

(e) A pressure switch has contacts that open or close when a pre-set pressure is reached. (2 marks)

(f) Any TWO of:

- An incorrect component has been connected in the appliance which increased the current.
 - The cross-sectional area of the flexible cord is too small.
 - The flexible cord is too long.
 - Fault in the appliance.
- (2 marks)

(g) The cross sectional area of the flexible cord conductors. (2 marks)

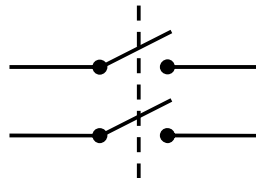
(h) A thermostat has contacts that open or close when the load reaches the pre-determined temperature. (2 marks)

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



(1 mark)

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



(1 mark)

(j) $I = \frac{W}{V}$ (1/2 mark)

$= \frac{2000}{230}$ (1/2 mark)

$= 8.7 \text{ amps}$ (1 mark)

Question 2

(a) Any ONE of:

- To protect the fixed wiring against excess current flow
- Safely interrupt and disconnect a faulty circuit

(2 marks)

(b) Any **FIVE** of :

- It will safely interrupt short circuit currents of much higher values or higher rupturing capacity.
- It eliminates arcing because the fuse element is sealed.
- It is obtainable in a range of Utilisation category (fusing factors).
- Current rating is clearly marked.
- Reliable operation within prescribed limits.
- Good discrimination.
- Constant fusing characteristics.
- Faster operation/acting.
- Doesn't deteriorate over time.

(5 marks)

(c) It is the maximum fault current that a fuse or circuit breaker can safely interrupt.

(2 marks)

(d)

- 45A is the current rating.
- 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).

(3 marks)

Question 3

(a) (i) (A) Three.

(1 mark)

(B)

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

(3 marks)

(i) (A) Two.

(1 mark)

(B)

Brown	Red	Phase
Blue/light blue	Black	Neutral

(2 marks)

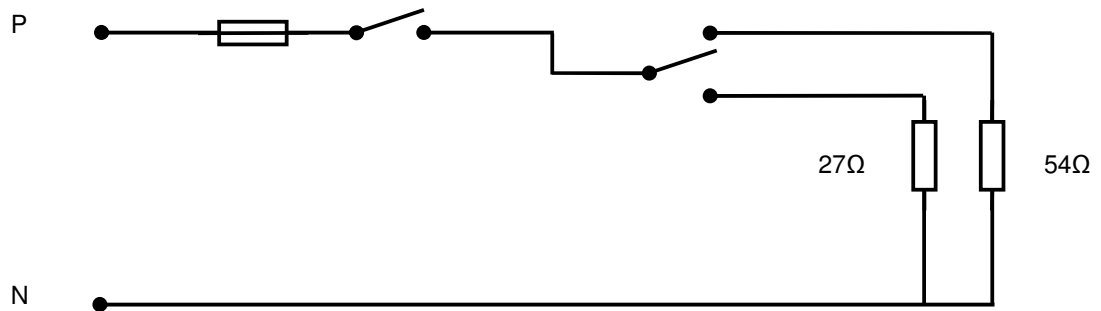
(b) Any THREE of:

- 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

(3 marks)

Question 4

(a)



- Correct polarity (1 mark)
- The fuse is in the phase and protects the whole circuit. (1 mark)
- The switch controls the whole circuit (except the fuse). (1 mark)
- The selector switch and resistors are connected so two different load settings can be achieved. (2 marks)

(b) $P = \frac{V^2}{R}$ (1/2 mark)

$= \frac{230 \times 230}{27}$ (1/2 mark)

$= 1960 \text{ W}$ (1 mark)

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

$= \frac{230}{27}$ (1/2 mark)

$= 8.5\text{A}$ (1 mark)

10A is the most suitable fuse (1 mark)

Section 2 - Plumbers Only

Question 5

- (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

- To ensure the tripping mechanism has not become stuck or "frozen"
- or
- To ensure it works correctly

or

PRCD

- To ensure the tripping mechanism has not become stuck or "frozen"
- or
- To ensure PRCD does not remain in the "on" position after loss of supply.

- (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)

Question 6

(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
- The degree of enclosure protection for electrical equipment
AS 60529
- A degree of protection in accordance with AS 1939.
AS/NZS 3000: 1.4.58
(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: 1.4.58
(2 marks)

(iii) Any ONE of:

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

(b) (i) Number 2
Any ONE of:

- Protection of fingers against access to hazardous parts, and protection of equipment against objects larger than 12.5 mm. (Note accept 12.5 mm² as this is how it is presented in some documents)
AS 1939 Supplement 1:1990
- Protection against solid objects up to 12 mm, e.g., fingers
IEC 60529
(1 mark)

(ii) Number 3
Any ONE of:

- Protection against spraying water at up to 60° from the vertical
AS 1939 Supplement 1:1990

- Protection against sprays to 60° from the vertical

IEC 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.

(2 marks)

Question 7

(a) The procedure has to cover:

- Identifying the correct fuse on the switchboard. (1 mark)
- Attaching a Danger tag to the circuit. (1 mark)
- Test for isolation at the supply side of the permanent connect unit using the prove-test-prove method. (2 marks)

(b) Repeat the procedure set out in (a) until the dishwasher is safely isolated (2 marks)

- (c)
- Ensure the permanent connection unit is securely fixed with no exposed live parts. (1 mark)
 - Replace danger tag with an out of service tag. (1 mark)

(d) Any TWO of:

- Insulation resistance test
 - Protective earthing conductor test
 - Polarity test
- (2 marks)

Question 8

(a) $I = \frac{W}{V}$ (½ mark)

$= \frac{3000}{230}$ (½ mark)

$= 13 \text{ amps.}$ (1 mark)

The permanent connection unit is not of an adequate rating to supply the 3000W element. (1 mark)

- (b) • Is the current rating of the thermostat adequate to handle the extra current drawn?
• Are the sub circuit cables of an adequate rating to supply the new element?
• Is the sub-circuit fuse of the appropriate rating? (3 marks)

(c) Any THREE 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.
- Check that ventilation inlets and exhausts are unobstructed.

AS/NZS 3760: 2.3.2
(3 marks)

Or

Any THREE of – from AS/NZS 3760:2003:

- Check for obvious damage or defects in the accessories or plugs.
- Check 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.
- 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.

AS/NZS 3760: 2.3.2
(3 marks)

(d) The person carrying out the repair/replacement.

(1 mark)

Question 9

- (a) (i) • Utilisation category (fusing factor) is the ratio of minimum fusing current to the current rating of the fuse.

alternatively this may be expressed as:

- Utilisation category (fusing factor) = $\frac{\text{Minimum Fusing Current}}{\text{Current Rating}}$ (2 marks)

- (ii) The lower the **Utilisation category (fusing factor)**, the less excess current is required to blow the fuse. (2 marks)

- (b) 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.
- (3 marks)

- (c) To ensure that the replacement fuse link will safely interrupt the prospective short-circuit current level for that circuit. (2 marks)

- (d) • To protect the fixed wiring against excess current flow
or
• Safely interrupt and disconnect a faulty circuit (1 mark)

Section 3 – Gasfitters Only

Question 10

(a) Any THREE of:

- TPS cable entering the switch with bare exposed basic insulation.
- Broken switch cover.
- Flexible conduit removed from its clamp.
- Cover off the element thermostat enclosure or not fitted.

(3 marks)

(b) Any TWO of:

- To prevent basic insulation from being exposed.
- To prevent the connections pulling away in the event of strain on the conduit.
- To prevent damage to cables.
- To prevent the earthing being compromised if the conduit is used as an earthing conductor

(2 marks)

(c) Any TWO of:

- 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.

(2 marks)

(d) Any THREE of:

- If covers are left off basic insulation will be exposed.
- If covers are left off live terminals will be exposed.
- If covers are left off moving parts will be exposed.
- If covers are unsecured access can be gained to live terminals.
- If covers are unsecured access can be gained to basic insulation.
- If covers are unsecured access can be gained to moving parts.

(3 marks)

Question 11

- (a)
- Use a meter that can accurately read values of less than 1 ohm. (1 mark)
 - Test between the earth pin of the plug and appliance. (1 mark)
 - To obtain an accurate reading choose a point that will provide a good connection to earth i.e. free from paint, corrosion etc. (1 mark)
 - Maximum acceptable value 1 ohm. (1 mark)
- (b)
- Use an insulation tester. (1 mark)
 - 500V d.c. test voltage. (1 mark)
 - Minimum acceptable value 1 M Ω . (1 mark)
 - Check meter operation. (1 mark)
 - Test between the phase & neutral and the frame of the appliance or the earth pin of the plug. (2 marks)

Question 12

(a) The procedure has to cover:

- Identifying the correct fuse on the switchboard. (1 mark)
- Attaching a Danger tag to the circuit. (1 mark)
- Testing for isolation at the supply side of the permanent connect unit using the prove-test-prove method. (2 marks)

(b) Repeat the procedure set out in (a) until the gas boiler is safely isolated (2 marks)

- (c) • Ensure the permanent connection unit is securely fixed with no exposed live parts. (1 mark)
- Replace danger tag with an out of service tag. (1 mark)

(d) Any TWO of:

- Insulation resistance test
 - Protective earthing conductor test
 - Polarity test
- (2 marks)

Question 13

- (a) (i) • Utilisation category (fusing factor) is the ratio of minimum fusing current to the current rating of the fuse.

alternatively this may be expressed as:

- Utilisation category (fusing factor) = $\frac{\text{Minimum Fusing Current}}{\text{Current Rating}}$ (2 marks)

- (ii) The lower the **Utilisation category (fusing factor)**, the less excess current is required to blow the fuse. (2 marks)

- (b) 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.
- (3 marks)

- (c) To ensure that the replacement fuse link will safely interrupt the prospective short-circuit current level for that circuit. (2 marks)

- (d) • To protect the fixed wiring against excess current flow
or
• Safely interrupt and disconnect a faulty circuit (1 mark)

Question 14

- (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

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

or

- To ensure it works correctly

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PRCD

- To ensure the tripping mechanism has not become stuck or "frozen"
- To ensure PRCD does not remain in the "on" position after loss of supply.

- (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)