



- (e) Any TWO of:
- By the words "double insulation".
  - By the international symbol for double insulated equipment – a square within a square.
  - By the words "Class II".
- (2 marks)
- (f) To disconnect a large fault current safely.
- (2 marks)
- (g) Any TWO of:
- An isolating transformer
  - An RCD affording personal protection
  - Monitored earth unit.
- (2 marks)
- (h) Any TWO of
- The wiring is wrongly installed.
  - The wrong isolating switch has been operated.
  - The isolating switch is damaged or faulty
  - The appliance is supplied from two sources.
- (2 marks)
- (i) A thermostat switch has contacts that open or close when a pre-set temperature is reached.
- (2 marks)
- (j) Any TWO of:
- Voltage applied.
  - Current level .
  - Contact duration.
  - Skin dryness/dampness
  - Current path.
  - Physical condition
- (2 marks)

## Question 2

(a) (i) 1 ohm.

(1 mark)

(ii) Any TWO of:

- It establishes low resistance path of no greater than 1 ohm.
- It ensures that the appliance frame is held at 0 V and no shock hazard exists.
- It ensures that the protection will operate.

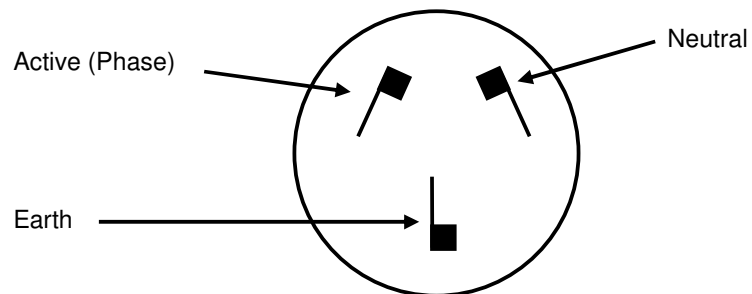
(2 marks)

(b) So that the earth pin:

- Is first to make contact when inserted,
- And the last to break contact when the plug is withdrawn,

(2 marks)

(c)



(3 marks)

(d) A nominal voltage of 230 volts a.c. between phase and neutral.

ER 2  
(2 marks)

### Question 3

- (a)
- Some current is diverted to earth (1 mark)
  - This causes an imbalance between phase and neutral currents (1 mark)
  - Which is detected by the sensing coil (1 mark)
  - Which trips and disconnects the supply to the load (1 mark)

(b) RCD

Any ONE of:

- To ensure the trip mechanism operates.
- To ensure the RCD can detect a current imbalance and trip the RCD

PRCD

Any ONE of:

- To ensure the trip mechanism operates.
- To ensure the RCD can detect a current imbalance and trip the RCD
- To ensure PRCD does not remain in the "on" position after loss of supply.

(1 mark)

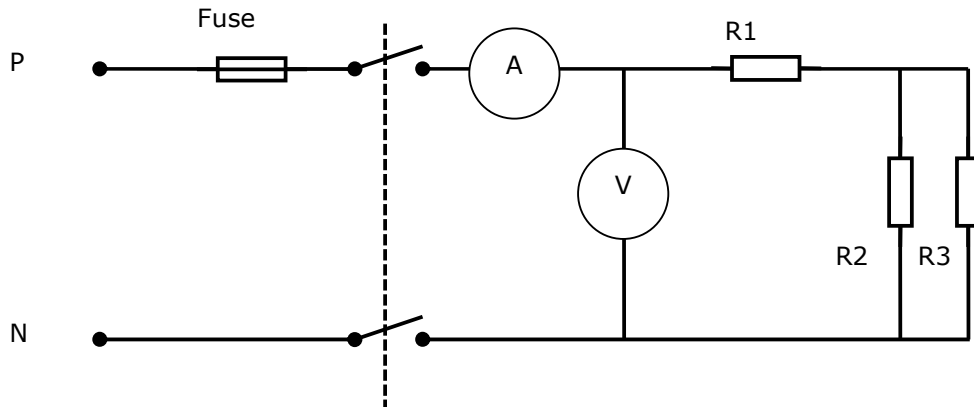
- (c)
- A breakdown in insulation
  - Results in a leakage current to earth
  - RCD will operate rapidly
  - Minimising shock level.
- (4 marks)

- (d) 30 mA
- (1 mark)

Fuse

### Question 4

(a)



- Correct polarity (1/2 mark)
- Correctly connected fuse (1/2 mark)
- Correctly connected switch (1/2 mark)
- Correctly connected voltmeter (1/2 mark)
- Correctly connected ammeter (1/2 mark)
- Correctly connected resistors. (1/2 mark)

$$(b) \frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3} \quad (1/2 \text{ mark})$$

$$\frac{1}{R_p} = \frac{1}{50} + \frac{1}{75} \quad (1/2 \text{ mark})$$

$$= \frac{5}{150} \quad (1/2 \text{ mark})$$

$$R_p = 30\Omega \quad (1/2 \text{ mark})$$

$$R_t = 100 + 30 = 130 \Omega \quad (1 \text{ mark})$$

$$I = \frac{V}{R} \quad (1/2 \text{ mark})$$

$$= \frac{230}{130}$$

$$= 1.77\text{A}$$

(½ mark)

(1 mark)

(c)  $W = V \times A$

(½ mark)

$$= 230 \times 1.77$$

(½ mark)

$$= 407.1\text{W}$$

(1 mark)

### Question 5

(a) (i) Just enough to terminate the bare wire securely in the connection or termination.

(1 mark)

- (ii) • Minimise the risk of shock.  
• Minimise the risk of short-circuit and earth faults.

(2 marks)

(b) (i) (A) Three.

(1 mark)

(B)

<b>Polarity</b>	<b>Colour</b>	<b>Alternate</b>
Phase	Brown	Red
Neutral	Blue/light blue	Black
Earth	Green/Yellow	Green

(3 marks)

(ii) (A) Two.

(1 mark)

(B)

<b>Polarity</b>	<b>Colour</b>	<b>Alternate</b>
Phase	Brown	Red
Neutral	Blue/light blue	Black

(2 marks)

## Question 6

(a) The method has to show:

- Identification of the fuse on the switchboard for the appliance. (1 mark)
- Switching off the main switch and removing fuse carrier.

or

Removing the load from circuit and removing fuse carrier (1 mark)

- Attaching a Danger tag. (1 mark)
- Testing for isolation at the supply side of the permanent connect unit using the prove-test-prove method. (2 marks)

(b) • Go through the isolation procedure as in (a) above. (1 mark)

- Re-testing for isolation using the prove test prove method as per (b) above. (2 marks)

(c) • Ensure the permanent connection unit cover is securely fixed in place to prevent access to live parts. (1 mark)

- Replace danger tag with an out of service tag. (1 mark)

## Question 7

- (a) (i) • Visual inspection (1 mark)
- All equipment shall be visually inspected and physically checked in accordance with Clause 2.3.2 AS/NZS 3760:2001: 2.3.1
- or
- An external inspection of the equipment and connecting facilities (e.g., supply flexible cord) AS/NZS 3760:2001: 2.3.1(a) (1 mark)

### (ii) Test No.1

- (1) Protective earthing conductor (earth continuity) test AS/NZS 3760: 2001: 2.3.3.1 AS/NZS 3760: 2003: 2.3.3.1 (1 mark)
- (2) Meter that can accurately read values of 1 ohm or less (1 mark)
- (3) Maximum 1 ohm AS/NZS 3760: 2001: 2.3.3.1 AS/NZS 3760: 2003: 2.3.3.1 (1 mark)

### Test No.2

- (1) Insulation resistance test. AS/NZS 3760: 2001: 2.3.3.2 (1 mark)
- (2) Insulation resistance tester AS/NZS 3760: 2001: 2.3.3.2 AS/NZS 3760: 2001: 2.3.3.2(b) (1 mark)
- (3) Not less than 1 Mohm AS/NZS 3760: 2001: 2.3.3.2(a) AS/NZS 3760: 2003: Table 2 (1 mark)

or

- (1) Insulation resistance test. AS/NZS 3760: 2001: 2.3.3.2 AS/NZS 3760: 2003: 2.3.3.2 (1 mark)
- (2) Leakage current tester AS/NZS 3760:2001: 2.3.3.2 (1 mark)
- (3) Not greater than 5mA

AS/NZS 3760: 2001: 2.3.3.2(a)  
AS/NZS 3760: 2003: Table 1  
(1 mark)

(b) (1) Withdrawn from service immediately, have a label attached to it warning against further use; and  
(1 mark)

(2) Sent for repair, disposal or destruction by an authorized repair agent or service personnel.  
(1 mark)

AS/NZS 3760: 2001: 2.4.1

### Question 8

- Carry out the protective earthing conductor test first. (1 mark)  
To ensure that the protective earthing conductor resistance is low (or 1 ohm or below) so no false insulation resistance test reading is obtained. (2 marks)
- Protective earthing conductor test
  - Use an ohmmeter or other instrument that can read values of less than 1 ohm (1 mark)
  - Test between the earth pin of the plug and the frame of the appliance (1 mark)
  - The acceptable test result is 1 ohm - maximum. (1 mark)
- Insulation resistance test
  - Use an insulation resistance tester (1 mark)
  - A test voltage of 500v d.c. (1 mark)
  - Test between phase/neutral and earth (1 mark)
  - The acceptable test result is 1 M $\Omega$ , minimum (1 mark)

## Question 9

(a) (i) Any ONE of:

- International Protection Code
- Ingress Protection
- A coding system to indicate the degree of protection provided by the enclosure against access to live parts from solid objects, or the ingress of water or other liquids  
AS 1939 supplement 1 – 1990
- Degrees of protection of electrical equipment  
AS 60529  
(2 marks)

(ii) Any ONE of:

- The degree of protection of persons against live or moving parts inside the enclosure  
And protection of the fitting against ingress of solid foreign bodies  
AS 1939 supplement 1 – 1990
- The degree of protection against solid objects
- Protection of persons against access to hazardous parts.  
AS/NZS 3000: 1.4.58
- Protection against solid objects  
AS 60529  
(2 marks)

(iii) Any ONE of:

- Protection of equipment from the harmful ingress of water  
AS 1939 supplement 1 – 1990
- Protection against the entry of water with harmful effects.  
AS/NZS 3000: 1.4.58
- Protection against liquids objects  
AS 60529  
(2 marks)

(b) (i) Number 3

Any ONE of:

- Protection of persons holding tools or wires (larger than 2.5 mm diameter) and protection of equipment against objects larger than 1 mm  
AS/NZS 3000: 1.4.58
- Protected against solid objects over 2.5 mm  
AS 60529  
(1 mark)

(ii) Number 4

Any ONE of:

- Protection against splashing and spraying water from all practicable directions  
AS/NZS 3000: 1.4.58
- Protected against water sprayed from all directions – limited ingress permitted

AS 60529  
(1 mark)

(c) A **damp situation** is a situation in which moisture is either permanently or intermittently present to such an extent as would be likely to impair the effectiveness or safety of an electrical installation.

AS/NZS 3000: 1.4.37  
(2 marks)

## Section 3 – Gasfitters Only

### Question 10

(a) (i) Just enough to terminate the bare wire securely in the connection or termination.

(1 mark)

- (ii) • Minimise the risk of shock.  
• Minimise the risk of short-circuit and earth faults.

(2 marks)

(b) (i) (A) Three.

(1 mark)

(B)

<b>Polarity</b>	<b>Colour</b>	<b>Alternate</b>
Phase	Brown	Red
Neutral	Blue/light blue	Black
Earth	Green/Yellow	Green

(3 marks)

(ii) (A) Two.

(1 mark)

(B)

<b>Polarity</b>	<b>Colour</b>	<b>Alternate</b>
Phase	Brown	Red
Neutral	Blue/light blue	Black

(2 marks)

## Question 11

- (a) (i) • Visual inspection (1 mark)
- All equipment shall be visually inspected and physically checked in accordance with Clause 2.3.2 AS/NZS 3760:2001: 2.3.1
- or
- An external inspection of the equipment and connecting facilities (e.g., supply flexible cord) AS/NZS 3760:2001: 2.3.1(a) (1 mark)

### (ii) Test No.1

- (1) Protective earthing conductor (earth continuity) test AS/NZS 3760: 2001: 2.3.3.1 AS/NZS 3760: 2003: 2.3.3.1 (1 mark)
- (2) Meter that can accurately read values of 1 ohm or less (1 mark)
- (3) Maximum 1 ohm AS/NZS 3760: 2001: 2.3.3.1 AS/NZS 3760: 2003: 2.3.3.1 (1 mark)

### Test No.2

- (1) Insulation resistance test. AS/NZS 3760: 2001: 2.3.3.2 (1 mark)
- (2) Insulation resistance tester AS/NZS 3760: 2001: 2.3.3.2 AS/NZS 3760: 2001: 2.3.3.2(b) (1 mark)
- (3) Not less than 1 Mohm AS/NZS 3760: 2001: 2.3.3.2(a) AS/NZS 3760: 2003: Table 2 (1 mark)

or

- (1) Insulation resistance test. AS/NZS 3760: 2001: 2.3.3.2 AS/NZS 3760: 2003: 2.3.3.2 (1 mark)
- (2) Leakage current tester AS/NZS 3760:2001: 2.3.3.2 (1 mark)
- (3) Not greater than 5mA

AS/NZS 3760: 2001: 2.3.3.2(a)  
AS/NZS 3760: 2003: Table 1  
(1 mark)

(b) (1) Withdrawn from service immediately, have a label attached to it warning against further use; and  
(1 mark)

(2) Sent for repair, disposal or destruction by an authorized repair agent or service personnel.  
(1 mark)

AS/NZS 3760: 2001: 2.4.1

## Question 12

- Carry out the protective earthing conductor test first. (1 mark)  
To ensure that the protective earthing conductor resistance is low (or 1 ohm or below) so no false insulation resistance test reading is obtained. (2 marks)
- Protective earthing conductor test
  - Use an ohmmeter or other instrument that can read values of less than 1 ohm (1 mark)
  - Test between the earth pin of the plug and the frame of the appliance (1 mark)
  - The acceptable test result is 1 ohm - maximum. (1 mark)
- Insulation resistance test
  - Use an insulation resistance tester (1 mark)
  - A test voltage of 500v d.c. (1 mark)
  - Test between phase/neutral and earth (1 mark)
  - The acceptable test result is 1 M $\Omega$ , minimum (1 mark)

### Question 13

- (a) (i) To ensure the highest standard of safety for electrical workers and others. (2 marks)
- (ii)
- Each tradesperson applies own tag. (1 mark)
  - Only that tradesperson can remove their own tag. (1 mark)
  - A supervisor may remove a tag if special circumstances warrant it and it is safe to do so. (1 mark)
- (b) (i)
- To ensure that the test instrument is operating correctly. (1 mark)
  - To ensure that the correct circuit has been isolated before it is worked on. (1 mark)
- (ii)
- First - prove the meter is operating correctly on a known live circuit. (1 mark)
  - Then - test that the isolated circuit shows no voltage present. (1 mark)
  - Then - again prove the meter is operating correctly on a known live circuit. (1 mark)

### Question 14

- (a) (i) • The motor will operate normally (1 mark)  
• The motor circuitry could be live whilst switched off (1 mark)
- (ii) Any ONE of:
- The motor will operate normally (½ mark)
  - The protective earthing conductor is the wrong colour – potential hazard. (½ mark)
- (iii) • The motor will not operate (1 mark)  
• Its framework will be alive at 230V to earth  
An immediate and serious shock hazard exists.  
OR  
Could operate the protective device (2 marks)
- (iv) Any ONE of:
- Earth continuity test
  - Polarity test (1 mark)
- (b) Any THREE of:
- The wiring is damaged, faulty or wrongly installed.
  - The wrong isolating switch has been operated.
  - The isolating switch is damaged or faulty
  - The appliance is supplied from two sources, e.g., main and control supplies. (3 marks)