

(g) The maximum current a flexible cord can carry safely without overheating depends mainly on:

1. The type of supply, a.c. or d.c.
2. The cross-sectional area of the flexible cord conductors
3. The length of flexible cord used
4. The number of cores in the flexible cord

(h) What current will be drawn by an electric dryer rated at 920 watts at 230 volts when operating at the rated voltage?

1. 2.5 amps
2. 4 amps
3. 0.25 amps
4. 0.4 amps

(i) When the medium position is selected on a three-heat switch controlling heating elements, it will connect:

1. Two elements in series with the supply
2. One element in series with a suitable resistance
3. One element only across the supply
4. Two elements in parallel across the supply

(turn over)

Question 1 continued

(j) What is the power output of a small electric motor with a nameplate that reads:-

Voltage	230
Phases	1
Horsepower	0.75
Speed	1425 r.p.m.

1. 373.3 watts

2. 375.5 watts

3. 559.5 watts

4. 750.3 watts

(turn over)

Question 2

(a) When replacing an HRC cartridge fuse which has blown, the replacement must have characteristics the same as the original. State **FOUR** electrical characteristics to be checked for similarity.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

(b) Rewireable fuses and HRC fuses may be found on switchboards. It is important to replace a blown fuse with one of the correct current rating. What would be the overall effect on a subcircuit if you used a replacement fuse that had:

(i) An under-rated current rating for the subcircuit it protects?

(1 mark)

_____

_____

_____

_____

(ii) An over-rated current rating for the subcircuit it protects?

(1 mark)

_____

_____

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(turn over)

Question 2 continued

(c) State **FOUR** technical advantages which HRC fuses have over rewireable fuses.

(4 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(3) _____

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(4) _____

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(turn over)

Question 3

(a) You have received a Class I, 230V, 1,000W plug-in heater for repair. There is a single-pole control switch on the heater.

- The insulation resistance test you carried out shows that there is a phase to frame fault on the heater. The fault has zero resistance.
- The protective earthing conductor test you carried out showed a resistance of 35Ω.

The heater was (accidentally) returned to the customer without being repaired. The customer plugged the heater in and turned it on:

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

(2 marks)

(ii) Explain the danger to the person using the heater.

(3 marks)

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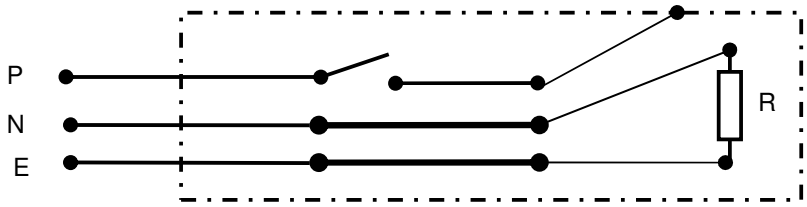
(turn over)

Question 3 continued

(iii) Calculate the shock voltage that will appear on the frame of the heater.

(2 marks)

(b) The figure below represents the circuit diagram of a Class I, plug-in heater with a single-pole control switch **after** it has been repaired. The frame of the appliance has been connected to the load side of the single-pole switch. One end of the heater element has been connected to the earth terminal.



State **THREE** possible effects on the safe operation of the heater if the heater was plugged into a live socket outlet and turned on.

(3 marks)

(1) _____

_____

(2) _____

_____

(3) _____

_____

(turn over)

Question 4

(a) Briefly explain why an ohmmeter is not the correct instrument to carry out an insulation resistance test on a portable electrical appliance.

(2 marks)

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_____

_____

_____

(b) You are required to carry out a protective earthing conductor test on a 230V, Class I plug-in electrical appliance.

(i) State the instrument that should be used and the range selected for this test.

(2 marks)

_____

_____

(ii) Briefly explain how the test should be carried out.

(2 marks)

_____

_____

_____

_____

(iii) (1) What is the acceptable resistance for this test?

(½ mark)

_____

(2) Is this resistance a minimum or maximum value?

(½ mark)

_____

(turn over)

Question 4 continued

(c) 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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(turn over)

Question 5

(a) Draw and label the circuit diagram of 230V single phase circuit protected by a fuse, controlled by a single pole switch and supplying three resistors connected in parallel.

R_1 = 50 ohms
R_2 = 10 ohms
R_3 = 15 ohms

(3 marks)

(turn over)

Question 5 continued

(b) (i) Calculate the current drawn by the circuit.

(4 marks)

(ii) Calculate the effect on the current if the 10Ω resistor became open-circuited?

(3 marks)

(turn over)

Question 6

(a) You have replaced the mineral insulated metal sheathed (MIMS) element and flexible cord in a Class I portable oven. The Electricity Regulations require certain checks and tests to be carried in accordance with AS/NZS 3760 before the oven is returned to service.

Refer to that Standard and complete the following table in relation to the tests required to be carried out using test instruments. **You must state whether the acceptable test result value is a minimum or maximum value.**

(6 marks)

Test	Test instrument	Acceptable test result value

(b) A polarity test should be carried out on a Class I electrical appliance after a replacement flexible cord has been fitted. The appliance is controlled by a single-pole switch. Detail the **FOUR** important points this polarity test will confirm?

(4 marks)

(1) _____

_____

(2) _____

_____

(3) _____

_____

(4) _____

_____

(turn over)

Question 7

(a) State **ONE** reason why it is recommended that the protective earth conductor should be left longer than the phase and neutral conductors when fitting a three core flexible cord to an appliance.

(1 mark)

_____

_____

_____

(b) State the **TWO** reasons why a two core flexible cord removed from a Class II electric clock, must not be used for the supply to a Class I electric drill.

(2 marks)

(1) _____

_____

(2) _____

_____

(c) Explain *why* the earth pin of a standard New Zealand 3 pin 10 amp plug is longer than the phase or neutral pins and *how* this contributes to electrical safety.

(2 marks)

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_____

_____

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(turn over)

Question 7 continued

(d) When selecting a flexible cord for fitting to a single phase electrical appliance, it is necessary to consider a range of factors. List **FIVE** factors which may need to be considered when selecting the cord

(5 marks)

(1) _____

_____

(2) _____

_____

(3) _____

_____

(4) _____

_____

(5) _____

_____

(turn over)

Question 8

(a) (i) Sketch a circuit diagram of a single-phase capacitor start motor.

(3 marks)

(ii) Describe how the direction of rotation can be reversed for a single-phase capacitor start motor.

(2 marks)

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_____

(iii) How is the start winding in a single-phase capacitor start motor disconnected when the motor it up to speed?

(1 mark)

_____

(turn over)

Question 8 continued

(iv) A single-phase capacitor start motor in a refrigerator will not start. When the power is switched on, the motor hums, but does not rotate. State **TWO** reasons for the likely cause of this fault.

(2 marks)

(1) _____

_____

(2) _____

_____

(b) Describe how the direction of rotation can be reversed for a Universal (series) motor

(2 marks)

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(turn over)

Question 9

An ohmmeter is to be used to measure the resistance of a plug-in heater designed for use on 230V/240V a.c. supply. The heater has two elements of 40Ω and 50Ω connected in parallel.

(a) If the heater was operating at 230V

(i) What value of current would the heater draw when it is turned on?

(4 marks)

(ii) What power (watts) will the heater dissipate?

(2 marks)

(turn over)

Question 9 continued

(iii) Find by calculation the change in the power dissipated if the 50Ω resistor was open-circuited.

(3 marks)

(b) With all elements working, would the power the heater dissipates increase if the supply voltage was 240 V? Give **ONE** reason to support your answer.

(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

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Questions Answered	**Marks**	
1		
2		
3		
4		
5		
6		
7		
8		
9		
TOTAL		