



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

ELECTRICAL SERVICE TECHNICIAN "A" EXAMINATION

12 September 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) Registered Electrical Service Technicians must complete refresher courses at regular intervals. Refer to the Electricity Regulations and state the interval at which the refresher courses must be completed?

1. 15 months
2. 18 months
3. 24 months
4. 12 months

(b) Select from the single core flexible cords listed below, the cord which would have the most electrical resistance.

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

(c) The symbol of a **square within a square** on a name-plate of an electrical appliance is used to indicate that the appliance is double-insulated. Which one of the following terms on an appliance nameplate would also indicate that the appliance is double-insulated:

1. Class I
2. Class II
3. All-insulated
4. 240V

(turn over)

Question 1 continued

(d) 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.

(e) The maximum current a flexible cord can carry safely without overheating depends mainly on:

1. The type of supply, a.c. or d.c.
2. The cross-sectional area of the flexible cord conductors
3. The length of flexible cord used
4. The number of cores in the flexible cord

(f) Which of the following documents details the specific tests which must be carried out after fitting a new flexible cord and plug to a 230V, plug-in electric motor?

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

(turn over)

Question 1 continued

(g) A switch controls two heating elements both of the same resistance. The settings that can be selected on the switch are "high", "medium" and "low". When the "high" position is selected on the switch, 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

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

1. 500 ohms
2. 20 Megohms
3. 10,000 ohms
4. 1 Megohm

(i) State the reason why a bayonet cap adaptor must not be used to supply a Class I electrical appliance.

1. Wrong voltage rating
2. No earthing facility
3. Not mechanically strong enough
4. The cord supplying the adaptor is the wrong shape

(turn over)

Question 1 continued

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

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



(turn over)

Question 2

(a) Refer to the Electricity Regulations and answer the following:

- (i) What is meant by the term **personal protective equipment**? (1 mark)

Ref:

- (ii) State the **TWO** safety responsibilities relating to personal protective equipment of a person who carries out work. (2 marks)

(1) _____

(2) _____

Ref:

(turn over)

Question 2 continued

- (b) (i) State **TWO** electrical safeguards which could be used with a Class I electrical appliance to provide personal safety when **operating outdoors**.

(2 marks)

(1) _____

(2) _____

- (ii) State **ONE** electrical protective device that will prevent an electric current flowing through the operator's body if a phase to framework fault occurs when **operating outdoors** and the appliance protective earthing conductor is defective.

(1 mark)

- (c) An isolating transformer is constructed with one socket outlet terminal to permit the use of only one electrical appliance. Two electrical appliances are used with this isolating transformer with the use of a 4-way multi-box socket outlet (an EPOD).

Explain how the simultaneous use of two electrical appliances from this isolating transformer increases the possibility of electric shock?

(4 marks)

(turn over)

Question 3

- (a) (i) Draw and label a circuit diagram of a single-phase capacitor start motor.

(3 marks)

- (ii) Describe how to reverse the direction of rotation in a single phase capacitor start motor.

(1 mark)

- (iii) How is the start winding in a single-phase capacitor start motor disconnected when the motor it up to speed?

(1 mark)

(turn over)

Question 3 continued

- (iv) What would be the affect on the performance of a single-phase capacitor start motor if the capacitor had become disconnected and the motor was switched on whilst connected to a load? State **ONE** reason to support your answer.

(2 marks)

- (b) (i) Describe how the direction of rotation can be reversed for a Universal (series) motor

(1 mark)

- (ii) State **TWO** typical applications for a Universal (series) motor

(2 marks)

(1) _____

(2) _____

(turn over)

Question 4

Two faulty 230V plug-in portable heaters have been bought in for repair. Both heaters are identical and are controlled by a selector switch that gives three heat settings – “high”; “medium; and “low”. The insulation tests on both heaters are satisfactory.

(a) (i) On heater 1, a continuity test shows the following readings:

- High 80Ω
- Medium 40Ω
- Low 20Ω

What is the cause of the fault?

(1 mark)

(ii) On heater 2, testing confirms that the selector switch is not faulty. A continuity test shows the following readings:

- High 40Ω
- Medium 40Ω
- Low Open circuit

What is the cause of the fault?

(1 mark)

(turn over)

Question 4 continued

- (b) Heater 2 has been repaired. Calculate the power consumed by the heater when operating at full voltage (230V) in the "high" position. (4 marks)

- (c) The Electricity Regulations permit a maximum voltage drop of 5% at the socket outlet into which heater 2 is plugged in.

Heater 2 has been repaired and is operating in the "high" position. Calculate the difference in the power consumed by heater 2 between when it is operating at full voltage and when it is operating at the maximum permissible volt drop.

(4 marks)

(turn over)

Question 5

(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)

Ref:

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

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)

Ref:

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

Ref:

(turn over)

Question 5 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)

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

(1 mark)

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

(2 marks)

(turn over)

Question 6

(a) Draw and label a circuit diagram of a 230V, Class I heater. The internal components of the heater are:

- Two elements, one of 25.5 ohms and the other of 51 ohms.
- A two-position selector switch to connect the supply to either of the elements.
- A fuse that protects the entire heater.

Your diagram must show the phase, neutral and earth connections.

(6 marks)

(turn over)

Question 6 continued

(b) Calculate the maximum power consumed by the heater.

(2 marks)

(c) Calculate the minimum current drawn by the heater.

(2 marks)

(turn over)

Question 7

- (a) In a house, a 20A HRC fuse protects a final subcircuit consisting of two socket outlets supplying various 230V plug-in electrical appliances. The fuse has blown. When the fuse is replaced, it blows again sometime after the supply has been restored to the circuit.

You have established that:

- The fuse is correctly rated for the circuit and is not faulty.
- The circuit is not faulty.
- None of the appliances are faulty

- (i) State the reason why the fuse keeps blowing.

(1 mark)

- (ii) Describe how you would establish that this is the reason why the fuse keeps blowing.

(2 marks)

- (iii) State the action that needs to be taken to stop the fuse blowing again.

(1 mark)

(turn over)

Question 7 continued

- (b) In an office, a 16A MCB protects a final subcircuit consisting of three socket outlets supplying various 230V plug-in electrical appliances. The MCB has tripped. When the MCB is reset, it immediately trips when the supply is restored to the circuit.

You have established that:

- The fuse is correctly rated for the circuit and is not faulty.
- The circuit is not faulty.
- The appliances are not overloading the circuit

- (i) State **ONE** reason why the MCB keeps tripping.

(1 mark)

- (ii) For the reason you have stated in (b)(i), describe how you would test to establish that this is the reason why the MCB keeps tripping.

(4 marks)

Type of test

How the test is carried out

Instrument used

Expected test result when the fault is located.

(turn over)

Question 7 continued

- (iii) State the action that needs to be taken to stop the MCB tripping again.
(1 mark)

(turn over)

Question 8

- (a) A single phase 230V Class I, plug-in electrical appliance is supplied via a flexible cord. State the **TWO** sets of colour coding, either of which can be used for the flexible cord. State the polarity for each colour.

Note: To gain marks for each set you must state the all the colours and polarity accurately.

(6 marks)

Set 1

Set 2

- (b) An electrical appliance is being supplied from a 25 metre three core flexible extension cord. The extension cord has been wound on a cable drum to provide a convenient means of storage.

State the **TWO** precautions, either of which could be taken to prevent the extension cord failing when in use.

(2 marks)

(1) _____

(2) _____

(turn over)

Question 8 continued

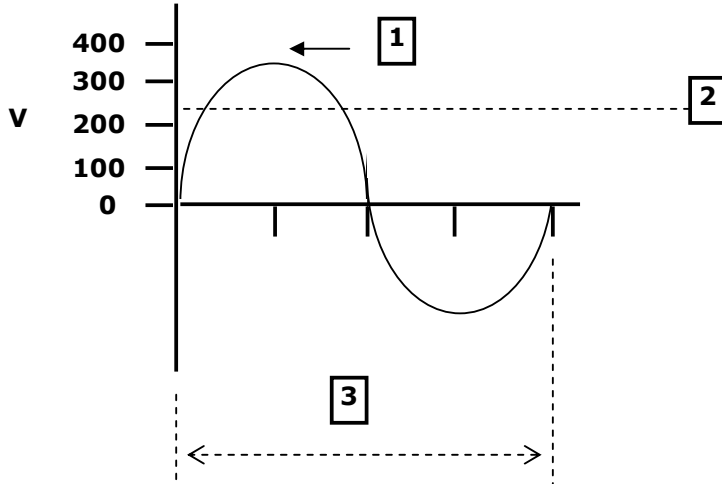
- (c) If the phrase "it is the maximum current that it is designed to carry safely" is used in respect to a flexible cord, what characteristic is being described?
(1 mark)

- (d) 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?
(1 mark)

(turn over)

Question 9

(a) The following diagram shows a 230V, 50 Hz waveform.



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

(1 mark)

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

(3 marks)

Item	Name	Value
1		
2		
3		

(turn over)

Question 9 continued

- (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)

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

- (i) Briefly describe how a protective earthing conductor contributes to the electrical safety of a Class I electrical 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)

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		