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

ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

22 September 2007

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 mark 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.

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) Under which of the following circuit conditions is a HRC fuse specifically designed to operate (blow)?

1. A sustained overload
2. A small overload of short duration
3. A high motor starting current
4. A short circuit condition

(b) The method of safely ensuring the <u>continued</u> isolation of a plug-in electrical appliance is:

1. Attaching an out-of-service tag to the electrical appliance
2. Turning off the main switch at the switchboard
3. Withdrawing the appliance plug from the socket
4. Removing the fuse that protects the plug socket

(c) What current will be drawn by a 230/240 volt electric soldering iron rated at 92 watts when operating at 240 volts?

1. 0.5 amps
2. 0.25 amps
3. 4 amps
4. 0.38 amps

(turn over)

Question 1 continued

(d) 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

(e) In accordance with the Electricity Regulations, which of the following phrases defines **direct contact**?

1. Contact by any person or animal, with parts live at extra-low voltage.
2. Contact by any person or animal with live parts.
3. Contact by a person or animal with exposed conductive parts that are live under fault conditions
4. Contact by a person or animal with earthed metal

(f) Which document details the specific tests which must be carried out after fitting a new flexible cord and plug to an electrical motor?

1. AS/NZS 3760
2. AS: 6370
3. AS/NZS 3019
4. AS/NZS: 3016

(turn over)

Question 1 continued

(g) At 10c per unit, what will be the cost of the electrical energy consumed in 2 hours by a heater which draws 10A from the 230V supply:

1. 20 cents
2. 46 cents
3. 200 cents
4. $4.60

(h) Which of the following three core flexible cords has the least conductor resistance?

1. 5 metres of 0.75mm² cord
2. 10 metres of 1.0mm² cord
3. 10 metres of 0.75mm² cord
4. 5 metres of 1.0mm² cord

(i) If the resistance in a circuit is doubled, the current flow will now be:

1. The same
2. Doubled
3. Halved
4. Four times greater

(turn over)

Question 1 continued

(j) When fighting a fire in live electrical equipment, which of the following fire extinguishers **<u>should not</u>** be used?

1. Water - gas expelled
2. Dry powder
3. Vaporising liquid
4. Carbon dioxide

(turn over)

Question 2

(a) Replacement flexible cords are to be fitted to some electrical appliances: (7 marks)

(i) What is the minimum number of cores required for a flexible cord for a Class I electrical appliance?

_____

(ii) What is the colour coding required for the cores of a flexible cord for a Class I electrical appliance?

_____

_____

_____

(iii) What is the minimum number of cores required for a flexible cord for a Class II electrical appliance?

_____

(iv) What is the colour coding required for the cores of a flexible cord for a Class II electrical appliance?

_____

_____

_____

(turn over)

Question 2 continued

(b) A 25 metre three core flexible extension cord has been wound on a cable drum to provide a convenient means of storage.

(i) Describe how the cord might fail if it is used while still wound on the drum.

(1 mark)

_____

_____

(ii) State the **TWO** operational precautions, either of which could be taken, to prevent **failure** of the cord when it is in use.

(2 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(turn over)

Question 3

(a) Draw and label a circuit diagram for a plug-in 230V, Class I fan heater rated at 2000W that shows:

- The supply to the heater including the earthing arrangements
- A fuse protecting the entire circuit
- The heater with a single pole control switch
- A phase-to-frame fault on the supply side of the control switch

You do not need to show the socket outlet into which the heater is plugged.

(4 marks)

(turn over)

Question 3 continued

(b) The test report for the plug-in 230V, Class I fan heater rated at 2000W states the following:

- The resistance between the earth pin of the plug and the frame of the heater is 11 ohms.
- Insulation resistance with the switch OFF – phase to frame short circuit.
- Insulation resistance with the switch ON – phase to frame short circuit.

The heater, with the control switch in the OFF position, was plugged into a live socket outlet without being repaired:

(i) Calculate the fault current flowing in the appliance. Assume resistance in the phase to frame short circuit is 0Ω.

(2 marks)

(ii) The circuit into which the heater is plugged is protected by a 16A HRC fuse with a utilisation category (fusing factor) of 1.5.

Calculate whether the fuse will operate (blow).

(2 marks)

(iii) Calculate the power dissipated in the fault.

(2 marks)

(turn over)

Question 4

(a) After repairing the electric motor and replacing the flexible supply cord of a 230V, Class I, dishwasher you must carry out an insulation resistance test.

(i) The dishwasher has semi-conductor devices used in its internal the circuitry. It is impractical to disconnect the semi-conductor devices. State **THREE** methods of carrying out an insulation resistance test that will not cause damage to the semi conductor devices.

(3 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(3) _____

_____

_____

(ii) Of the method you have described in (a)(i) above:

(A) What instrument should be used to make this test?

(1 mark)

_____

(B) What is the test voltage used for this test.

(1 mark)

_____

(C) State the acceptable value for this test. Also state whether this value is a minimum or maximum.

(1 mark)

_____

(turn over)

Question 4 continued

(D) Briefly describe how you would carry out this test.

(2 marks)

_____

_____

_____

_____

(b) An insulation resistance test was carried out on a Class I, plug-in electrical appliance. The test result was 50 MΩ.

The appliance was immediately put into service and a person received an electrical shock from the frame of the appliance.

Explain why the person received the electric shock when the insulation resistance test value was 50 MΩ and:

- The protection did not operate.
- The protection was correctly rated and not faulty

(2 marks)

_____

_____

_____

_____

(turn over)

Question 5

(a) The New Zealand single phase 230V a.c. supply operates at a frequency of 50 Hz. Briefly describe the meaning of the term Hz.

(1 mark)

_____

_____

_____

(b) Draw and label one cycle of the 230V a.c. supply voltage wave form, showing the values for:

- The time interval
- The peak voltage
- The RMS voltage

(4 marks)

(turn over)

Question 5 continued

(c) It is necessary to have a reliable protective earthing conductor in a Class I electrical appliance.

(i) Briefly describe how the protective earthing conductor contributes to the electrical safety of the appliance.

(2 marks)

_____

_____

_____

_____

_____

_____

(ii) Briefly describe the actions you would take if the protective earthing conductor test on a Class I electrical appliance **you have repaired** is 15Ω.

(3 marks)

_____

_____

_____

_____

_____

_____

(turn over)

Question 6

(a) Draw and label a circuit diagram of a single phase circuit protected by a fuse, controlled by a single pole switch and supplying four resistors.

R_1 is the 1st resistor and is connected in series with the ammeter.
R_2 is the 2nd resistor and is connected in series with R_1
R_3, and R_4 are connected in parallel and are connected after R_2.

R_1 = 50 ohms
R_2 = 10 ohms
R_3 = 20 ohms
R_4 = 25 ohms

(3 marks)

(turn over)

Question 6 continued

(b) If the voltmeter reads 230V

(i) Calculate the reading of the ammeter.

(5 marks)

(ii) Calculate the power dissipated in the circuit if resistance R_3 became open-circuited?

(2 marks)

(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 that has a rating sufficient to operate an electric clock must not be used for a Class I electric drill.

(2 marks)

(1) _____

_____

(2) _____

_____

(c) Describe **THREE** technical qualities that an insulating material must possess to be suitable for use as insulation in a flexible cord.

(3 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(3) _____

_____

_____

(turn over)

Question 7 continued

(d) (i) Briefly explain the conditions that make an energy controller (Simmerstat) function.

(2 marks)

_____

_____

_____

(ii) Briefly explain the conditions that make a thermostat function.

(2 marks)

_____

_____

_____

(turn over)

Question 8

(a) The Electricity Act requires that a registered electrical service technician who works for payment of reward must hold an additional type of licence.

(i) What is the name of the licence?

(1 mark)

_____

Ref: ……

(ii) On what date in any year does the licence expire?

(1 mark)

_____

Ref: ……

(iii) To whom must application be made for the licence?

(1 mark)

_____

Ref: ……

(b) Registered electrical service technicians are one of **SEVEN** classes of persons listed in the Electricity Act who may do, or assist in doing prescribed electrical work. Refer to the Electricity Act and list **THREE** other classes of person who may do or assist in doing prescribed electrical work.

(3 marks)

(1) _____

(2) _____

(3) _____

Ref: ……

(turn over)

Question 8 continued

(c) No electrical service technician shall assist to carry out prescribed electrical work unless they have completed safety tuition in **FOUR** specific subjects within the previous 24 months. Refer to the Electricity Regulations and state those **FOUR** subjects.

(4 marks)

(1) _____

_____

(2) _____

_____

(3) _____

_____

(4) _____

_____

(turn over)

Question 9

(a) Briefly explain how a Residual Current Device (RCD) operates to provide safety to the user of an electrical appliance when an earth leakage fault occurs.

(4 marks)

(b) State **THREE** disadvantages of rewireable fuses when compared to HRC fuses.

(3 marks)

(1)

(2)

(3)

(turn over)

Question 9 continued

(c) Briefly state **THREE** safety reasons why it is not permitted to bridge the terminals of HRC fuse carriers with fuse wire of the same current rating as the blown cartridge.

(3 marks)

(1) _____

_____

_____

(2) _____

_____

_____

(3) _____

_____

_____

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		