



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

## ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

**20 June 2009**

### 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 some of the following documents in this examination:**

- The Electricity Act 1992 reprint dated 19 August 2005
- The Electricity Regulations 1997 reprint dated 2 September 2005
- AS 60529 **or** AS 1939 Supplement 1-1990
- AS/NZS 3000:2000 and Amendments 1, 2 and 3 **or** AS/NZS 3000:2007
- AS/NZS 3760:2003 and Amendment 1

**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 the identifying number, 1 or 2 or 3 or 4, for each part in the box provided

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

1. Lowest voltage drop
2. Highest voltage drop
3. Highest heating effect
4. Lowest current

(b) At 11.64 cents per unit, what will be the cost of the energy consumed in 10 hours by a heater that draws 15A from the 230V supply?

1. \$3.45
2. \$4.02
3. 34.5c
4. \$27.60

(c) A final subcircuit fuse blows when the correctly rated fuse link is 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. Damage could occur to the circuit wiring
4. It could solve the problem

**(turn over)**

## Question 1 continued

(d) To comply with AS/NZS 3760, the insulation resistance test of a repaired electrical appliance must not be less than:

1. 500 ohms
2. 20 Megohms
3. 1 ohm
4. 1 Megohm

(e) In a series circuit, the section which has the highest voltage drop also has the:

1. Highest resistance
2. Highest current flow
3. Lowest voltage drop
4. Lowest heating effect

(f) Which of the following wiring changes would reverse the direction of rotation of a single-phase, split-phase induction motor?

1. Reverse the phase and neutral supply conductor connections
2. Reverse the connections of the start windings and the run windings
3. Reverse the connections of the run winding at the motor terminal block.
4. Turn the rotor around.

**(turn over)**

## Question 1 continued

(g) To determine the voltage drop in a flexible cord, the information required is:

1. Voltage and cross-sectional area
2. Current and resistance
3. Resistance and cross-sectional area
4. Current and voltage

(h) What power is consumed by an electrical appliance that has resistance of  $52.5\Omega$  and draws a current of 6A?

1. 0.38 kW
2. 15.29 kW
3. 1.89kW
4. 1.57 kW

(i) 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

(j) Which of the following wiring changes would reverse the direction of rotation of a universal motor?

1. Reverse the phase and neutral supply conductor connections at the motor terminal block.
2. Reverse the connections of the start winding
3. Reverse the connections of the run winding
4. Reverse the connections of the armature.

**(turn over)**

## Question 2

A 230V, single-phase Class I plug-in electric heater is controlled by selector switch with three settings – “high”, “medium” and “low”.

The heater comprises two elements each of the same resistance. When an ohmmeter is connected to the heater it measures  $104\Omega$  with the switch in the low position.

The voltage at the socket outlet is permitted to be  $\pm 5\%$  at any given time.

- (a) Calculate the **maximum** power consumed by the heater when operating at 230V.

(4 marks)

- (b) Calculate the power the heater consumes in the “medium” position when operating at 230V.

(1½ marks)

**(turn over)**

## Question 2 continued

- (c) Calculate the **minimum** current drawn by the heater when operating at 230V

(2 marks)

- (d) Calculate the **maximum** power consumed by the heater when operating at its **minimum** permitted voltage.

(2½ marks)

**(turn over)**

### Question 3

Rewireable fuses, HRC fuses and MCBs may be found on switchboards.

(a) 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)

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(ii) An over-rated current rating for the subcircuit it protects? (1 mark)

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(b) State **THREE** advantages that HRC fuses have when compared to rewireable fuses. (3 marks)

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

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

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

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### Question 3 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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- (d) (i) Under which circuit condition is the thermal overload mechanism of an MCB specifically designed to operate (trip)?

(1 mark)

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- (ii) Under which circuit condition is the electromagnetic mechanism of an MCB specifically designed to operate (trip)?

(1 mark)

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## Question 4

(a) 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 for this test. (1 mark)

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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? (1 mark)

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(2) Is this resistance a minimum or maximum value? (1 mark)

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(b) 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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### 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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## Question 5

In a sawmill office, a 20A HRC with a fusing factor of 1.5 protects a final subcircuit consisting of two plug sockets supplying various 230V plug-in electrical appliances. The fuse has blown. When the fuse is replaced, it blows again when the supply is restored to the circuit.

- **The fuse is correctly rated for the circuit and is not faulty.**
- **The circuit has been tested and found to be clear of faults.**

There are **TWO** possible causes of this fault, one of which requires the use of a test instrument to locate the fault.

(a) The first fault

You do not need test instruments to diagnose this fault.

(i) State the type of fault that has occurred.

(1 mark)

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(ii) State the action you would take to establish the cause of the fault.

(2 marks)

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(iii) State the action taken to fix the fault.

(1 mark)

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## Question 5 continued

(b) The second fault

You need a test instrument to diagnose this fault.

(i) State the type of fault that has occurred.

(1 mark)

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(ii) State the action you would take to establish the cause of the fault. Include in your answer:

- The type of test
- The type of test instrument used
- The test voltage
- The likely test result if a fault has occurred.

(4 marks)

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(iii) State the action taken to fix the fault.

(1 mark)

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## Question 6

- (a) You need to insert a new HRC fuse link into a fuse carrier to replace a *blown* fuse on a switchboard. You **cannot** turn the main switch off on the switchboard. Briefly describe **TWO** actions you would take to ensure your own safety.

(2 marks)

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

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

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- (b) (i) What is the essential safety difference between switching an electrical appliance off and isolating an electrical appliance?

(2 marks)

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- (ii) Describe a method of safely ensuring the continued isolation of a faulty plug-in electrical appliance that you are going to repair.

(1 mark)

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**(turn over)**

## Question 6 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) \_\_\_\_\_

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

\_\_\_\_\_

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

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

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- (d) Refer to the Electricity Regulations and state what is meant by the term **personal protective equipment**?

(1 mark)

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Ref: .....

**(turn over)**

## Question 7

(a) A 230 V plug-in, Class I, electrical appliance has MOV surge protection fitted. You have repaired the appliance and need to carry out an insulation resistance test. Refer to AS/NZS 3760 and answer the following:

(i) State the insulation resistance test voltage that should be applied.  
(1 mark)

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Ref: .....

(ii) State the acceptable test result from the insulation resistance test.  
(1 mark)

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Ref: .....

(b) A 230 V plug-in, Class I, electrical appliance has MOV surge protection fitted. You have repaired the appliance **but you do not want to** carry out an insulation resistance test. Refer to AS/NZS 3760 and answer the following:

(i) State the type of test that can be carried out instead of an insulation resistance test.  
(1 mark)

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Ref: .....

(ii) State the acceptable test result from the test you have stated in (b)(i).  
(1 mark)

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Ref: .....

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## Question 7 continued

- (c) You are carrying out an insulation resistance test on an electrical appliance that has semi-conductor devices used in the internal circuitry. The semi-conductor devices cannot be disconnected.

State **TWO** methods of carrying out the insulation resistance test that will not cause damage to the semi conductor devices.

(2 marks)

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

\_\_\_\_\_

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

\_\_\_\_\_

- (d) Following repairs to the electric motor and flexible supply cord of a 230V, Class I, concrete mixer, an insulation resistance test with an insulation resistance tester is to be carried out.

- (i) What is the test voltage used for the insulation resistance test.

(1 mark)

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- (ii) State the acceptable result for this test.

(1 mark)

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

(2 marks)

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## Question 8

(a) You have tested a plug-in Class I, 230V, 2000W commercial vacuum cleaner and the results are as follows:

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

The cleaner incorporates a control switch. If the cleaner was plugged into a live socket outlet with the control switch in the "off" position:

(i) Calculate the fault current flowing in the appliance. The resistance in the phase to frame short circuit is 0 $\Omega$ .

(2 marks)

(ii) The cleaner is plugged into a circuit that 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 8 continued

(iii) Calculate the power consumed in the fault.

(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.

(3 marks)

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

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

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

\_\_\_\_\_

(ii) 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 9

An ohmmeter is 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  $40\Omega$  and  $50\Omega$  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 consume?  
(2 marks)

**(turn over)**

## Question 9 continued

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

(3 marks)

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

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### 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</b>		