



(d) Any ONE of:

- The neutral ensures a low impedance fault loop on an earth fault.
- The lower the resistance of the fault circuit, the higher the fault current and the more reliable the operation of protection equipment (fuses and circuit breakers).
- 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.
- If a phase to earth fault occurs the protection will operate.

(2 marks)

(e) Any ONE of:

- Earth leakage current in the circuit.
- Earth leakage current in the appliance.

(2 marks)

## Question 2

- (a) That the correct fuse has been identified.  
(accept any reasonable answer) (1 mark)
- (b) • Current (load)  
• Length of run or volt drop (2 marks)
- (c) (i) An appliance that has been isolated cannot be switched on accidentally (2 marks)
- (ii) Any ONE of:
- Attach a safety warning tag
  - Remove the plug
  - Use a locking device (1 mark)
- (d) Any FOUR of:
- Inspect instrument, clips, leads and probes to ensure they are in good condition.
  - Ensure correct range is selected on the instrument.
  - Ensure leads are correctly connected. (4 marks)

### Question 3

(a) (i) Danger Tag

Where there is a possibility of personal danger through someone turning on the electricity a Danger Tag must be fastened to the relevant isolating switch.

(2 marks)

(ii) Out-of-Service Tags

Where equipment is faulty or damaged and using that equipment would cause damage or injury an Out-of-Service Tag must be fastened to it.

(2 marks)

(iii) Any THREE of:

- Make sure the correct isolating switch is tagged.
- Make sure the switch is in the "OFF" position before it is tagged
- Fasten the Danger Tag securely so that it will not come off.
- Ensure your tag is fastened even though other may also be attached

(3 marks)

- (b)
- The test instrument is checked to be operating correctly on a known live source.
  - The equipment is tested to confirm (or otherwise) that it is isolated.
  - The test instrument is again checked on a known live source to ensure it still operates correctly.

(3 marks)

#### QUESTION 4

(a) (i) Fault current  $I = \frac{V}{R}$  (1/2 mark)

$$= \frac{230}{7}$$

(1/2 mark)

$$= 32.86A$$

(1 mark)

(ii) • The fusing current =  $10 \times 1.5 = 15A$  (1 mark)

• The fault current of 32.86 would operate the fuse. (1 mark)

(b) (i) Most of the internal wiring will be alive at 230V to earth with the switch in the "OFF" position. (2 marks)

(ii) Any FOUR of:

- The phase and neutral can be transposed at the plug on the flexible cord
- The phase and neutral can be transposed at the internal terminals in the appliance (other than at the switch)
- The phase and neutral can be transposed in an extension cord supplying the appliance.
- The phase and neutral can be transposed at the socket outlet supplying the appliance.
- Incorrect polarity at switchboard.

(4 marks)

### Question 5

- (a) A sustained overload (1 mark)
- (b)
- Current rating (1 mark)
  - Voltage rating (1 mark)
  - Category of duty (Rupturing Capacity) (1 mark)
  - Utilisation category (fusing factor) (Class) (1 mark)
- (c)
- 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, isolating the circuit (1 mark)
- (d) Portable Residual Current Device (1 mark)

## Question 6

(a) Any TWO of:

- Automatic disconnection of the supply in accordance with clause 1.7.4.3
- The use of Class II equipment of equivalent insulation, in accordance with clause 1.7.4.4
- Electrical separation in accordance with clause 1.7.4.5
- Protection may be provided by the use of separated extra-low voltage (SELV)
- Protection may be provided by the use of protected extra-low voltage (PELV)

AS/NZS 3000: 1.7.4.2

AS/NZS 3000: 1.7.2  
(2 marks)

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

AS/NZS 3000: 3.8.1  
AS/NZS 3000: Table 3.5  
(1 mark)

(ii) Green or Green/Yellow combination.

AS/NZS 3000: 3.8.1  
AS/NZS 3000: Table 3.5  
(1 mark)

(c) Any TWO of:

- Fittings that in normal use, or in the event of abnormal operation, function unsafely so as to cause danger to persons, property, or animals.

ER76A (1)(a)

- Fittings that have inadequate protection against direct contact or indirect contact.

ER76A (1)(b)

- Fittings that have unearthed conductive parts separated from live parts only by basic insulation.

ER76A (1)(c)

- Fittings that are installed in such a way that any designed cooling conditions are impaired.

ER87(1)(d)

- Fittings which cause or are subject to high temperatures or electric arcs are placed in such a position or are unguarded so as to create a risk of ignition of flammable materials or of injury to persons or damage to property.

ER87(1)(e)

- Cables, including underground cables, are not adequately protected against the risk of damage by nature of their covering or their method of installation.

ER87(1)(f)

- Cables are bent beyond their design criteria.

ER87(1)(g)

(2 marks)

(d) Items of apparel and equipment worn by a person that are intended either to prevent the occurrence of harm to the person or to minimise any harm that may occur from hazards that are present in the workplace or hazards that may arise in the course of work

ER 2

(2 marks)

(e) The cords must be of a heavy duty type or a non-heavy duty type installed in a suitable wiring enclosure.

AS/NZS 3000: 3.9.8.4

(2 marks)

## Question 7

- (a) (i) A practising licence  
EA 95(1)  
(1 mark)
- (ii) 30 June.  
(also accept 1 July)  
EA 100  
(1 mark)
- (iii) The Registrar  
100(4)  
(1 mark)
- (b) 1 year  
GK  
(1 mark)
- (c) Any TWO of:
- Registered line mechanics
  - Registered electrical inspectors
  - Persons who are authorised to carry out such work under a provisional licence
  - Trainees
  - Qualified engineers
- EA 108 (2)  
(2 marks)

(d) Any TWO of:

- The appliance is fixed wired and connected through a continuous flexible cord to a supply of electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts:  
ER 77(3)(a)
- The appliance is supplied with electricity from a safety extra-low voltage source:  
ER 77(3)(b)
- The appliance is double-insulated and is supplied with electricity through a residual current device.  
ER 77(3)(c)
- The appliance is supplied with electricity from a monitored earth circuit where the supply to the appliance is automatically disconnected if the earth to the appliance is broken or disconnected:  
ER 77(4)(b)
- The appliance is supplied with electricity from a source connected to earth so that the voltage to earth will not be greater than 55 volts a.c.:  
ER 77(4)(c)
- The appliance is supplied with electricity through a residual current device:  
ER 77(4)(d)
- The appliance is supplied with electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts  
ER 77(4)(e)
- The appliance is double insulated.  
ER 77(4)(f)  
(4 marks)

### Question 8

(a) AS: /NZS 3760

**ER 38(3)**  
(1 mark)

(b)

<b>(i) Type of test</b>	<b>(ii) Type of instrument</b>	<b>(iii) Test result</b>
Protective conductor continuity	Meter that will accurately read values of less than 1 ohm	1 ohm - maximum
Insulation resistance test	Insulation resistance tester	1 Megohm - minimum

- 1 mark for column (i)
- 1 mark for column (ii)
- 2 marks for column (iii)

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 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 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

## Question 9

- (a) • Visual check  
AS/NZS 3000: 6.2.1
- Continuity of the earthing system
  - Insulation resistance
  - Correct circuit connections or polarity
- AS/NZS 3000: 6.3.3.1  
(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: 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 $\Omega$  on the 500 V d.c. range or 10 M $\Omega$  on the 1000 V d.c. range.  
(1 mark)  
AS/NZS 3000: 6.3.3.3.1
- (e) Any ONE of:
- 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)  
(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 6.3.3.2.1  
(2 marks)

## Question 10

- (a) (1) Safe working practices appropriate to the work being undertaken.  
(2) Testing to ensure safety before/during and after completion of the work.  
(3) Basic first aid  
(4) CPR

ER 26(2)  
(2 marks)

- (b) At intervals not exceeding 24 months.

ER 26(3)  
(2 marks)

- (c) Must take all practicable steps to:
- Ensure employees are competent to do the work
  - or
  - Are under the supervision of a person competent to do that work

ER 25(3)  
(2 marks)

- (d) The owner or occupier of the property and the Secretary of Commerce

ER 50  
(2 marks)

- (e) Any TWO of:

- The name of the person so notifying and the place at which that person may be contacted (including where possible a telephone number and facsimile number):
- The place, date, and time of the accident:
- A complete description of the accident:
- A description of any injuries, damage, or losses resulting from the accident:
- Where known, the names and contact information of any witness, investigator at the scene, or other person who could provide cogent information on the accident:
- Possible causative factors (if any are known):
- Any resuscitation applied, including the method, the length of time applied, the reason for discontinuing, and the person that applied the resuscitation:
- Any associated equipment involved, including the type, whether or not it operated correctly, and any reasons why it did not operate correctly:
- The condition of the associated equipment involved, including its age:
- Where known, the name, age, sex, occupation, and residential address of the victim.

ER 106(1)  
(2 marks)