

## ES7 – Security Theory/Regulations Answer Schedule

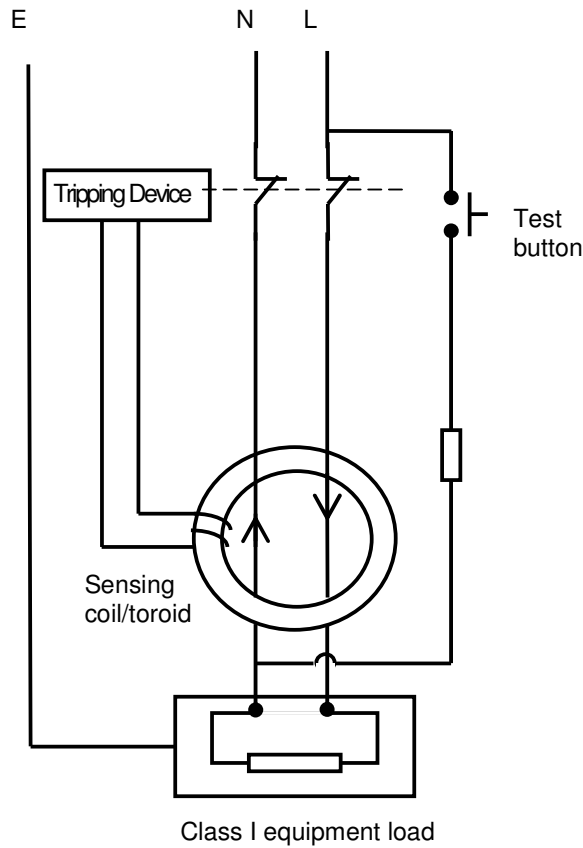
- Notes:
- (1 mark) means that the preceding statement/answer earns 1 mark.
  - This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.
  - Symbols 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) As the current increases the time taken to operate decreases. (2 marks)
- (b) 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)
- (c) Any TWO of:
- Don't energise circuit until all connections are completed
  - Keep clearance between instrument clips, leads and probes
  - Avoid contact with live conductors or earth or earthed metal when the circuit is live
  - Set instruments on correct scale prior to connection
  - Correct category of instrument is used
  - Personal protective equipment is used
- (2 marks)
- (d) 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)
- (e) Any TWO of:
- Fire hazard.
  - Flash-burns.
  - Explosion.
- (2 marks)

**Question 2**

(a)



- Correctly connected test circuit and resistance (1 mark)
  - Correctly connected sensing coil/toroid (1 mark)
  - Correctly connected phase, neutral and earth. (1 mark)
  - Correctly connected tripping circuit (1 mark)
- (b)
- 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, opening the RCD contacts (1 mark)
- (c)
- PRCD      **P**ortable **R**esidual **C**urrent **D**evice. (1 mark)
- RCBO      **R**esidual Current-Operated **C**ircuit **B**reaker with **O**vercurrent Protection (1 mark)

### Question 3

- (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) Any FOUR of:
- Identify
  - Isolate
  - Test
  - Tag
  - Lock out
- (4 marks)

#### Question 4

- (a) (i) The maximum current that a fuse-link will carry continuously without deterioration or operating.

OR

The maximum level of overcurrent protection for the circuit

(2 marks)

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

=  $\frac{67.5}{1.5}$

= 45 A

(1 mark)

- (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.

(2 marks)

(d) Any THREE 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.
- Alters protection characteristics – changes Utilisation category

(3 marks)

### 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 plug and the switchboard earth bar (1 mark)
  - Meter: Ohmmeter capable of accurately reading values of 1 ohm or less (½ mark)
  - Maximum reading:  $0.5\Omega$   
or  
Low enough to operate the protective device (½ mark)
- (ii) Insulation Resistance
- Test between all conductors (1 mark)
  - Meter: Insulation resistance tester 500V d.c. (½ mark)
  - Minimum reading  $1M\Omega$  (½ mark)
- (iii) Polarity  
Check visually and with instruments that all phase conductors are switched and that all conductors go to the correct terminals (2 marks)
- (iv) Visual check  
Any FOUR of:
- No access to live parts without the use of a tool
  - Covers are all on
  - Connections are tight
  - Correct colour code
- Any other reasonable answers (2 marks)

## Question 6

(a) 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.

AS/NZS 3000: 2.5.3.4  
(2 marks)

(b) Red and any colour except Black, Light Blue, Green or Green/Yellow.

AS/NZS 3000: 3.8.1  
AS/NZS 3000: Table 3.5  
(2 marks)

(c) 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)

(d)  $230 - 11.5 = 218.5 \text{ V}$  ( $230 \times 5\% = 11.5\text{V}$ )

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

(e) A and C

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

## Question 7

- (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 M $\Omega$  the 500 V range or 10 M $\Omega$  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.
  - Will 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  
(1 mark)

### Question 8

- (a)
- Insulation.
  - Barriers or enclosures.
  - Obstacles.
  - Placing out of reach.

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: 1.7.3.4.2  
(3 marks)

- (d) Two

(1 mark)

### 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 (2 marks)  
ER 37(3)

**Question 10**

(a) AS: /NZS 3760

(1 mark)

(b)

Type of test	(i) Type of instrument required	(ii) Test result
<b>Earthing continuity</b>	<i>Ohmmeter capable of accurately reading values of 1 ohm or less</i>	<i>Max 1 ohm resistance</i>
<b>Insulation resistance test</b>	<i>Insulation resistance tester</i>	<i>min 1 Mohm</i>  <i>or</i>  <i>5 mA leakage</i> <i>Class I equipment</i>  <i>Or</i>  <i>1 mA leakage</i> <i>Class II equipment</i>

AS/NZS 3760: Table 2  
(4 marks)

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

- Check for obvious damage or defects in the accessories, connectors, 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.

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, connectors or plugs and 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.

AS/NZS 3760: 2.3.2