

Version 3- ESTA 1019- Electrical Service Technician “A” Answer Schedule

- Notes:1. (1 mark) means that the preceding statement/answer earns 1 mark.
2. This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.
3. Symbols and terms - alternatives
Power W or P
Voltage V or E or U
Phase Active
4. Key to abbreviated terms:
EA Electricity Act 1992
ER Electricity Regulations 1997
AS/NZS Australia and New Zealand Joint Standard
NZS New Zealand Standard
AS Australian Standard
ECP New Zealand Electrical Code of Practice
GK General Knowledge
5. Where applicable, the parts of an answer underlined are the points that need to be covered.

Question 1

Each part in this question is worth 2 marks.

- (a) 250 volts **multi-choice answer – (4)**
- (b) Current and resistance **multi-choice answer –(2)**
- (c) 6A **multi-choice answer – (3)**
- (d) Water - gas expelled **multi-choice answer – (1)**
- (e) Disconnect a large fault current **multi-choice answer –(3)**
- (f) Heating effect increases four times **multi-choice answer – (4)**
- (g) A 230/230 volt isolating transformer **multi-choice answer – (2)**
- (h) 5 metres of 1.0mm² cord **multi-choice answer – (3)**
- (i) To minimise the possibility of electric shock. **multi-choice answer – (2)**
- (j) One element only across the supply **multi-choice answer –(4)**

Question 2

(a) (i) $W = \frac{V^2}{R}$ (1/2 mark)
 $= \frac{230 \times 230}{24}$ (1/2 mark)
 $= 2204.17 \text{ W}$ (1 mark)

(ii) $I = \frac{V}{R}$ (1/2 mark)
 $= \frac{230}{24}$ (1/2 mark)
 $= 9.58 \text{ A}$ (1 mark)

(b) (i) Maximum voltage drop
 $= 230 \times \frac{5}{100}$ (1/2 mark)
 $= 11.5 \text{ V}$ (1/2 mark)
 $I = \frac{V}{R}$ (1/2 mark)
 $= \frac{218.5}{24}$ (1/2 mark)
 $= 9.1 \text{ A}$ (1 mark)

(ii) (1) $W = \frac{V^2}{R}$ (1/2 mark)
 $= \frac{218.5 \times 218.5}{24}$ (1/2 mark)
 $= 1989.26 \text{ W}$ (1 mark)

(2) Drop in power dissipated = $2204.17 - 1989.26$ (1/2 mark)
 $= 214.91 \text{ W}$
Or
9.8% (1/2 mark)

Question 3

(a) Any **FIVE** of – from AS/NZS 3760:2001:

- Check for obvious damage or defects in the accessories or plugs.
- Check that flexible cords are effectively anchored to equipment and plugs.
- Check that the inner cores of flexible supply cords are not exposed or twisted;
- Check that the external sheaths are not cut, abraded, twisted, or damaged to such an extent that the insulation of the inner cores is visible
- Check that unprotected conductors or insulation tape are not in evidence.
- Check that any controls are in good working order i.e. they are secure, aligned and appropriately identified.
- Check that covers, guards and the like are secured in the manner intended by the manufacturer or supplier.
- Check that safety facilities and devices are in good working order.
- Check that ventilation inlets and exhausts are unobstructed.

AS/NZS 3760: 2.3.2
(5 marks)

Or

Any **FIVE** of – from AS/NZS 3760:2003:

- Check for obvious damage or defects in the accessories or plugs.
- Check for discolouration that may indicate exposure to heat, chemicals and moisture.
- Check that flexible cords are effectively anchored to equipment and plugs.
- Check that the inner cores of flexible supply cords are not exposed or twisted;
- Check that the external sheaths are not cut, abraded, twisted, or damaged to such an extent that the insulation of the inner cores is visible
- Check that unprotected conductors or banding insulation tape are not in evidence.
- Check that any operating controls are in good working order i.e. they are secure, aligned and appropriately identified.
- Check that covers, guards and the like are secured in the manner intended by the manufacturer or supplier.
- Check that ventilation inlets and exhausts are unobstructed.
- The pins of insulated pin plugs should be inspected for damage to the insulation of the pins.

AS/NZS 3760: 2.3.2
(5 marks)

(b) Any **TWO** of:

- No guarantee of polarity
- No earthing facility
- Insufficient current rating

(2 marks)

(c) • So that it is first to make contact when inserted,

(1 mark)

- And the last to break contact when the plug is withdrawn,

(1 mark)

(d) Any ONE of:

- The load current is likely to arc across the micro gap as the switch contacts are opened and damage them.
- It is easier to extinguish an a.c. arc as the current goes through zero in each half-cycle.
- Breaking current with d.c. often results in a build-up of contact material which eventually shorts-out the contacts

(1 mark)

Question 4

(a) Parallel resistances

$$\frac{1}{R_t} = \frac{1}{R_2} + \frac{1}{R_3} \quad (1/2 \text{ mark})$$

$$= \frac{1}{60} + \frac{1}{12} \quad (1/2 \text{ mark})$$

$$= \frac{6}{60} \quad (1/2 \text{ mark})$$

$$R_t = \frac{60}{6} \quad (1/2 \text{ mark})$$

$$= 10 \Omega \quad (1 \text{ mark})$$

Or

$$\begin{aligned} R_t &= \frac{\text{Product}}{\text{Sum}} \\ &= \frac{60 \times 12}{60 + 12} \\ &= 10 \Omega \end{aligned}$$

$$\begin{aligned} \text{Total resistance} &= 30 + 10 \\ &= 40 \text{ ohms} \end{aligned} \quad (1 \text{ mark})$$

$$W = \frac{V^2}{R} \quad (1/2 \text{ mark})$$

$$= \frac{230 \times 230}{40} \quad (1/2 \text{ mark})$$

$$= 1322.5 \text{ W} \quad (1 \text{ mark})$$

(b) Total current

$$I = \frac{V}{R} \quad (1/2 \text{ mark})$$

$$= \frac{230}{40} \quad (1/2 \text{ mark})$$

$$= 5.75 \text{ A} \quad (1 \text{ mark})$$

(c) Voltage dropped across R1

$$V_{R1} = IR_{R1}$$

(½ mark)

$$= 5.75 \times 30$$

(½ mark)

$$= 172.5V$$

(1 mark)

Question 5

(a) • Any **FOUR** of:

- **Ensure conductor insulation is up to the terminals.**
- **Apply cord clamp**
- **Terminate conductors to correct terminals or correct colour coding.**
- **Assemble plug ensuring there are no exposed conductors or basic insulation.**
- **Protective earthing conductor is longer than the other conductors.**

And

- **Carry out appropriate tests - polarity, earth continuity, insulation resistance, visual).**

Note: Failure to test the appliance after the fitting of the plug is considered dangerous and no marks are to be awarded for this part of question 5, if testing is not shown.

(5 marks)

(b) Any **FIVE** of:

- Number of cores required
- Mechanical strength
- Operating environment
- Flexibility needed
- Application temperature at point of entry to appliance
- Colour coding
- **Whether it is a Class I or Class II appliance**

(5 marks)

Question 6

(a) Any TWO of:

- Connect phase and neutral together, and test between this linked pair and earth.
- Bridge out the semi-conductor devices before testing.
- Test between phase and earth and neutral and earth.
- Use a 250V d.c. insulation resistance tester

(2 marks)

(b) (i) An insulation resistance tester.

(1 mark)

(ii) 500 V d.c..

(1 mark)

(iii) A minimum value of 1 M Ω .

(1 mark)

- (iv)
- Test between the phase and frame of the appliance or the earth on the plug.
 - Test between the neutral and frame of the appliance or the earth on the plug.

(2 marks)

(c) (i) 250 V d.c.

AS/NZS 3760:2001 2.3.3.2(d) Note (1)
AS/NZS 3760:2003 2.3.3.2(b)
(1 mark)

- (ii)
- To avoid triggering the MOV
 - To ensure the equipment does not fail the test

AS/NZS 3760:2001 2.3.3.2(d) Note (1)
AS/NZS 3760:2003 2.3.3.2(b)
(2 marks)

Question 7

- (a) (i) The high resistance protective earthing conductor will mean that:
- A potential difference will develop across the protective earthing conductor.
 - A shock hazard will exist because the appliance frame will be live.
 - The protection will not operate in the required manner.
- (3 marks)
- (ii) $I = \frac{V}{R}$
- (½ mark)
- $= \frac{230}{35}$
- (½ mark)
- $= 6.57A$
- (1 mark)
- (iii) $V = IR$
- (½ mark)
- $= 6.57 \times 35$
- (½ mark)
- $= 230 \text{ volts}$
- (1 mark)
- (b) • Most of the internal wiring will be alive at 230V to earth with the switch in the “OFF” position.
- If a phase – to – frame fault occurs, there could be a voltage to earth with the switch in the “OFF” position.
- (2 marks)
- (c) There is a fault in the fixed wiring
- (1 mark)

Question 8

- (a) (i) A practising licence
EA 95(1)
(1 mark)
- (ii) 30 June of the year it is stated to expire.
(also accept 1 July)
Electricity Amendment Act 1997 4(2)(b)
(1 mark)
- (iii) The Registrar
EA 96(1) or 100(4)
(1 mark)
- (b) Any THREE of:
- Registered electricians
 - Registered line mechanics
 - Registered electrical inspectors
 - Persons who are authorised to carry out such work under a provisional licence
 - Trainees
 - Qualified engineers
- EA 108 (2)
(3 marks)
- (c)
- Safe working practices
 - Testing
 - CPR
 - Basic first aid
- ER 26(2)
(4 marks)

Question 9

(a)

Test or check	Type of test instrument	Acceptable test result	State whether this is a minimum or maximum value
<i>Earth continuity</i>	<i>Any instrument that can accurately read values of 1 ohm or less</i>	<i>1 ohm</i>	<i>Maximum</i>
<i>Insulation resistance</i>	<i>Insulation resistance tester</i>	<i>10,000 ohms or 0.01 Mohms</i>	<i>Minimum</i>

(4 marks)

(b) Any TWO of:

- To establish that a low resistance exists of no greater than 1 ohm.
- To ensure the appliance is effectively earthed.
- To ensure no potential difference can develop across the protective earthing conductor.
- To ensure the appliance frame is held at 0 V and no shock hazard exists.
- To ensure the protection will operate.

(2 marks)

(c) Any ONE of:

- To ensure that the phase, neutral and earth conductors are terminated at the correct terminals.
- To ensure that a switch is in the phase (active) conductor.

(1 mark)

(d) Any ONE of:

- To ensure the insulation resistance is not less than a minimum of 1 MΩ or 10,000 Ω or 0.01 Mohms.
- To see if the insulation can withstand the voltage pressure

(1 mark)

(e) Any ONE of:

- To ensure that the Protective Earthing conductor is continuous and of a resistance less than 1 ohm.
- To ensure that a false reading is not obtained if the Protective Earthing Conductor resistance is very high or is open-circuited.

(2 marks)