ES8 – Security Theory/Regulations 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

(a) Any ONE of:

- Because the fuse or circuit breaker must be capable of safely clearing that level of fault current without damage.
- Ensure protection has enough rupturing capacity to clear fault.
- Makes sure protection can operate in 0.4 seconds.

(2 marks)

(b) 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)

(c) Any TWO of:

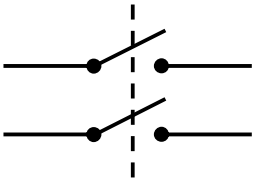
- Fire hazard.
- Flash-burns or "arc-eye".
- Explosion.

(2 marks)

(d) (i) **Single pole switch** shown in the **on** position.

(1 mark)

(ii) **Double pole switch** shown in the **off** position.



(1 mark)

(e) Any ONE of:

- Maximum voltage applied to the device in the reverse bias condition without damage.
- Maximum voltage able to be applied in the reverse current flow direction without damage.

(2 marks)

Question 2

(a) (i) The maximum current that a fuse-link will carry continuously without deterioration or operating at rated voltage.
OR
The maximum level of overcurrent protection for the circuit

(2 marks)

(ii) Current rating = $\frac{\text{Fusing Current}}{\text{Utilisation Category (fusing factor)}}$

(½ mark)

$= \frac{22.5}{1.5}$

(½ mark)

= 15 A

(1 mark)

Note: Accept a Utilisation Category in the range 1.25 to 1.6.

(b) Any TWO of:

- If correctly threaded, prevents fuse element from bulging out the side of the carrier and being accessible to touch.
  or
  If incorrectly threaded, contact could be made with the fuse element.

- If correctly threaded, under overload conditions the heat produced in the element is confined to the tunnel area.
  or
  If incorrectly threaded, the arc or molten metal may escape under overload conditions.

- If correctly threaded, under fault conditions the arc and molten element is confined within the fuse carrier and base.
  or
  If incorrectly threaded, the arc or molten metal may escape under fault conditions.

- If correctly threaded, the fuse wire is sheltered in the tunnel and well clear of the terminals which act as a heat sink.
  Or
  If incorrectly threaded, will be slow to respond to overload fault.

(2 marks)

(c) Any TWO of:

- It will not safely interrupt short circuit currents of high values.
- Arcing is possible because the fuse element is not sealed.
- Unreliable operation.
- Poor discrimination.
- Inconsistent fusing characteristics.
- Deteriorates over time.
- Possibility of contact with protruding fuse wire

(2 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 <u>not</u> generally available.
- Fuse holder is not fire proof.
- Slower operation/acting.
- They can be loaded with a larger size fusing element that is too large for the cable it is protecting.

(2 marks)

Question 3

(a) (i) To shunt excess current away from the load.
or
Maintain a constant voltage across the load

(1 mark)

(ii) A Zener diode is designed so that the critical reverse/breakdown voltage is precise and can be determined.

(1 mark)

(iii) • It protects the Zener diode from damage by limiting the current.

(1 mark)

• It creates a voltage divider.

(1 mark)

• That drops the difference in voltage between the Zener voltage and the supply voltage

(1 mark)

• Creates a constant voltage (regulated) output.

(1 mark)

(b) Any TWO:

- Inductor
- Capacitor
- Resistor

(2 marks)

(c) Any TWO:

- Current drops to zero
- Current drops to less than holding current
- Remove anode to cathode voltage.
- Apply reverse polarity voltage across the SCR.

(2 marks)

Question 4

(a)
- Current rating (1 mark)
- Voltage rating (1 mark)
- Category of duty (Rupturing Capacity) (1 mark)
- Utilisation category (fusing factor) (Class) (1 mark)

(b) As the current increases the time taken to operate decreases.

Note: A drawn representation of the characteristic is acceptable. (2 marks)

(c) (i) Small overload: A small overload:
- causes a bi-metal to heat up and bend, (1 mark)
- operating a trip mechanism that (1 mark)

disconnects the circuit

(ii) Short circuit. A larger overload:
- causes a strong magnetic field (1 mark)
- which attracts a trip mechanism (1 mark)

that disconnects the circuit rapidly

Question 5

(a) Carrying out a checking or testing procedure with or without test instruments in order to prove that it is safe and has been wired correctly

(2 marks)

(b) (i) Protective earth continuity

- Test between the earth contact on the socket outlet and the switchboard earth bar

(1 mark)

- Meter: Meter capable of accurately reading values of 1 ohm or less

(1 mark)

- Maximum reading: 0.5Ω

(1 mark)

Or

- Test between the neutral and earth pins at the socket outlet

(1 mark)

- Meter: Meter capable of accurately reading values of 1 ohm or less

(1 mark)

- Maximum reading: 1Ω would confirm that each has a resistance of 0.5Ω

(1 mark)

- test

(ii) Insulation Resistance

- Disconnect main earthing conductor from the earth bar

(1 mark)

- Test phase and neutral, phase and earth, neutral and earth.

(1 mark)

- Meter: Insulation resistance tester

(½ mark)

- Minimum reading 1MΩ

(½ mark)

(iii) Polarity

The method must show a test or check that establishes that each conductors go to its correct terminal.

(1 mark)

(c) Any ONE of:

- No access to live parts without the use of a tool
- Connections properly terminated
- Correct colour code

Any other reasonable answers

(1 mark)

Question 6

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

(ii) Means those fittings forming part of an electrical installation that are used for the supply of electricity to the main switchboard of that installation

ER2
(2 marks)

(b) Precautions shall be taken to ensure the safety of persons and to avoid damage to property and the electrical installation equipment during inspection and testing.

AS/NZS 3000: 6.1
(2 marks)

(c) Any colour except Black, Light Blue, Green or Green/Yellow.

AS/NZS 3000: 3.8.1
(2 marks)

(d) (i) 5% of 230 volts = 11.5 volts

(ii) 5% of 400 volts = 20 volts

ER 53(3)
(2 marks)

(e) A and C

ER 17(d), (j)
(2 marks)

Question 7

(a) (i) 1 ohm

AS/NZS 3760:2001: 2.3.3.1
AS/NZS 3760:2003: 2.3.3.1
(1 mark)

(ii) Any ONE of:

- The resistance to earth from protectively earthed parts in Class I equipment must be low enough to permit adequate fault current to flow to earth thereby ensuring that the overcurrent protective device opens quickly.

AS/NZS 3760:2001: Foreword

- To ensure that the resistance of the protective conductor is sufficiently low to ensure the operation of the circuit protecting the equipment.

AS/NZS 3760:2003: 2.3.3.1
(2 marks)

- Holds the frame of the appliance at earth potential under fault conditions.

(iii) Any ONE of the following methods:

<u>Method 1</u>

- Disconnect the protective earthing conductor from the security alarm panel 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 and/or,

(1 mark)

- Replace supply lead and plug,

(1½ 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)

(i)	Red	(i)	Brown
(ii)	Black	(ii)	Light Blue
(iii)	Green	(iii)	Green/Yellow

Accept answers from AS/NZS 3000 or AS/NZS 3760

(3 marks)

(c) Two

(1 mark)

Question 8

(a) (i) The neutral bar associated with the RCD for the sockets outlets.

GK
(1 mark)

(ii) MCBs or HRC fuses

GK
(1 mark)

(b) (i) Any TWO of:

- Where socket-outlets are added to a final subcircuit, provided that the existing subcircuit is not RCD protected.
- Where socket-outlets are added to a final subcircuit, provided that the existing socket-outlets on the circuit are not RCD protected.
- Where points are added to a final subcircuit in a domestic or residential-type area of an electrical installation, provided that the existing final subcircuit is not RCD protected.
- Where socket-outlets or points that are not RCD protected are replaced.
- In New Zealand, where all points on a new final subcircuit are protected by an RCD installed at the first point of that new final subcircuit.

AS/NZS 3000: 2.5.3.4
(2 marks)

(ii) A socket-outlet, or a connecting device installed in accordance with Clause 4.11 (c), for the connection of fixed or stationary electric cooking appliances, such as ranges, ovens or hotplates.

AS/NZS 3000: 2.5.3.1
(1 mark)

(iii) 30 mA

AS/NZS 3000: 2.5.3.1
(1 mark)

(c) Any TWO of:

- Current rating
- Voltage drop
- Environmental conditions
- Mechanical protection
- Short circuit conditions
- Voltage rating
- Construction

(2 marks)

(d) Any TWO of:

- Avoid cutting conductor strands
- Ensure insulation is maintained right up to the terminal
- Ensure terminal connections are tight

(2 marks)

Question 9

(a) Certificate of compliance (CoC)

(1 mark)
ER 39(1)

(b) Any ONE of:

- Within 1 day of the completion of the work
- Within 1 day of the termination of the contract

(1 mark)
ER 39(5)

(c) (i) The owner of the fittings or the occupier of the premises

(1 mark)
ER 40(2)

(ii) Within 20 working days of completion

(1 mark)
ER 40(2)

(d) (i) 3 years

(1 mark)
ER 40(4)

(ii) Any ONE of:

- The Board
- The Secretary in the case of an employer licence

(1 mark)
ER 40(5)

(e) Any ONE of:

- A registered electrical inspector:
- A registered electrician:
- A registered line mechanic:
- A qualified engineer:
- A provisional licence holder:
- A person authorised to certify the prescribed electrical work under an employer licence.

(1 mark)
ER 39(4)

(f) (i) Section 6 of AS/NZS 3000

(1 mark)
ER 37(3)

(ii) After the work is completed and before connection to the supply

(1 mark)
ER 37(3)

(iii) On a Certificate of Compliance

(1 mark)
GK

Question 10

(a) To ensure that the insulation resistance between all live conductors and earth or, as the case may be, all live parts and earth is adequate to ensure the integrity of the insulation.

AS/NZS 3000: 6.3.3.3.1
(2 marks)

(b)
- To prevent electric shock hazards from inadvertent contact
- To prevent fire hazards from short-circuits
- To prevent equipment damage.

AS/NZS 3000: 6.3.3.3.1
(3 marks)

(c) (i) 500V d.c.

AS/NZS 3000: 6.3.3.3.1
(1 mark)

(ii) The insulation resistance tester used shall be able to maintain its terminal voltage within +20%, -10% of the nominal open-circuit terminal voltage, when measuring a resistance of 1 ḾΩ the 500 V range or 10 MΩ the 1000 V range.

AS/NZS 3000: 6.3.3.3.1
(1 mark)

(d)
- To ensure that the earthing systems has been installed in a manner that will cause circuit protective devices to operate if there is a fault between live parts, other than the neutral, and the mass of earth.
- Tol ensure that electrical equipment parts that are earthed do not reach dangerous voltages when such earth faults occur.

AS/NZS 3000: 6.3.3.2.1
(2 marks)

(e) Any ONE of:

- Short circuit between the conductors.
- Transposition of conductors which could result in the earthing system and any exposed conductive parts of the electrical installation becoming energized
- Interconnection of conductors between different circuits.

AS/NZS 3000: 6.3.3.5.2

- To prevent protective earthing conductors normally carrying current
- Fire damage or personal injury, particularly in high current locations, because of a short-circuit current flowing between live conductors and through part of the earthing system

AS/NZS 3000: 6.3.3.5.1
(1 mark)