



<b>Candidate Code No.</b>	
<b>For Board Use Only</b>	
Result	Result
Date	Date
Int	Int

## **ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION**

**18 November 2006**

### **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. 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 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) If the resistance in a circuit is doubled and the applied voltage is increased four times, the current flow will now be:

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

(b) The flexible cord supplying a double insulated 230V electric clock from a three pin socket is to be replaced. The most appropriate type of flexible cord to use would be:

1. Twisted conductor three core unsheathed
2. Two single core conductors, unsheathed
3. Ordinary duty three core tough plastic sheathed
4. Light duty two core tough plastic sheathed

(c) Which of the following voltage ranges defines **extra-low voltage** in accordance with the Electricity Regulations 1997?

1. 0 V to 50V a.c.  
0 V to 120V ripple-free d.c.
2. 0 V to 120V a.c.  
0 V to 32V ripple-free d.c.
3. 50 V to 115V a.c.  
50 V to 115V d.c.
4. 50 V to 120 V a.c.  
12 V to 50V ripple-free d.c.

**(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) To comply with the Electricity Regulations, a double insulated handheld electrical appliance used in a damp indoor situation requires:

1. A supply from an isolating transformer
2. No additional protection
3. Earthing by a separate protective earthing conductor
4. To be fitted with a flexible cord having a braided metallic outer covering

(f) An HRC type fuse is used in a circuit primarily to: -

1. Prevent an unauthorised increase in fuse rating
2. Reduce the possibility of electric shock
3. Disconnect an overload
4. Disconnect a large fault current

(g) A portable isolating transformer designed for personal protection is required to be tested after a new flexible cord has been fitted. What is the minimum insulation resistance test value which would be acceptable for the transformer when measured between the supply conductors and its metal case?

1. 1 Megohm
2. 0.5 ohm
3. 50 Megohms
4. 1 ohm

## Question 1 continued

(h) A sub circuit fuse blows when correctly specified fuse links are inserted. What may result if the fuse link is replaced with one of a larger current rating?

1. The voltage drop in the circuit will increase
2. The current drawn by the load will increase
3. It could cause damage to the circuit wiring
4. It could solve the problem

(i) The main reason for carrying out an insulation resistance test on an electrical appliance is to:

1. Check that the electrical appliance will function correctly
2. Verify that the insulation of current carrying components is capable of withstanding the normal supply voltage
3. Verify that the insulation resistance does not exceed the limit of 1 Megohm
4. Verify that the insulation of current carrying components is capable of withstanding the maximum load current

(j) 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

**(turn over)**

## Question 2

- (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)

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- (b) Sketch one cycle of the 230V, 50 Hz supply voltage wave form, showing the values for:

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

(4 marks)

- (c) Single-phase plug-in electrical appliances normally operate at standard low voltage. Refer to the Electricity Regulations and define the term standard low voltage as it applies to single-phase plug-in electrical appliances.

(1 mark)

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Ref: .....

**(turn over)**

## Question 2 continued

(d) Refer the Electricity Regulations and define the following terms:

(i) Low voltage

(1 mark)

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Ref: .....

(ii) Direct contact

(1 mark)

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Ref: .....

(iii) Isolated

(1 mark)

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Ref: .....

(iv) Indirect contact

(1 mark)

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Ref: .....

**(turn over)**

### Question 3

- (a) A protective earthing conductor test was carried out on Class I, 230 V single-phase plug-in washing machine. It was found that a termination in the machine had a resistance of  $20\Omega$ .

The washing machine was put back into service without being repaired. It was plugged into a live socket outlet and turned on. The outlet is protected by a 15A HRC fuse with a 1.25 Utilisation category (fusing factor).

A phase to earth fault occurred on the washing machine.

- (i) Calculate the current that would flow in the protective earthing conductor.

(2 marks)

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

(2 marks)

**(turn over)**

### Question 3 continued

- (iii) Determine by calculation whether or not the fuse would operate.  
(2 marks)

- (b) A 230V, Class I, plug-in electrical appliance is controlled by a single pole switch. 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)

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\_\_\_\_\_

**(turn over)**

## Question 4

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

(4 marks)

(1) \_\_\_\_\_

(2) \_\_\_\_\_

(3) \_\_\_\_\_

(4) \_\_\_\_\_

- (b) State **THREE** advantages which HRC fuses have over rewirable fuses.

(3 marks)

(1) \_\_\_\_\_

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(2) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3) \_\_\_\_\_

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(turn over)

### Question 4 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) \_\_\_\_\_

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## Question 5

- (a) After repairs have been carried out to a Class I plug-in heater, a **visual** inspection should be carried out in addition to the prescribed electrical tests. Refer to AS/NZS 3760 and describe **FIVE** visual checks that should be carried out

(5 marks)

(1) \_\_\_\_\_

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(2) \_\_\_\_\_

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(3) \_\_\_\_\_

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(4) \_\_\_\_\_

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(5) \_\_\_\_\_

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Ref: .....

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## Question 5 continued

(b) You are required to carry out an 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)

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

(2 marks)

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

(½ mark)

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

(½ mark)

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**(turn over)**

## Question 6

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

(i) Protective earthing conductor resistance test

(1 mark)

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(ii) Polarity test

(1 mark)

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(iii) Insulation resistance test

(1 mark)

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(b) Briefly explain why it is important to carry out a Protective Earthing conductor test on a Class I electrical appliance before carrying out an insulation resistance test

(2 marks)

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## Question 6 continued

- (c) 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) \_\_\_\_\_

\_\_\_\_\_

- (d) (i) What type of test instrument would you use to test for polarity?  
(1/2 mark)

\_\_\_\_\_

- (ii) What range would you select on the test instrument?  
(1/2 mark)

\_\_\_\_\_

**(turn over)**

## Question 7

(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?

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

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

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

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**(turn over)**

## Question 7 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) State the **TWO** operational precautions, either of which could be taken to prevent **insulation failure** when the cord is in use.

(2 marks)

(1) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(ii) Describe how the cord might fail if one of the precautions you have stated in (b)(i) was not taken?

(1 mark)

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\_\_\_\_\_

\_\_\_\_\_

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**(turn over)**

## Question 8

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

$$R_1 = 50 \text{ ohms}$$

$$R_2 = 10 \text{ ohms}$$

$$R_3 = 15 \text{ ohms}$$

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

(3 marks)

## Question 8 continued

(b) If the voltmeter reads 230V:

(i) Calculate the reading of the ammeter?

(4 marks)

(ii) Calculate the total power dissipated by the resistors?

(2 marks)

(c) If the voltmeter reads 230V and the resistances were connected in series, would the power dissipated be more or less than when connected in parallel  
(1 mark)

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## Question 9

A 230V plug-in water heater contains two heating elements, each having a resistance of 46 ohms. The water heater is controlled by a three-heat switch.

(a) If the water heater is switched to the low position, calculate:

(i) The current drawn (2 marks)

(ii) The total power dissipated by the water heater. (2 marks)

(b) If the water heater is switched to the high position, calculate

(i) The circuit resistance (2 marks)

**(turn over)**

### **Question 9 continued**

(ii) The current drawn from the supply

(2 marks)

(iii) The total power dissipated by the water heater.

(2 marks)

### 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	
<b>1</b>		
<b>2</b>		
<b>3</b>		
<b>4</b>		
<b>5</b>		
<b>6</b>		
<b>7</b>		
<b>8</b>		
<b>9</b>		
<b>TOTAL MARKS</b>		