

# TEWC 146 - TRADESPERSONS ELECTRICAL WORK CERTIFICATE MARKING SCHEDULE

- Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.
2. This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.
3. Symbols and terms - alternatives  
 Power W or P  
 Voltage V or E or U  
 Phase Active
4. Key to abbreviated terms:  
 EA Electricity Act 1992  
 ER Electricity Regulations 1997  
 AS/NZS Australia and New Zealand Joint Standard  
 NZS New Zealand Standard  
 AS Australian Standard  
 ECP New Zealand Electrical Code of Practice  
 GK General Knowledge

## Section 1 – All Candidates

### Question 1

- (a)  $R = \frac{V^2}{P}$  (1/2 mark)  
 $= \frac{230 \times 230}{2300}$  (1/2 mark)  
 $= 23 \Omega$  (1 mark)
- (b) It is the maximum fault current that a fuse or circuit breaker can safely interrupt. (1 mark)  
 (1 mark)
- (c) (i)  $1\Omega$  (1 mark)  
 (ii)  $1 M\Omega$  (1 mark)
- (d) Means a continuous conducting circuit from, and back to, the source of electricity. (2 marks)
- (e) The insulation resistance tester set on the 500V range will not provide an accurate measurement for values lower than  $0.5M\Omega$ . (2 marks)

- (f) 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 3000:2000: 1.4.37

AS/NZS 3000:2007: 1.4.40

(2 marks)

- (g) Any TWO of:

- To prevent access to basic insulation.
- To prevent access to live terminals.
- To prevent access to moving parts.

(2 marks)

- (h) An ohmmeter will not deliver sufficient voltage to stress the insulation and expose any weakness.

(2 marks)

- (i) (i) A pre-set pressure has been reached.  
or  
The pressure has dropped below a pre-set level

(1 mark)

- (ii) A pre-set temperature has been reached.  
or  
The temperature has dropped below a pre-set level

(1 mark)

- (j) Any TWO of:

- The wrong isolating switch has been operated.
- The circuit is being fed from two different sources.
- The isolating switch is switching the neutral conductor.

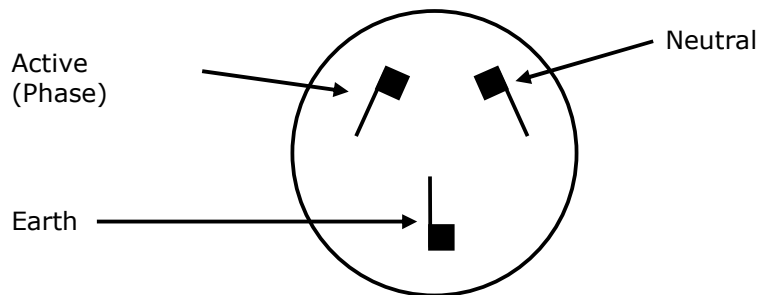
(2 marks)

## Question 2

- (a) (i) 400V (½ mark)  
(ii) 230V (½ mark)  
(iii) 230V (½ mark)  
(iv) 0V (½ mark)

- (b) • The earth pin is the first to make contact when inserted, (1 mark)  
• The earth pin is the last to break contact when the plug is withdrawn, (1 mark)

(c)



(3 marks)

- (d) (i) 1 ohm.

AS/NZS 3760: 2.3.3.1  
(1 mark)

(ii) Any TWO of:

- It establishes low resistance path of no greater than 1 ohm.
- It ensures no potential difference can develop across the protective earthing conductor.
- It ensures that the appliance frame is held at near to 0 V and no shock hazard exists.
- It ensures that the protection will operate.

(2 marks)

### Question 3

(a) (i) The imbalance between neutral current and the phase current. (1 mark)

- (ii)
- 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, opening the RCD contacts (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

or

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) • The RCD disconnects the supply before the leakage current reaches levels that could cause harm to humans. (2 marks)

- The RCD disconnects the supply very rapidly if the leakage current is above levels that could cause harm to humans (2 marks)

(2 marks)

(d) 30 mA

NZS 3019: 3.3j, B9.2.1  
(1 mark)

#### Question 4

$$(a) R_T = \frac{R_1 \times R_2}{R_1 + R_2} \quad (1/2 \text{ mark})$$

$$= \frac{40 \times 50}{40 + 50} \quad (1/2 \text{ mark})$$

$$= 22.2\Omega \quad (1 \text{ mark})$$

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

$$= \frac{230}{22.2} \quad (1/2 \text{ mark})$$

$$= 10.4A \quad (1 \text{ mark})$$

$$(b) P = VA \quad (1/2 \text{ mark})$$

$$= 230 \times 10.4 \quad (1/2 \text{ mark})$$

$$= 2390 \text{ W} \quad (1 \text{ mark})$$

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

$$= \frac{230 \times 230}{40} \quad (1/2 \text{ mark})$$

$$= 1320W \quad (1 \text{ mark})$$

The power consumed would drop 1070W (1 mark)

(d) Yes. (1/2 mark)

It would rise to 2590 W because the power consumed is proportional to the square of the supply voltage.

(1/2 mark)

## Section 2 - Plumbers Only

### Question 5

- (a) (i) Three. (1 mark)
- (ii) Two (1 mark)
- (iii) Table 3.5 of AS/NZS 3000:2000

<b>COLOURS OF CABLE CORES</b>		
<b>Function</b>	<b>Identifying colours</b>	
	<b>Recommended</b>	<b>Alternative</b>
Active (Phase)	<b>Red</b>	<b>Any colour except green/yellow, green, black, light blue</b>
Neutral	<b>Black</b>	<b>Light blue</b>
Earth	<b>Green/yellow</b>	<b>Green</b>

**Figure 3.1 of AS/NZS 3000:2007**

<b>Function</b>	<b>Superseded</b>	<b>Current AS/NZS flexible cords</b>
Active (Phase)	<b>Red</b>	<b>Brown</b>
Neutral	<b>Black</b>	<b>Light blue</b>
Earth	<b>Green</b>	<b>Green/yellow</b>

(3 marks)

- (b) (i)
  - Minimise the risk of shock.
  - Minimise the risk of short-circuit.(2 marks)
- (ii) Any ONE of:
- Ensure that the flexible cord is securely anchored
  - Ensure that the cord grip is on the sheath of the flexible cord, not on the basic insulation.
  - Ensure that the basic insulation exposed for the purpose of termination is kept to a minimum
  - Ensure all covers securely in place.
- (1 mark)
- (iii) (1) If strain is applied to the flexible cord the protective earthing conductor will be the last to pull away from the terminals.

(1 mark)

- (2) If all conductors are the same length, the earth may pull away first leaving the appliance operational but unearthed.

(1 mark)

## Question 6

(a) The procedure has to cover:

- Removing the correct fuse and attaching a Danger tag. (2 marks)
- Removing the isolator cover and testing for voltage at the supply side of the isolator using the prove-test-prove method. (2 marks)

(b) The description has to cover:

1. An insulation resistance test showing: (½ mark)
  - the use of an insulation resistance tester (½ mark)
  - a 500V d.c. test voltage (½ mark)
  - testing between phase and earth and neutral and earth (½ mark)
  - the test result limit is 10,000 ohms or 0.01 Mohms (1 mark)
  - the test result being a minimum value (½ mark)

Note: A leakage current test as described in AS/NZS 3760 is a suitable alternative.

2. A protective earthing conductor test showing: (½ mark)
  - the use of a meter that can accurately read values of 1 ohm or less (½ mark)
  - a testing between the PEC of the flexible cord and the case of the cylinder (½ mark)
  - the test result limit is 1 ohm (½ mark)
  - the test result being a maximum value (½ mark)

## Question 7

(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  
(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 against ingress of solid objects  
AS/NZS 3000:2007: Figure G1a  
(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 against harmful ingress of water  
AS/NZS 3000:2007: Figure G1b  
(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: Figure G1a

(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 egress permitted.  
AS 60529
- Protection against water splashed from all directions – limited egress permitted.

AS/NZS 3000:2007: Figure G1b  
(1 mark)

(c) Any ONE of:

- Electrical appliances that do not have personal electrical protection such as an RCD
- Electrical appliances that are not supplied by an individual isolating transformer.
- Electrical appliances that are not supplied at extra low voltage from an individual transformer.

ER 90(b)  
(2 marks)

### Question 8

(a) (i) Any ONE of:

- To establish that a low resistance exists of no greater than 1 ohm.
  - To ensure the frame will remain near earth potential even under fault conditions
  - To ensure a high current will flow in the event of a short to the frame
  - To ensure sufficient current will flow for the protection to operate (quickly).
  - To verify the connections of the earth conductor are healthy.
- (2 marks)

(ii) Any ONE of:

- To ensure that the insulation resistance is not less than 1 M $\Omega$
  - To ensure the insulation will not fail at its operating electrical voltage.
  - To verify that the insulation of current carrying components is capable of withstanding the normal supply voltage.
  - To ensure there is no accidental connection between live parts and earth.
- (2 marks)

(iii) Any ONE of:

- To ensure that the phase, neutral and earth conductors are terminated at the correct terminals
  - To ensure that the switch is in the phase conductor.
- (1 mark)

- (b)
- Use a meter that can accurately read values of 1 ohm or less. (1 mark)
  - Touch the leads together and adjust for zero. (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)

### Question 9

(a) (i) Most of the internal wiring remains alive at 230V to earth (1 mark)

- (ii)
- 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.
- (2 marks)

(b) 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)

(c) (i) 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)

(ii) 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.
- (2 marks)

## Section 3 – Gasfitters Only

### Question 10

(a) (i) Most of the internal wiring remains alive at 230V to earth (1 mark)

- (ii) • 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. (2 marks)

(b) 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)

(c) (i) 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)

(ii) 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. (2 marks)

**Question 11**

(a) (i) Three.

(1 mark)

(ii) Two

(1 mark)

Table 3.5 of AS/NZS 3000:2000

<b>COLOURS OF CABLE CORES</b>		
<b>Function</b>	<b>Identifying colours</b>	
	<b>Recommended</b>	<b>Alternative</b>
Active (Phase)	<b>Red</b>	<b>Any colour except green/yellow, green, black, light blue</b>
Neutral	<b>Black</b>	<b>Light blue</b>
Earth	<b>Green/yellow</b>	<b>Green</b>

Figure 3.1 of AS/NZS 3000:2007

<b>Function</b>	<b>Superseded</b>	<b>Current AS/NZS flexible cords</b>
Active (Phase)	<b>Red</b>	<b>Brown</b>
Neutral	<b>Black</b>	<b>Light blue</b>
Earth	<b>Green</b>	<b>Green/yellow</b>

(3 marks)

- (b) (i) • Minimise the risk of shock.  
• Minimise the risk of short-circuit.

(2 marks)

(ii) Any ONE of:

- Ensure that the flexible cord is securely anchored
- Ensure that the cord grip is on the sheath of the flexible cord, not on the basic insulation.
- Ensure that the basic insulation exposed for the purpose of termination is kept to a minimum
- Ensure all covers securely in place.

(1 mark)

(iii) (1) If strain is applied to the flexible cord the protective earthing conductor will be the last to pull away from the terminals.

(1 mark)

- (2) If all conductors are the same length, the earth may pull away first leaving the appliance operational but unearthed. (1 mark)

## Question 12

(a) The procedure has to cover:

- Removing the correct fuse and attaching a Danger tag. (2 marks)
- Removing the isolator cover and testing for voltage at the supply side of the isolator using the prove-test-prove method. (2 marks)

(b) The description has to cover:

1. An insulation resistance test showing: (1/2 mark)
  - the use of an insulation resistance tester (1/2 mark)
  - a 500V d.c. test voltage (1/2 mark)
  - testing between phase and earth and neutral and earth (1/2 mark)
  - the test result limit is 10,000 ohms or 0.01 Mohms (1 mark)
  - the test result being a minimum value (1/2 mark)

Note: A leakage current test as described in AS/NZS 3760 is a suitable alternative.

2. A protective earthing conductor test showing: (1/2 mark)
  - the use of a meter that can accurately read values of 1 ohm or less (1/2 mark)
  - a testing between the PEC of the flexible cord and the case of the cylinder (1/2 mark)
  - the test result limit is 1 ohm (1/2 mark)
  - the test result being a maximum value (1/2 mark)

### Question 13

(a) (i) Any ONE of:

- To establish that a low resistance exists of no greater than 1 ohm.
  - To ensure the frame will remain near earth potential even under fault conditions
  - To ensure a high current will flow in the event of a short to the frame
  - To ensure sufficient current will flow for the protection to operate (quickly).
  - To verify the connections of the earth conductor are healthy.
- (2 marks)

(ii) Any ONE of:

- To ensure that the insulation resistance is not less than 1 M $\Omega$
  - To ensure the insulation will not fail at its operating electrical voltage.
  - To verify that the insulation of current carrying components is capable of withstanding the normal supply voltage.
  - To ensure there is no accidental connection between live parts and earth.
- (2 marks)

(iii) Any ONE of:

- To ensure that the phase, neutral and earth conductors are terminated at the correct terminals
  - To ensure that the switch is in the phase conductor.
- (1 mark)

- (b)
- Use a meter that can accurately read values of 1 ohm or less. (1 mark)
  - Touch the leads together and adjust for zero. (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)

## Question 14

(a) (i) (1) Visual inspection (1 mark)

(2) Any ONE of:

- All equipment shall be visually inspected and physically checked in accordance with Clause 2.3.2

AS/NZS 3760:2001: 2.3.1

- 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) • Repair the appliance. (1 mark)
- Retest the appliance to ensure it complies with AS/NZS 3760. (1 mark)