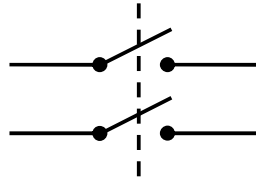


- (c) (i) **Single pole switch** shown in the **on** position.



(1 mark)

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



(1 mark)

- (d) Disconnect the supply if any circuit fault occurs.

(2 marks)

- (e) The MCB must be capable of withstanding the PSC at the switchboard on which it is installed.

(2 marks)

Question 2

(a) The protective device electrically nearest the fault operates, before any other protective device.

(2 marks)

(b) 10A Is the maximum current the fuse can continuously carry without deterioration.

(½ mark)

440V is the maximum voltage the fuse can withstand

(½ mark)

without flashover.

(½ mark)

AC40. 40,000AC is the maximum

(½ mark)

prospective short circuit current

(½ mark)

the fuse can safely interrupt

(½ mark)

(½ mark)

(c) Any TWO of:

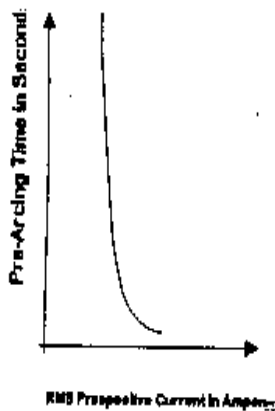
- Thermal or bi-metal strips
- Magnetic
- Combined thermal/magnetic

(1 mark)

(d) As current through a protective device increases, the time taken to operate decreases.

(2 marks)

(e)



(1 mark)

Question 3

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

OR

The maximum level of protection for the circuit

(2 marks)

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

$$= \frac{67.5}{1.5}$$

$$= 45 \text{ A}$$

(1 mark)

(b) • Join the phase and neutral together to avoid damage to electronic components during testing.

(1 mark)

• Test with a 250V d.c. insulation resistance tester from the appliance framework to phase and neutral.

(2 marks)

• The test reading must be greater than 1 M Ω .

(1 mark)

(c) 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 4

- (a) (i) Any meter that can accurately read values of 1 ohm or less. (1 mark)
- (ii) Measure the resistance between the earth pin and the exposed metal of the appliance frame. (2 marks)
- (iii) (1) 1 ohm (1 mark)
- (2) Maximum (1 mark)
- (b) The output voltage of the ohmmeter is insufficient to stress the insulation (2 marks)
- (c) • The supply and/or the appliance would be short-circuited. (2 marks)
- Meter protection would operate,
or
The circuit protection would operate.
or
A personal hazard – flash burns.
or
Meter and/or appliance components could be damaged. (1 mark)

Question 5

- (a) • Imbalance between the phase and neutral currents. (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) 30 milliamps (1 mark)
- (c) Because the RCD limits the time a current can flow through a body. (2 marks)
- (d) The RCCB does not provide overcurrent or short-circuit protection. (1 mark)
- (e) • Yes
- The PRCD will not reliven when supply is restored.
or
The device must be reset before use. (2 marks)

Question 6

- (a) (i) 1 ohm
AS/NZS 3760: 2.3.3.1 and/or Appendix A
- (ii) 1 Megohm
AS/NZS 3760: 2.3.3.2 and/or Appendix B
(2 marks)
- (b) Must only be used in, or with, any works, electrical installations or electrical appliances that operate at standard low voltage.
(2 marks)
ER 74(1)(a)
- (c) (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)
- (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(2)(d), (j)
(2 marks)

Question 7

- (a) (i) Certificate of compliance (CoC) ER 39(1)
(1 mark)
- (ii) Any ONE of:
- Within 1 day of the completion of the work
 - Within 1 day of the termination of the contract
- ER 39(5)
(1 mark)
- (iii) The owner of the fittings or the occupier of the premises ER 40(2)
(1 mark)
- (iv) Within 20 working days of completion ER 40(2)
(1 mark)
- (v) 3 years ER 40(4)
(1 mark)
- (vi) Copies of the certificate can be returned to the Board ER 40(5)
(1 mark)
- (vii) Any ONE of:
- A registered electrical inspector:
 - A registered line mechanic:
 - A qualified engineer:
 - A provisional licence holder:
 - A person authorised to certify the prescribed electrical work under an employer licence.
 - A registered electrician
- ER 39(4)
(1 mark)
- (b) (i) Section 6 of AS/NZS 3000 ER 37(3)
(1 mark)
- (ii) After the work is completed and before connection to the supply ER 37(3)
(2 marks)

Question 8

(a) AS/NZS 3760

(1 mark)

(b)

Type of test	(i) Type of instrument required	(ii) Test result
Earthing continuity	<i>Ohmmeter or other instrument with a low reading ohms scale</i>	<i>Max 1 ohm resistance</i>
Insulation resistance test	<i>Insulation resistance tester</i>	<i>1 Megohm</i>

(4 marks)

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

- Check for obvious damage or defects in the accessories, connectors, plugs or extension outlet sockets.
- Check that flexible cords are effectively anchored to equipment, plugs and cord extension sockets.
- 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.
- For portable outlet devices, check that the warning indicating the maximum load to be connected to the device is intact and legible.
- 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.
- Check that ventilation inlets and exhausts are unobstructed.

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, plugs or extension outlet sockets; and for discolouration that may indicate exposure to heat, chemicals and moisture.
- Check that flexible cords are effectively anchored to equipment, plugs and cord extension sockets.
- 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.
- For portable outlet devices (power boards), check that the warning indicating the maximum load to be connected to the device is intact and legible.
- 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.
- Check that ventilation inlets and exhausts are unobstructed.
- The pins of insulated pin plugs should be inspected for damage to the insulation of the pins, and, if fitted, the shroud on cord extension sockets.

AS/NZS 3760: 2.3.2
(5 marks)

Question 9

(a) (i) 1 ohm

AS/NZS 3760:2001: 2.3.3.1

AS/NZS 3760:2003: 2.3.3.1

(1 mark)

- (ii) • 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

or

- 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)

(b) • 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 tight, sound and clean.

(1 mark)

- Re-test the protective earthing conductor to ensure resistance is 1 Ω , or less

(½ mark)

(c)

- | | |
|-------------|----------------------------|
| (i) Red | (i) Brown |
| (ii) Black | (ii) Light Blue or
blue |
| (iii) Green | (iii) Green/Yellow |

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

Note: If candidates mix the colours, the answer is incorrect

(3 marks)

(d) Two

(1 mark)

Question 10

(a) Any FOUR of:

From AS/NZS 3000:2000: 6.3.3.1

- Continuity of the earthing system
- Insulation resistance
- Polarity
- Correct circuit connections

or

From AS/NZS 3000:2007: 8.3.3

- Continuity of the earthing system
- Insulation resistance
- Polarity
- Correct circuit connections
- Verification of impedance required for automatic disconnection of supply
- Operation of RCDs

(2 marks)

(b) To ensure that the insulation resistance between all live conductors and earth and all live parts and earth is adequate.

AS/NZS 3000:2000: 6.3.3.3.1

AS/NZS 3000:2007: 8.3.6.1

(2 marks)

(c) 500 V d.c.

AS/NZS 3000:2000: 6.3.3.3.1

AS/NZS 3000:2007: 8.3.6.1

(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.

AS/NZS 3000:2000: 6.3.3.3.1

AS/NZS 3000:2007: 8.3.6.1

(1 mark)

(e) Any ONE of:

From AS/NZS 3000:2000

- To ensure protective earthing conductors do not normally carry current.
AS/NZS 3000: 6.3.3.5.1(a)
- To ensure no short circuit exists
AS/NZS 3000: 6.3.3.5.1(b)
AS/NZS 3000: 6.3.3.4.1(a)
- To ensure no conductive parts become energised.
AS/NZS 3000: 6.3.3.5.2(b)
AS/NZS 3000: 6.3.3.4.1(b)
- To ensure there is no interconnection of conductors between different circuits
AS/NZS 3000: 6.3.3.4.1(b)
- To prevent the connection of switches in neutral conductors.
AS/NZS 3000: 6.3.3.4.1(c)

or

From AS/NZS 3000:2007: 8.3.8.1

- To ensure protective earthing conductors do not normally carry current.
 - To ensure no short circuit exists
 - To ensure there is no interconnection between circuits
- (1 mark)

- (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.
AS/NZS 3000:2000: 6.3.3.2.1
AS/NZS 3000:2007: 8.3.5.1
(2 marks)