



(d) In respect of electricity supplied by either a single-phase MEN system or a multiple-phase MEN system, a nominal voltage of 230 volts a.c. between phase and neutral

ER 2  
(2 marks)

(e) Any **TWO** of:

- High electrical resistance or dielectric strength.
- Good flexibility.
- Non absorbent.
- Withstand mechanical stress.
- Withstand corrosive environments
- Withstand the ambient temperature.
- Withstand heat from the circuit conductors.
- Abrasion resistance.

(2 marks)

(f) • Safe Working Practices that are appropriate to the type of work being undertaken.  
• Testing to ensure safety before, during and after the completion of work.

ER 26  
(2 marks)

(g)  $W = \frac{V^2}{R}$

(1/2 mark)

$$= \frac{230 \times 230}{32}$$

(1/2 mark)

$$= 1653W$$

(1 mark)

(h) 415V is the maximum nominal circuit voltage of the circuit.  
AC 46 is the category of duty (i.e. 46,000A prospective short-circuit current).

(2 marks)

(i) There is no voltage between either of the secondary terminals and earth.

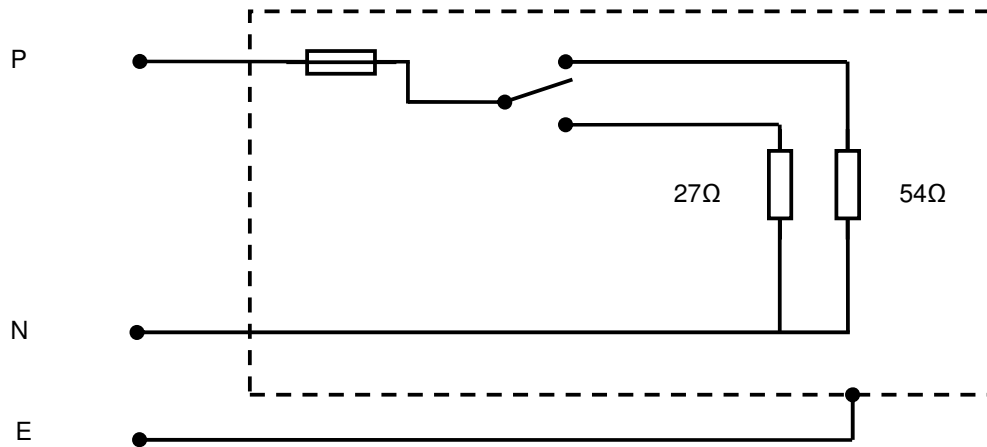
(2 marks)

(j) 1 ohm.

(2 marks)

## Question 2

(a)



- Correct polarity (1½ marks)
- The fuse is in the phase and protects all the heater components. (½ mark)
- The selector switch and resistors are connected so two different load settings can be achieved. (2 marks)
- Fully correct diagram (2 marks)

(b)  $W = \frac{V^2}{R}$  (½ mark)

$= \frac{230 \times 230}{27}$  (½ mark)

$= 1959.26W$  (1 mark)

(c)  $I = \frac{V}{R}$  (½ mark)

$= \frac{230}{54}$  (½ mark)

$= 4.26A$  (1 mark)

### Question 3

(a) (i) (A) Three.

(1 mark)

Brown	Red	Phase
Blue/light blue	Black	Neutral
Green/Yellow	Green	Earth

(3 marks)

(ii) (A) Two.

(1 mark)

(B)

Brown	Red	Phase
Blue/light blue	Black	Neutral

(2 marks)

(b) Any THREE of:

- Length of cord
- Cross-sectional area
- Number of cores
- Type of insulation or sheath
- Correct conductor colours

(3 marks)

#### Question 4

(a) The neutral and phase currents are balanced.

(1 mark)

(b) • There is an 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 and the RCD contacts open

(1 mark)

(c) RCD

• To ensure the tripping mechanism has not become stuck or "frozen"

or

• To ensure it works correctly (rapidly)

or

PRCD

• To ensure the tripping mechanism has not become stuck or "frozen"

or

• To ensure PRCD does not reset to the "on" position after supply is re-established.

(1 mark)

(d) (i) 300ms or 0.3 seconds

(1 mark)

(ii) 40ms or 0.04 seconds

(1 mark)

(e) PRCDs are voltage dependent to ensure that, when supply is lost:

• Portable or hand-held appliances do not automatically restart when supply is restored.

(1 mark)

• The PRCD has to be manually reset to establish the supply.

(1 mark)

## Section 2 - Plumbers Only

### Question 5

- (a) (i) The isolation method has to show:
- Identification of the correct MCB. (1 mark)
  - Prove-test-prove to ensure circuit is isolated. (2 marks)
  - Attaching a danger tag to MCB (1 mark)
- (ii) Ensure permanent connection unit is secured and there are no live terminals exposed (1 mark)
- (b) • There would be exposed live terminals in the fuse base.  
• The circuit can be easily relivened by inserting a fuse carrier in the fuse.  
• Don't need a tool to reliven. (3 marks)
- (c) Any TWO of:
- To prevent basic insulation being exposed
  - To prevent live terminals being exposed
  - To prevent access to moving parts
  - To prevent ingress of foreign matter or liquids (2 marks)

### Question 6

- (a) It is the maximum current that a flexible cord is designed to carry safely without overheating. (2 marks)
- (b) • The cord will overheat and cause a fire risk. (1 mark)
- The insulation deteriorates and breaks down (1 mark)
- (c) Any FOUR of:
- Number of cores required
  - Mechanical strength
  - Operating environment
  - Flexibility needed
  - Application temperature at point of entry to appliance
  - Colour coding
  - Voltage rating
  - Current rating
  - Length
  - Cross-sectional area
- (4 marks)
- (d) • Minimise the risk of shock.
- Minimise the risk of short-circuit. (2 marks)

## Question 7

- (a) • Protective earthing conductor test (½ mark)
- Any ONE of:
    - \* Any meter that can accurately read values of less than 1Ω.
    - \* An ohmmeter that is of Class 5 accuracy or better (½ mark)
  - 1Ω (½ mark)
  - Maximum (½ mark)  
AS/NZS 3760: 2001: 2.3.3.1  
AS/NZS 3760: 2003: 2.3.3.1
- Insulation resistance test (½ mark)
- Insulation resistance tester (½ mark)
  - 500 V d.c. (1 mark)
  - 1 MΩ (½ mark)
  - Minimum (½ mark)  
AS/NZS 3760: 2001: 2.3.3.2  
AS/NZS 3760: 2003: 2.3.3.2, Table 2
- (b) • Not less than 1 MΩ (½ mark)
- AS/NZS 3760: 2001: 2.3.3.3 or Appendix C3  
Or  
AS/NZS 3760: 2003: 2.3.3.3 (½ mark)
- (c) • To ensure that the control switch switches the active conductor.  
• The active pin on the plug is connected to the active terminal in the appliance  
• The neutral pin on the plug is connected to the neutral terminal in the appliance  
• The earth pin on the plug is connected to the frame of the appliance. (4 marks)

### Question 8

(a) The description must include:

- Use of an ohmmeter  
or  
A meter that can accurately read values of 1 ohm or less. (1 mark)
- Testing between the earth pin of the plug and the frame of the appliance. (1 mark)
- A test result of 1 ohm maximum. (1 mark)

(b) The description has to include:

- Use an insulation tester. (1 mark)
- A test voltage of 500V d.c. (1 mark)
- Bridging the phase and neutral (1 mark)
- Testing between the phase & neutral and the frame of the appliance. (1 mark)
- A test result of 1 M $\Omega$  minimum. (1 mark)

(c) The output voltage of the multimeter is insufficient to stress the insulation (1 mark)  
And detect any weaknesses (1 mark)

## Question 9

(a) (i) Any ONE of:

- 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 enclosure protection for electrical equipment  
AS 60529
- A degree of protection in accordance with AS 1939.  
AS/NZS 3000:2000: 1.4.58
- A degree of protection in accordance with AS 60529.  
AS/NZS 3000:2007: 1.4.61
- A degree of protection of an item of enclosed equipment is expressed as an IP (International Protection) rating in accordance with AS 60529.  
AS/NZS 3000:2007: G1  
(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
- Protection against solid objects  
AS 60529
- The degree of protection against solid objects
- Protection of persons against access to hazardous parts.  
AS/NZS 3000:2000: 1.4.58
- Protection of against ingress of solid objects.  
AS/NZS 3000:2007: Table G1(a)  
(2 marks)

(iii) Any ONE of:

- Protection of equipment against harmful ingress of water.  
AS 1939 supplement 1 – 1990
- Protection against liquids  
AS 60529
- A degree of protection against entry of water with harmful effects.  
AS/NZS 3000:2000: 1.4.58
- Protection of against harmful ingress of water.  
AS/NZS 3000:2007: Table G1(b)  
(2 marks)

(b) **3** Any ONE of:

- Protection of persons holding tools or wires (larger than 2.5 mm) and protection of equipment against objects larger than 2.5mm<sup>2</sup>.  
AS 1939 supplement 1
- Protected against solid objects over 2.5 mm (tools and small wires)  
AS 60529
- The access probe of 2.5 mm diameter shall not penetrate.  
AS/NZS 3000:2007: Table G1(a)  
(1 mark)

**4** Any ONE of:

- Protection against splashing and spraying water from all practicable directions.  
AS 1939 supplement 1
- Protection against water sprayed from all directions – limited ingress permitted.  
AS 60529
- Protection against water splashed from all directions. Limited ingress permitted.  
AS/NZS 3000:2007: Table G1(b)  
(1 mark)

(c) A situation in which moisture is either permanently present, or intermittently present to such an extent as would be likely to impair the effectiveness or safety of an electrical installation which complies with this Standard for ordinary situations.

AS/NZS 3000:2000 1.4.37  
AS/NZS 3000:2007 1.4.40  
(2 marks)

## Section 3 – Gasfitters Only

### Question 10

- (a) • The motor will operate normally (1 mark)
- The neutral would be switched (1 mark)
- The motor circuitry would be live when the isolating switch is in the "off" position. (1 mark)
- (b) The RCCB will trip as the PEC would carry the return current. (1 mark)
- (c) (1) The motor will not operate (1 mark)
- (2) - The MCB would not operate (1 mark)
- The frame of the motor will be live with the isolator in the "off" position (1 mark)
- The motor framework will be alive at 230V to earth (1 mark)
- (3) The MCB would trip only if there was a fortuitous connection between the frame of the motor and earth. (3 marks)

Note the answer is either (1) and (2) or (1) and (3)

- (d) Any TWO of:
- Earth continuity test
  - Polarity test
  - Insulation resistance test between the phase conductor and the motor frame.
- (2 marks)

### Question 11

- (a) It is the maximum current that a flexible cord is designed to carry safely without overheating. (2 marks)
- (b) • The cord will overheat and cause a fire risk. (1 mark)  
• The insulation deteriorates and breaks down (1 mark)
- (c) Any FOUR of:
- Number of cores required
  - Mechanical strength
  - Operating environment
  - Flexibility needed
  - Application temperature at point of entry to appliance
  - Colour coding
  - Voltage rating
  - Current rating
  - Length
  - Cross-sectional area
- (4 marks)
- (d) • Minimise the risk of shock.  
• Minimise the risk of short-circuit. (2 marks)

## Question 12

- (a) • Protective earthing conductor test (½ mark)
- Any ONE of:
    - \* Any meter that can accurately read values of less than 1Ω.
    - \* An ohmmeter that is of Class 5 accuracy or better (½ mark)
  - 1Ω (½ mark)
  - Maximum (½ mark)  
AS/NZS 3760: 2001: 2.3.3.1  
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- Insulation resistance test (½ mark)
- Insulation resistance tester (½ mark)
  - 500 V d.c. (1 mark)
  - 1 MΩ (½ mark)
  - Minimum (½ mark)  
AS/NZS 3760: 2001: 2.3.3.2  
AS/NZS 3760: 2003: 2.3.3.2, Table 2
- (b) • Not less than 1 MΩ (½ mark)
- AS/NZS 3760: 2001: 2.3.3.3 or Appendix C3  
Or  
AS/NZS 3760: 2003: 2.3.3.3 (½ mark)
- (c) • To ensure that the control switch switches the active conductor.  
• The active pin on the plug is connected to the active terminal in the appliance  
• The neutral pin on the plug is connected to the neutral terminal in the appliance  
• The earth pin on the plug is connected to the frame of the appliance. (4 marks)

### Question 13

(a) The description must include:

- Use of an ohmmeter  
or  
A meter that can accurately read values of 1 ohm or less. (1 mark)
- Testing between the earth pin of the plug and the frame of the appliance. (1 mark)
- A test result of 1 ohm maximum. (1 mark)

(b) The description has to include:

- Use an insulation tester. (1 mark)
- A test voltage of 500V d.c. (1 mark)
- Bridging the phase and neutral (1 mark)
- Testing between the phase & neutral and the frame of the appliance. (1 mark)
- A test result of 1 M $\Omega$  minimum. (1 mark)

(c) The output voltage of the multimeter is insufficient to stress the insulation (1 mark)  
And detect any weaknesses (1 mark)

### Question 14

- (a) (i)
  - That the test instrument functions correctly.
  - That the circuit to be worked on has been correctly isolated and is safe to work on. (2 marks)
- (ii)
  - Check that test instrument works correctly on a known live source. (1 mark)
  - Test for isolation (between all conductors) on the circuit being isolated. (1 mark)
  - Check again that test instrument works correctly on a known live source. (1 mark)
- (b) (i) To ensure an isolated circuit remains isolated until the person who attached the tag changes the status of the circuit. (1 mark)
- (ii)
  - Their name
  - The company (or department) they work for.
  - The date
  - The time (2 marks)
- (iii) In any situation where you need to ensure that the isolated equipment (or circuit) that you are working on remains isolated (2 marks)