

ES4 – Security Theory/Regulations Answer Schedule

- Notes:
- (1 mark) means that the preceding statement/answer earns 1 mark.
 - 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.
 - Symbols and terms - alternatives
Power W or P
Voltage V or E or U
Phase Active
 - 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) Under fault conditions the earthing of the metal frame:
- Keeps the frame of appliance at earth potential.
 - And ensures the operation of protective devices
- (2 marks)
- (b) Any TWO of:
- Thermal or bi-metal strips
 - Magnetic
 - Combined thermal/magnetic
- (2 marks)
- (c) This is the maximum continuous current that the fuse can carry without deterioration.
- (2 marks)
- (d) Any ONE of:
- For protecting people against electric shock that could cause injury or death.
 - Disconnect the supply if any earth fault occurs.
- (2 marks)
- (e) A certificate of compliance
- (2 marks)

Question 2

- (a) • Tag to be sufficiently large and conspicuous with prominent, bold lettering. (2 marks)
- Must have words printed on both sides, like “**Danger**”, “**Hold**”, “**Safety Critical**”, “**Do Not Operate**”, “**Do Not Remove**”, etc. (2 marks)
- It should also carry information as follows:
- **Your name**
 - **Date** and time of placing tag
 - **Identification and location of machine**
 - **Reasons or comments as applicable**
- (2 marks)
- (b) (1) Identify
- (2) Isolate
- (3) Test
- (4) Tag
- (4 marks)

Question 3

(a) Any FOUR of:-

- It will safely interrupt short circuit currents of much higher values.
- 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.

(4 marks)

(b) As current through a fuse or circuit breaker increases beyond its current rating, 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 4

(a) Any THREE of:

- Inspect instrument, clips, leads and probes to ensure they are in good condition.
- Don't energise circuit until all connections have been completed.
- Don't make any changes to circuit while power is on.
- Make sure environment is safe.
- Ensure supply is through and isolating transformer or RCD.
- Work on rubber mats.
- Avoid personal contact with either live conductors or earth when using instruments on live circuits.
- Ensure correct range is selected on the instrument.

(3 marks)

(b) Any THREE of:

- Attach a safety warning tag
- Lock open the isolating switch.
- Lock open the circuit breaker controlling the circuit supplying the security control panel.
- Move the fuse carriers of the fuses controlling the circuit supplying the security control panel to a safe location.
- Use an access permit or "hold card" system.
- Disconnect the circuit supplying the security control panel.

(3 marks)

(c) Isolation – means deliberately disconnected from the electricity supply and precautions taken to prevent reconnection

Switched off means that the electricity ceases to be supplied to the appliance
(3 marks)

(d) The current rating is too low for the circuit, and could blow for no apparent reason well below the circuit full-load current.

(1 mark)

Question 5

(a) (i) $R = (96 \times V_{out}) - 120$ (1/2 mark)

$= R + 120 = 96 \times V_{out}$ (1/2 mark)

$V_{out} = \frac{1032 + 120}{96}$ (1/2 mark)

$= 12 \text{ V}$ (1 mark)

(ii) V_{in} should be at least 2.5 volts greater than V_{out} . (1/2 mark)

$= 12 + 2.5$ (1/2 mark)

$= 14.5 \text{ V}$ (1/2 mark)

(iii) The 14.5 V will be the approx. RMS value and the reservoir capacitor will probably charge up to approx. the peak value. (1 mark)

$14.4 \times 1.414 = 20.5 \text{ V plus a margin}$ (1/2 mark)

Appropriate voltage rating is about 25 V (1/2 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 6

(a) Any TWO of:

Final subcircuits that supply:

- Socket-outlets having rated currents not exceeding 63A
 - Hand-held Class I equipment
 - Portable equipment intended for manual movement during use.
- AS/NZS 3000: 1.7.4.3.4
(2 marks)

(b) $230 - 11.5 = 218.5 \text{ V}$

(2 marks)
ER 53(3)(b)

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

AS/NZS 3000: 3.8.1
(2 marks)

(d) Any TWO of:

- Provided with adequate mechanical protection to prevent damage.
AS/NZS 3000: 3.9.4.6
- Provided with earthed metallic armouring, screen, covering or enclosure.
AS/NZS 3000: 3.9.4.6
- Protected by an RCD with a maximum rated residual current of 30 mA.
AS/NZS 3000: 3.9.4.6
- Provided by the mechanical characteristics of the wiring system.
AS/NZS 3000: 3.3.7
- Provided by the location selected.
AS/NZS 3000: 3.3.7
- Provided by the provision of additional local or general mechanical protection.
AS/NZS 3000: 3.3.7
- Within a concrete or similar floor at a depth of less than 50 mm from any surface;
AS/NZS 3000: 3.9.4.2(a)
- Fixed in position below a timber or similarly fixed floor less than 50 mm from the underside of the floor.
AS/NZS 3000: 3.9.4.2(b)
- Pass through or are fixed in position within 50 mm of a ceiling fixing support;
AS/NZS 3000: 3.9.4.3(a)
- Are less than 50 mm from the surface of the ceiling material in contact with the fixing support.

- AS/NZS 3000: 3.9.4.3(b)
 - Steel conduits or other metallic tubing or conduit. AS/NZS 3000: 3.10.2.1(a)
 - Flexible metallic conduit. AS/NZS 3000: 3.10.2.1(b)
 - Rigid and flexible non-metallic conduit. AS/NZS 3000: 3.10.2.1(c)
 - Corrugated non-metallic conduit. AS/NZS 3000: 3.10.2.1(d)
 - Cable trunking with or without compound filling. AS/NZS 3000: 3.10.2.1(e)
 - Other wiring enclosures providing protection at least equivalent to those listed in Items (a) to (e). AS/NZS 3000: 3.10.2.1(f)
 - Precast concrete slabs having a thickness of not less than 40 mm and a classification of not less than grade 15 in accordance with AS 3600. AS/NZS 3000: 3.11.3.3(a)
 - Concrete slabs cast on site having a thickness of not less than 100 mm. AS/NZS 3000: 3.11.3.3(b)
 - A continuous concrete pour having a thickness of not less than 75 mm. AS/NZS 3000: 3.11.3.3(c)
 - Fibrous cement slabs having a thickness of not less than 12 mm. AS/NZS 3000: 3.11.3.3(d)
 - Bricks manufactured specifically for the protection of electric cables. AS/NZS 3000: 3.11.3.3(e)
 - Polymeric cable cover strip complying with AS 4702. AS/NZS 3000: 3.11.3.3(f)
 - Other materials which offer the same degree of protection afforded by the materials in Items (a) to (f). AS/NZS 3000: 3.11.3.3(g)
- (e) (i) 1 ohm AS/NZS 3760
2001: 2.3.3.1
2003: 2.3.3.1
(1 mark)
- (ii) 1 Megohm AS/NZS 3760
2001: 2.3.3.2
2003: Table 2
(1 mark)

Question 7

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

(ii) Any ONE of:

- MCBs
- HRC fuses
- Overcurrent protection
- RCBOs

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

Question 8

- (a) Certificate of compliance (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 (2 marks)
ER 37(3)

Question 9

(a) 1 ohm

AS/NZS 3760:2001: 2.3.3.1

AS/NZS 3760:2003: 2.3.3.1

(1 mark)

(b) 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.

(c) • Disconnect the protective earthing conductor from the security alarm panel and test

(1/2 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

(1/2 mark)

(d)

- | | |
|-------------|--------------------|
| (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)

(e) Two

(1 mark)

Question 10

(a) Any FOUR of:

- Continuity of the earthing system
- Insulation resistance
- Polarity
- Correct circuit connects
- Operation of RCDs

AS/NZS 3000: 6.3.3.1
(2 marks)

(b) Any TWO of:

- To ensure that the insulation resistance between all live conductors and earth is adequate.
- To ensure that the insulation resistance between all live parts and earth is adequate.
- Prevent electrical shock hazard from inadvertent contact.
- To prevent fire hazards from short circuits.
- To prevent equipment damage.

AS/NZS 3000: 6.3.3.3.1
(2 marks)

(c) 500 V d.c.

AS/NZS 3000: 6.3.3.3.1
(1 mark)

(d) Maintain its terminal voltage with +20%, -10% of the nominal open circuit terminal voltage.

(1 mark)

When measuring a resistance of 1 M Ω on the 500 V d.c. range or 10 M Ω on the 1000 V d.c. range.

(1 mark)

AS/NZS 3000: 6.3.3.3.1

(e) Any ONE of:

- To prevent the transposition of active and neutral conductors of the consumers mains or submains (with MEN connection at outbuilding or detached portion) resulting in the electrical installation earthing system becoming energized; and

AS/NZS 3000 : 6.3.3.4.1(a)

- To prevent combinations of incorrect active, neutral and earthing conductor connections resulting in the exposed conductive parts of the electrical installation becoming energized; and

AS/NZS 3000 : 6.3.3.4.1(b)

- To prevent the connection of switches in neutral conductors, resulting in parts of appliances, such as heating elements and lampholders, remaining energized when the switches are in the 'OFF' position.
AS/NZS 3000 : 6.3.3.4.1(c)
 - To ensure protective earthing conductors do not normally carry current.
AS/NZS 3000 : 6.3.3.5(a)
 - To ensure no short circuit exists, because a short-circuit current flowing between live conductors and through part of the earthing system can cause considerable fire damage or personal injury, particularly in high current locations.
AS/NZS 3000 : 6.3.3.5(b)
- (f)
- 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.
 - Will ensure that electrical equipment parts that are earthed do not reach dangerous voltages when earth faults occur.
- (2 marks)
AS/NZS 3000: 6.3.3.2.1