

ES10 – Security Theory/Regulations Answer Schedule

- Notes:
- (1 mark) means that the preceding statement/answer earns 1 mark.
 - This schedule sets out the accepted answers to the examination questions. A 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
 - Those parts of an answer that are under-lined indicate the parts required to be covered by a candidate.

Question 1

(a) Any ONE of:

- The neutral ensures a low impedance fault loop on an earth fault.
- To ensure the protection will operate in the event of a fault.
- Limits the voltage to 230 V to earth.
- Mass of earth provides an alternative return path for the current if neutral is lost.
- Limit the potential to earth under fault conditions.
- To ensure the ground surrounding an installation is at the same potential as earthed metal

(2 marks)

(b) Any TWO of:

- Thermal or bi-metal strips
- Magnetic
- Combined thermal/magnetic

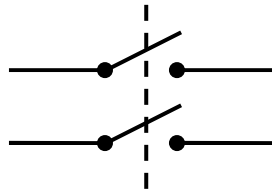
(2 marks)

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



(1 mark)

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



(1 mark)

(d) Any ONE of:

- For protecting people against electric shock that could cause injury or death.
- Disconnect the supply if any earth fault occurs.

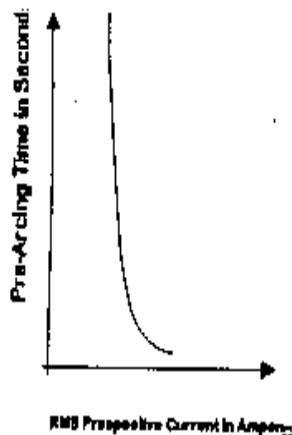
(2 marks)

(e) A certificate of compliance

(2 marks)

Question 2

- (a) • When a fault occurs the protective device ("minor" device) nearest the fault operates.
• Before any other protective device ("major" device). (2 marks)
- (b) 60A The maximum current the fuse can safely carry continuously
440V The maximum voltage the fuse can safely interrupt.
AC40 This indicates the maximum fault current the fuse can safely interrupt. (3 marks)
- (c) When a protective device cannot withstand the prospective short circuit current, it must be backed-up by a device which can. (2 marks)
- (d) As current through a fuse or circuit breaker increases beyond its current rating, the time taken to operate decreases. (2 marks)
- (e)



(1 mark)

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) 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 short-circuit 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.

(2 marks)

(c) (i) Small overload: A small overload:

- causes a bi-metal to heat up and bend,
- operating a trip mechanism that

(1 mark)

disconnects the circuit

(1 mark)

(ii) Short circuit. A larger overload:

- causes a strong magnetic field
- which attracts a trip mechanism

(1 mark)

that disconnects the circuit rapidly

(1 mark)

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.
- Ensure correct range is selected on the instrument.
- Ensure leads are correctly connected.

(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

(2 marks)

Switched off means that the electricity ceases to be supplied to the appliance

(1 mark)

(d) The fuse could blow for no apparent reason when the circuit is carrying much less than full-load current (that is, nuisance tripping).

(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) (i) Effectively connected to the general mass of Earth
(1 mark)

(ii) In relation to fittings or electrical appliances, means that the fittings or appliances are deliberately disconnected from any source of electricity.
(1 mark)
ER2

(c) Any colour except Black, Light Blue, Green or Green/Yellow.
AS/NZS 3000: 3.8.1 and Table 3.5
(2 marks)

(d) Circuits including submains and final subcircuits supplying fixed or stationary equipment.
AS/NZS 3000: 1.7.4.3.4(b)
(2 marks)

(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.
- Where all points on a new final subcircuit are protected by an RCD installed at the first point of that new final subcircuit.
- Where a socket outlet or connecting device is installed in accordance with clause 4.11(c) for the connection of fixed or stationary cooking appliances.

AS/NZS 3000: 2.5.3.4
AS/NZS 3000: 2.5.3.1
(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) • Insulation, in accordance with Clause 1.7.3.3.
• Barriers or enclosures, in accordance with Clause 1.7.3.4.
• Obstacles, in accordance with Clause 1.7.3.5.
• Placing out of reach, in accordance with Clause 1.7.3.6.

AS/NZS 3000: 1.7.3.2
(4 marks)

(b) Any TWO of:

- IPXXB
- IP2X.
- IP4X for horizontal top surfaces that are readily accessible.

AS/NZS 3000: 1.7.3.4.1
(2 mark)

- (c) • The use of a key or tool
• An interlocking device is fitted
• An intermediate barrier is provided

AS/NZS 3000: 1.7.3.4.3
(3 marks)

(d) Three

(1 mark)

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) The method has to show:

- The checking of the terminations.

(1 mark)

- The checking of the cord.

(1 mark)

- Retesting the appliance.

(1 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) Lodge a written complaint with the Registrar (2 marks)
EA 119

(b) Any TWO of:

- Remove name from register
- Suspend the registration
- Restricted to such work as the Board may specify
- Restricted to work only on approved premises
- Restricted to work only in the employ of an approved employer
- Impose a fine
- Censure
- Take no action (make no order)

EA 127(2)
(2 marks)

(c) (i) Practising licence

EA 95
(1 mark)

(ii) The Registrar

EA 96(1)
(1 mark)

(iii) When the holder ceases to be registered.

(2 marks)
EA 138

(d) That consists of or includes loss of consciousness

or

That necessitates the person suffering the injury

(i) Being admitted to hospital

(ii) Receiving medical treatment from a health care professional

(2 marks)
EA 16(2)(a)(b)