



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

ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

13 September 2008

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 will need to use some of 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) or AS/NZS 3000:2007; 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) Which of the following voltage ranges defines **low voltage** in accordance with the Electricity Regulations?

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

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

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

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

1. 500 ohms
2. 0.5 ohms
3. 1 Megohm
4. 20 Megohms

(turn over)

Question 1 continued

(d) The Electricity Regulations requires that a registered electrical service technician completes refresher courses at regular intervals. At what intervals must those refresher courses be completed?

1. 5 years
2. 18 months
3. 24 months
4. 1 year

(e) Which of the following wiring changes would reverse the direction of rotation of a single phase Universal (series) motor?

1. Reverse the phase and neutral supply conductor connections at the motor terminal block.
2. Reverse the connections of the field windings and the armature windings
3. The direction of rotation cannot be changed on this type of motor.
4. Reverse the connections of the field windings.

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

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

(turn over)

Question 1 continued

(g) It is recommended that not more than one portable electrical appliance is used at any one time from an isolating transformer. The reason for this is to:

1. Prevent transformer overloading.
2. Minimise the problem of excessive voltage drop.
3. Prevent polarity interchange.
4. Minimise the possibility of electric shock.

(h) What is the power consumed by a 230V electrical appliance that has a resistance of 20 ohms?

1. 2645 watts
2. 4600 watts
3. 115 watts
4. 264.5 watts

(i) 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 a person or animal with exposed conductive parts that are live under fault conditions
3. Contact by any person or animal with live parts.
4. Contact by a person or animal with earthed metal

(turn over)

Question 1 continued

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

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



(turn over)

Question 2

- (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.

(4 marks)

(1) _____

(2) _____

- (b) An HRC fuse supplying two socket outlets has blown on a switchboard. You have disconnected all of the electrical appliances from the two socket outlets.

When you inserted a new HRC fuse link into the fuse carrier, it blew again.

- (i) Where is the fault located?

(1 mark)

- (ii) Who would you call to repair the fault?

(1 mark)

(turn over)

Question 2 continued

- (c) What is the difference between "switching off" an electrical appliance and "isolating" an electrical appliance?

(2 marks)

- (d) An electrical appliance is to be repaired and you have isolated the appliance by removing the plug from the socket outlet. Describe **TWO** methods of ensuring the continued isolation of the electrical appliance.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 3

(a) Draw and label a circuit diagram of a single phase circuit supplying three resistors. Include the following:

- A fuse that protects the entire circuit and all components.
- A single pole switch that controls the entire circuit and all components (except the fuse)
- An ammeter to measure the total circuit current
- A voltmeter to measure the voltage across the resistors

Resistor 1 (R1) is 150Ω

Resistor 2 (R2) is 100Ω

Resistor 3 (R3) is 70Ω

R1 and R2 are connected in series. R3 is connected in parallel with the series resistors.

(4 marks)

(turn over)

Question 3 continued

(b) Calculate the total resistance of the circuit.

(2 marks)

(c) If the reading on the ammeter is 4.2A, calculate the voltage of the circuit.

(2 marks)

(d) Calculate the total power consumed by the resistors.

(2 marks)

(turn over)

Question 4

- (a) You are carrying out an insulation resistance test on an electrical appliance that has semi-conductor devices used in its internal circuitry. It is impractical to disconnect the semi-conductors.

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

(2 marks)

(1) _____

(2) _____

- (b) You have repaired the electric motor and flexible supply cord of a 230V, Class I, plug-in dishwasher. You need to carry out an insulation resistance test.

- (i) What instrument should be used to make the insulation resistance test?

(1 mark)

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

(1 mark)

- (iii) State the permitted minimum insulation value for this test.

(1 mark)

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

(2 marks)

(turn over)

Question 4 continued

- (c) Briefly explain why a multimeter set on the low ohms scale should not be used to carry out an insulation resistance test on a portable electrical appliance.

(2 marks)

- (d) State **ONE** test, other than an insulation resistance test, that can be used to test the integrity of the insulation of a Class I, plug-in electrical appliance.

(1 mark)

(turn over)

Question 5

(a) New flexible cords are to be fitted to two different single-phase plug-in electrical appliances.

(8½ marks)

(i) Refer to AS/NZS 3760 and complete the following for an earthed (Class I) electrical appliance:

(A) What is the minimum number of conductors required in the flexible cord?

(B) What is the colour of the Active (Phase) conductor?

(C) What is the colour of the Neutral conductor?

(D) What is the colour of the Earth conductor?

(E) State the test or tests required to be carried out using test instruments?

(F) What are the permitted values for the results of the test or tests required to be carried out using test instruments?

(turn over)

Question 5 continued

(ii) Refer to AS/NZS 3760 and complete the following for a double insulated (Class II) electrical appliance:

(A) What is the minimum number of conductors required in the flexible cord?

(B) What is the colour of the Active (Phase) conductor?

(C) What is the colour of the Neutral conductor?

(D) What is the colour of the Earth conductor?

(E) State the test or tests required to be carried out using test instruments?

(F) What are the permitted values 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 6

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

Note: The visual checks (inspections) must relate only to a plug-in electrical appliance.

(4 marks)

(1) _____

(2) _____

(3) _____

(4) _____

Ref:

- (b) A microgap switch rated at 10 amp, 230V a.c. is used as the control switch on the Class I heater. State **ONE** reason why this switch would not be suitable for use on a d.c. circuit of similar current and voltage.

(1 mark)

(turn over)

Question 6 continued

- (c) Explain why the earth pin of a standard New Zealand 3 pin, 10 amp plug used to supply a Class I electrical appliance is longer than the phase or neutral pins.

(2 marks)

- (d) State the **THREE** reasons why a bayonet cap adaptor must not be used to supply a Class I plug-in heater.

(3 marks)

(1) _____

(2) _____

(3) _____

(turn over)

Question 7

(a) You have tested a Class I, 230V, 2000W fan heater and find that:

- The resistance between the earth pin of the plug and the frame of the heater is 7Ω .
- The insulation resistance test shows that there is a phase to frame fault with the appliance switch off.

If the heater was plugged into a live socket outlet without being repaired:

- (i) Calculate the current that would flow in the protective earthing conductor. Assume that there is no resistance in the fault.
(2 marks)

- (ii) The live socket outlet is protected by a 10A HRC fuse with a 1.5 Utilisation category (fusing factor). Explain with the aid of calculations the effect on the operation of the fuse.
(2 marks)

(turn over)

Question 7 continued

(b) A 230V, Class I, plug-in electrical appliance is controlled by a single pole switch. Following repairs to the appliance a phase – neutral transposition occurred.

(i) State the effect of a phase – neutral transposition on the safe operation of the electrical appliance.

(1 mark)

(ii) Describe the **THREE** areas in the appliance where a phase – neutral transposition can occur.

(3 marks)

(1) _____

(2) _____

(3) _____

(c) Briefly explain how a low protective earthing conductor resistance value contributes to the electrical safety of the appliance when a fault occurs between the phase and exposed metal.

(2 marks)

(turn over)

Question 8

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 consumed by the water heater.

(2 marks)

(turn over)

Question 8 continued

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

(i) The circuit resistance

(2 marks)

(ii) The current drawn from the supply

(2 marks)

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

(2 marks)

(turn over)

Question 9

- (a) You have completed repairing a plug-in, Class I electrical appliance and the protective earthing conductor test result was 15Ω . State the sequence of actions you would take to ensure the appliance complies with AS/NZS 3760. (4 marks)

- (b) A Class I, 230V electrical appliance is used in damp conditions.

- (i) Briefly describe how the damp conditions could affect the operation of the appliance. (2 marks)

- (ii) Briefly describe the danger that may exist for an operator who uses the appliance without an electrical safeguard and a phase to frame fault occurs. (2 marks)

(turn over)

Question 9 continued

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

(2 marks)

(1) _____

(2) _____

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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	
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