ESTA 1031

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

ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

8 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 the thermal overload mechanism of an MCB specifically designed to operate (trip)?

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

(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. Disconnecting the circuit at the switchboard
4. Removing the fuse that protects the plug socket

(c) What current will be drawn by a 230/240 volt electric dryer rated at 920 watts when operating at 240 volts?

1. 2.5 amps
2. 3.8 amps
3. 0.25 amps
4. 0.4 amps

(turn over)

Question 1 continued

(d) When turned to the low position, the three heat switch controlling a small domestic oven will connect the electrical supply to:

1. One element in series with a suitable resistor
2. Two elements in parallel
3. One element only
4. Two elements in series

(e) In accordance with the Electricity Regulations, which of the following voltages is the **standard low voltage** in respect to a single phase MEN system?

1. 120V.
2. 110V.
3. 230V
4. 50V.

(f) Which of the following documents specifies the tests to be carried out on an electrical appliance which is for hire or lease?

1. AS/NZS 3000
2. NZ 3019
3. AS 1939
4. AS/NZS 3760

(turn over)

Question 1 continued

(g) The electrical energy consumed in 8 hours by an electric heater that draws 4A from the 230V mains supply is:

1. 9.2 kWh
2. 7.36 kWh
3. 3.68 kWh
4. 0.46 kWh

(h) When preparing flexible cord conductors for termination in a portable electric heating oven, the insulation should be removed:

1. just up to the terminals
2. only far enough to prevent heat deterioration of the insulation
3. at least 10mm from the terminal post
4. and replaced by vulcanised rubber tape

(i) If the voltage in a circuit decreases, the power dissipated by that circuit will:

1. Stay the same
2. Double
3. Increase
4. Decrease

(turn over)

Question 1 continued

(j) To comply with the Electricity Regulations, the maximum voltage to earth which can be used to supply a handheld electrical appliance is:

1. 230 Volts
2. 250 Volts
3. 400 Volts
4. 32 Volts

(turn over)

Question 2

(a) New flexible cords are to be fitted to two different single-phase plug-in electrical appliances. Refer to AS/NZS 3760 and complete the following:
(8½ marks)

(i) Earthed electrical appliance

(A) The minimum number of conductors required in the flexible cord

_____

(B) The colour of the Active (Phase) conductor

_____

(C) The colour of the Neutral conductor

_____

(D) The colour of the Earth conductor

_____

(E) The test or tests required to be carried out using test instruments

_____

_____

(F) The acceptable value for the results of the test or tests required to be carried out using test instruments.

_____

_____

(ii) Double insulated electrical appliance

(A) The minimum number of conductors required in the flexible cord

_____

(B) The colour of the Active (Phase) conductor

_____

Question 2 continued

(C) The colour of the Neutral conductor

_____

(D) The colour of the Earth conductor

_____

(E) The test or tests required to be carried out using test instruments

_____

_____

(F) The acceptable value for the results of the test or tests required to be carried out using test instruments.

_____

_____

(b) 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?

(1½ marks)

_____

_____

(turn over)

Question 3

(a) The test report for a plug-in Class I, 230V, 2000W commercial vacuum cleaner states the following:

- The resistance between the earth pin of the plug and the frame of the cleaner is 10.6 Ω.
- The insulation resistance test shows a phase to frame short circuit with the cleaner switch off.

The cleaner has not been repaired.

If the cleaner was plugged into a live socket outlet but not switched on:

(i) Calculate the fault current flowing in the appliance. The resistance in the phase to frame short circuit is 2Ω.

(2 marks)

(ii) The circuit into which the cleaner 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)

(turn over)

Question 3 continued

(iii) Calculate the power dissipated in the faulty cleaner.

(2 marks)

(b) (i) A 230V, Class I, plug-in electrical appliance is controlled by a single pole switch. You are testing the appliance with an ohmmeter and find that the neutral is switched.

Describe the **THREE** situations that could cause the neutral to be switched instead of the phase in the appliance.

(3 marks)

(1) _____

_____

(2) _____

_____

(3) _____

_____

(ii) State **ONE** unsafe effect on the operation of an electrical appliance a phase and neutral transposition could create.

(1 mark)

_____

_____

(turn over)

Question 4

(a) Briefly explain **ONE** reason for carrying out the following **tests** on an electrical appliance.

(i) Protective earthing conductor resistance test

(1 mark)

_____

_____

_____

(ii) Polarity test

(1 mark)

_____

_____

_____

(iii) Insulation resistance test

(1 mark)

_____

_____

_____

(b) Briefly state the primary reason why it is important to carry out a Protective Earthing conductor test on a Class I electrical appliance <u>before</u> carrying out an insulation resistance test

(2 marks)

_____

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_____

(turn over)

Question 4 continued

(c) Semi-conductor devices are used in the circuitry of a Class I plug-in electrical appliance. You are to carry out a test to establish the integrity of the insulation between the active conductor and earth in the appliance and specific precautions must be taken to avoid damage to semi-conductor devices.

It is not possible to disconnect the semi-conductor devices. State **TWO** methods of testing the insulation without causing damage to the semi conductor devices. Include in your answer, where applicable:

- Any test voltage applied.
- The acceptable test result value and whether that value is a minimum or maximum.

(5 marks)

(1) _____

_____

_____

_____

(2) _____

_____

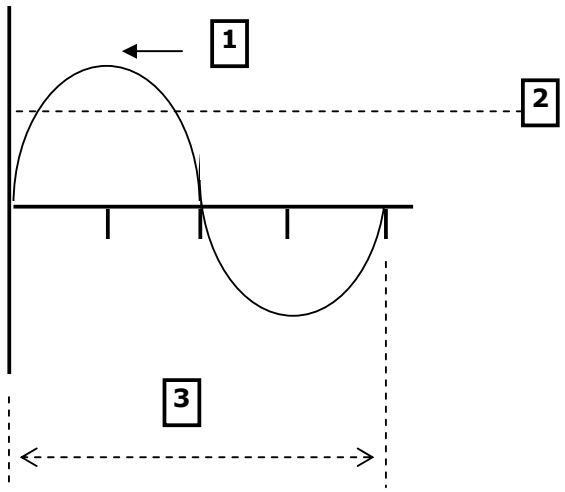
_____

_____

(turn over)

Question 5

(a) The following diagram shows a 230 V wave form.



(i) Is it an a.c. voltage or d.c. voltage waveform?

(1 mark)

_____

(ii) Name the numbered items and state the values that applies to each item

(3 marks)

1. _____

2. _____

3. _____

(b) 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)

_____

_____

_____

(turn over)

Question 5 continued

(c) It is necessary to have a reliable protective earthing conductor (earth continuity conductor) for a class 1 electrical appliance.

(i) Briefly describe how this 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 double pole switch and supplying five 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, R_4, and R_5 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
R_5 = 50 ohms

Include an ammeter to measure the total circuit current and a voltmeter to measure the voltage across the resistors.

(4 marks)

(turn over)

Question 6 continued

(b) From the circuit diagram you have drawn in (a), calculate the reading of the ammeter if the voltmeter reads 230V.

(5 marks)

(c) From the circuit diagram you have drawn in (a), if the voltmeter reads 230V, what would be the effect on that reading if resistance R_1 became open-circuited?

(1 mark)

(turn over)

Question 7

(a) Describe briefly, the main sequence of actions involved in fitting a three-pin plug to a three-conductor PVC sheathed flexible cord supplying a Class I electric heater. The action taken to ensure the appliance is safe must be included

(5 marks)

(turn over)

Question 7 continued

(b) State one type of electrical appliance controlled by a thermostat.

(1 mark)

_____

(c) (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) _____

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(2) _____

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(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

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Questions Answered	**Marks**	
1		
2		
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7		
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9		
TOTAL		