

Version 2- ESTA 1017- 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

Question 1

Each part in this question is worth 2 marks.

- (a) 2645 watts **multi-choice answer – (4)**
- (b) 559.5 watts **multi-choice answer – (3)**
- (c) Disconnect a large fault current **multi-choice answer –(1)**
- (d) 1 Meg Ohm **multi-choice answer – (2)**
- (e) 10 metres of 0.75mm² cord **multi-choice answer – (3)**
- (f) 435 mA **multi-choice answer – (2)**
- (g) Two elements in series **multi-choice answer – (1)**
- (h) Just up to the terminals **multi-choice answer – (1)**
- (i) 10A **multi-choice answer – (4)**
- (j) Lowest current **multi-choice answer – (3)**

Question 2

- (a) (i) Means any voltage exceeding 50 volts a.c. or 120 volts ripple free d.c. but not exceeding 1,000 volts a.c. or 1,500 volts d.c.

(ER2)
(1 mark)

- (ii) Means contact, by any person or animal, with live parts, including contact by any thing being carried or worn by that person or animal

(ER2)
(2 marks)

- (iii) In relation to fittings or electrical appliances, means that the fittings or appliances are deliberately disconnected from any source of electricity

(ER2)
(2 marks)

- (b) Any example from the following definition of an “earth situation”:

- Within 2.5 m in any direction from a conductive floor (such as earthen, concrete, tile or brickwork flooring) on which a person may stand.
- Within 2.5 m in any direction from a permanently damp surface on which a person may stand.
- Within 2.5 m in any direction from a metallic conduit or pipe, metallic cable sheath or armour on which a person may stand.
- Within 2.5 m in any direction from any conductive material on which a person may stand.
- External to a building, except for an isolated piece of equipment such as switchgear or a luminaire which is mounted more than 2.5 m from the ground and from any exposed conductive part or other conductive material which is in contact with earth.
- Within 2.5 m of the ground, floor or platform in rooms containing socket-outlets, the earthing terminals of which are earthed, and where there is a reasonable chance of a person making simultaneous contact with any exposed conductive part of electrical equipment and any exposed conductive part of an appliance connected to any of the socket-outlets.
- All parts of a bathroom, laundry, lavatory, toilet or kitchen.

(2 marks)
AS/NZS 3000: 1.4.41

- (c) **Any THREE of:**

- Flashover.
- Leakage.
- Shock hazard.
- **No effective earth on the appliance**

(3 marks)

Question 3

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

$$= \frac{230}{24} \quad (1/2 \text{ mark})$$

$$= 9.58A \quad (1 \text{ mark})$$

$$(ii) \quad W = VA \quad (1/2 \text{ mark})$$

$$= 230 \times 9.58 \quad (1/2 \text{ mark})$$

$$= 2203.4W \quad (1 \text{ mark})$$

or

$$= I^2R$$
$$= 9.58 \times 9.58 \times 24$$
$$= 2202.63W$$

$$= \frac{V^2}{R}$$
$$= \frac{230 \times 230}{24}$$
$$= 2204.16 \text{ W}$$

$$(b) \quad (i) \quad 11\% \text{ of } 230 \text{ V} = 25.3 \text{ V} \quad (1 \text{ mark})$$

Maximum variations are:

$$230V + 13.8 = 243.8V$$

$$230V - 25.3 = 204.7V$$

(1 mark)

(ii) Power dissipated at **243.8V**

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

$$= \frac{\mathbf{243.8 \times 243.8}}{24} \quad (1/2 \text{ mark})$$

$$= \mathbf{2476.6W} \quad (1 \text{ mark})$$

(iii) Power dissipated at 204.7V

$$P = \frac{V^2}{R}$$

(½ mark)

$$= \frac{204.7 \times 204.7}{24}$$

(½ mark)

$$= 1745.92W$$

(1 mark)

Question 4

(a) Any FOUR of:

- Number of cores required
- Mechanical strength
- Operating environment
- Flexibility needed
- Application temperature at point of entry to appliance
- Colour coding

(4 marks)

(b)

Type of appliance	Phase colour	Neutral colour	Earth colour	Minimum No. of cores required
Earthed electrical appliance	Red or Brown	Black or Light Blue or Blue	Green/Yellow Or Green	Three
Double insulated electrical appliance	Red or Brown	Black or Light Blue or Blue	N/A	Two

Note: The colour "blue" for the neutral is as indicated on page 30 of AS/NZS 3760:2003

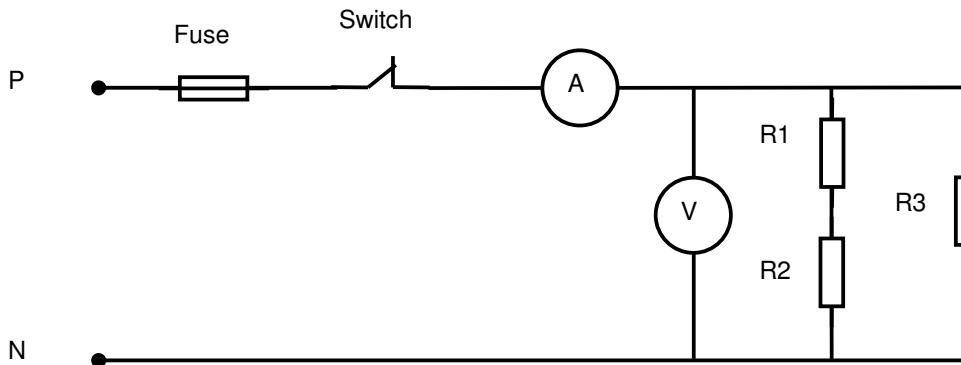
(4 marks)

(c) It is the maximum current that a flexible cord is designed to carry safely

(2 marks)

Question 5

(a)



- Fuse connected in the active (½ mark)
- Fuse protects all of the circuit and components (½ mark)
- Switch connected in the active (½ mark)
- Switch controls all the components (½ mark)
- Correctly connected voltmeter (½ mark)
- Correctly connected ammeter (½ mark)
- Correctly connected series resistors. (½ mark)
- Correctly connected parallel resistors. (½ mark)

(Total 4 marks)

(b) (i) $R_t = \frac{\text{Product}}{\text{Sum}}$
 $= \frac{(150 + 100) \times (70)}{(150 + 100) + (70)}$ (½ mark)

$= \frac{17500}{320}$ (½ mark)

$= 54.69\Omega$ (1 mark)

$I = \frac{V}{R}$ (½ mark)

$= \frac{230}{54.69}$ (½ mark)

$= 4.2A$ (1 mark)

$$\begin{aligned} \text{(ii) } P &= VI && \text{(1/2 mark)} \\ &= 230 \times 4.2 && \text{(1/2 mark)} \\ &= 966\text{W} && \text{(1 mark)} \end{aligned}$$

Question 6

(a) Any ONE of the following methods:

Method 1

- Disconnect the protective earthing conductor from the appliance and test (½ mark)
- If the resistance of protective earthing conductor is more than 1 Ω, replace the flexible cord. (1 mark)
- If the resistance of protective earthing conductor is less than 1 Ω, re-terminate protective earthing conductor, ensuring that the termination is sound and clean. (1 mark)
- Re-test the protective earthing conductor to ensure resistance is 1 Ω, or less (½ mark)

Method 2

- Ensure all earth terminations and connections are tight and properly installed or
- Replace supply lead and plug, (2½ marks)
- In order to get a result of 1Ω or less. (½ mark)

Method 3

- Clip one terminal of ohm-meter to the plug earth pin and test between this reference and points along the earth circuit to identify the high resistance. (1 mark)
- Repair faulty terminations or replace faulty cord. (1½ marks)
- Retest between plug earth and appliance frame to ensure <1.0Ω. (½ mark)

(b) Any TWO of:

- An isolating transformer
- An RCD rated for personal protection
- A monitored earth unit (2 marks)

- (c) (i)
- To avoid possible contact with a live terminal when removing or replacing the fuse carrier (2 marks)
 - To avoid flash burns from the fuse if it "blows" again because the initial fault has not been cleared (2 marks)
- (ii) There is a fault in the fixed wiring (1 mark)

Question 7

(a)

Test or check	Type of test instrument	Minimum or maximum test result value
<i>Earth continuity</i>	Any instrument with a low reading ohms scale	<i>Max 1 ohm</i>
<i>Insulation resistance</i>	<i>Insulation resistance tester</i>	<i>Min 10,000 ohms</i>

(5 marks)

(b) (i) Any ONE 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.

(1 mark)

(ii) Any ONE of:

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

(1 mark)

(iii) Any ONE of:

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

(1 mark)

(c) 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)

Question 8

- (a) • Neutral current out of balance with the phase current. (1 mark)
- A magnetic field is induced into the iron core. (1 mark)
- The induced magnetic field induces a current in the sensing coil (1 mark)
- The tripping coil is energised, isolating the circuit (1 mark)
- (b) Portable Residual Current Device (1 mark)
- (c) Any THREE of:-
- It will safely interrupt short circuit currents of much higher values or higher rupturing capacity.
 - It eliminates arcing because the fuse element is sealed.
 - It is obtainable in a range of Utilisation category (fusing factors).
 - Current rating is clearly marked.
 - Reliable operation within prescribed limits.
 - Good discrimination.
 - Constant fusing characteristics.
 - Faster operation/acting.
 - Doesn't deteriorate over time.
- (3 marks)
- (d) Any TWO of:
- If the fuse blows again an arc may be established between the fuse terminals causing damage or injury
 - Cannot safely interrupt short circuit currents of much higher values.
 - Fuse wire may protrude past the holder which creates an exposure to shock.
 - Suitable fixing for the fuse wire is not generally available.
 - Fuse holder is not fire proof.
 - Slower operation/acting.
- (2 marks)

Question 9

(a) (i) Current flowing $I = \frac{V}{R}$
 $= \frac{230}{7}$
 $= 32.88$ amps fault current would flow

(1 mark)

(1 mark)

- (ii) • The fusing current = $10 \times 1.5 = 15A$ (1 mark)

- The fault current would operate the fuse. (1 mark)

(b) (i) Any ONE of:

- The appliance may be polarity sensitive.
- 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)

(ii) Any FOUR of:

- The phase and neutral can be transposed at the plug on the flexible cord
- The phase and neutral can be transposed at the internal terminals in the appliance (other than at the switch)
- The phase and neutral can be transposed in an extension cord supplying the appliance.
- The phase and neutral can be transposed at the socket outlet supplying the appliance.
- Incorrect polarity at switchboard.

(4 marks)