ER 12 – Electrician Regulations Answer Schedule

Note: (1 mark) means that the preceding statement earns 1 mark.

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.

With calculation questions award ½ marks if only the correct answer is stated

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

Question 1

Any FOUR of:

- Registered electricians
- Registered line mechanics
- Registered electrical inspectors
- Registered electrical service technicians
- Persons who are authorised to carry out such work under a provisional licence
- Trainees
- Qualified engineers

EA 108 (2)

Question 2

- When the connection is solely for the purpose of carrying out any (½ mark)
- testing, (½ mark)
- inspection or (½ mark)
- certification. (½ mark)

EA 114(4)

Question 3

Any ONE of:

- A supervisor of electrical work whose registration allows that supervisor to do the work
- A registered person whose registration allows that person to do the work, where the registered person is under the supervision of a supervisor of electrical work whose registration allows that supervisor to do the work

ER 23(a),(b)

Question 4

Any TWO of:

- The conductors or fittings on which the work was done are tested to ensure the operational safety of the completed work
- In the case of maintenance, alterations, or additions, the work does not reduce the safety of existing works or electrical installations; and
- During testing, all practicable steps are taken to ensure the safety of persons, property, and the works and electrical installations.

ER 37(1)

- Must ensure that work is tested and verified in accordance with section 6 of AS/NZS 3000 after the work is complete and before the installation is connected to a supply of electricity

ER 37(3)

Question 5

230 x 5% = 11.5V

(1 mark)

230 – 11.5 = 218.5 V

(1 mark)
ER 53(3)(b)

Question 6

(a) Must only be used in, or with, any works, electrical installations or electrical appliances that operate at standard low voltage.

(1 mark)
ER 74(1)(a)

(b) AS/NZS 3760

(1 mark)
ER 76(4)

Question 7

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)

Question 8

- The metal is not fully isolated from both live parts and earth.
- The metal is located within arm's reach.

ER 84(2)

Question 9

- Warrant of electrical fitness or WOEF
- Certificate of compliance or COC

ER 97(4)(a),(b)

Question 10

Any TWO of:

- Comply with IEC 60309 or equivalent or AS/NZS 3112
- Be rated at or above 15 amperes
- Have supplementary protection against electric shock

ER 98(3)(a)(b)

Question 11

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)

Question 12

Final subcircuits of:

- Socket-outlets.
- Lighting.

AS/NZS 3000: 2.5.3.1

Question 13

Any TWO of:

- Provided with adequate mechanical protection to prevent damage.
  AS/NZS 3000: 3.9.4.6
- Provided with earthed metallic armouring, screen, covering or enclosure.
  AS/NZS 3000: 3.9.4.6
- Protected by an RCD with a maximum rated residual current of 30 mA.
  AS/NZS 3000: 3.9.4.6

- Provided by the mechanical characteristics of the wiring system.
  AS/NZS 3000: 3.3.7
- Provided by the location selected.
  AS/NZS 3000: 3.3.7
- Provided by the provision of additional local or general mechanical protection.
  AS/NZS 3000: 3.3.7

- Within a concrete or similar floor at a depth of less than 50 mm from any surface;
  AS/NZS 3000: 3.9.4.2(a)

- Fixed in position below a timber or similarly fixed floor less than 50 mm from the underside of the floor.
  AS/NZS 3000: 3.9.4.2(b)

- Pass through or are fixed in position within 50 mm of a ceiling fixing support;
  AS/NZS 3000: 3.9.4.3(a)

- Are less than 50 mm from the surface of the ceiling material in contact with the fixing support.
  AS/NZS 3000: 3.9.4.3(b)

- Precast concrete slabs having a thickness of not less than 40 mm and a classification of not less than grade 15 in accordance with AS 3600.
  AS/NZS 3000: 3.11.3.3(a)

- Concrete slabs cast on site having a thickness of not less than 100 mm.
  AS/NZS 3000: 3.11.3.3(b)
- A continuous concrete pour having a thickness of not less than 75 mm.
  AS/NZS 3000: 3.11.3.3(c)
- Fibrous cement slabs having a thickness of not less than 12 mm.
  AS/NZS 3000: 3.11.3.3(d)
- Bricks manufactured specifically for the protection of electric cables.
  AS/NZS 3000: 3.11.3.3(e)
- Polymeric cable cover strip complying with AS 4702.
  AS/NZS 3000: 3.11.3.3(f)
- Other materials which offer the same degree of protection afforded by the materials in Items (a) to (f).
  AS/NZS 3000: 3.11.3.3(g)

Question 14

Any TWO of:

- Where they are buried in concrete or plaster containing corrosion agents
- Where they are installed underground in accordance with clause 3.11
- Where they are in other locations where corrosion is likely to occur.

AS/NZS 3000: 3.9.8.3.1

Question 15

Any TWO of:

- Protection against direct contact with live parts
- Protection against indirect contact with exposed conductive parts.
- Protection against hazardous parts.
- Protection against spread of fire.
- General condition of electrical equipment.

AS/NZS 3000: 6.2.2(a)

Question 16

- Protection by means of obstacles in accordance with Clause 1.7.3.5.
- Protection by placing out of reach in accordance with Clause 1.7.3.6.

Candidates can provide the answer from 1.7.3.5 and 1.7.3.6, provided they apply both in a negative context.

AS/NZS 3000: 7.1.3

Question 17

(a) Number 2
Protection of fingers against access to hazardous parts, and protection of equipment against objects larger than 12.5 mm.
(Note accept 12.5 mm^2 as this is how it is presented in some documents)

(1 mark)

(b) Number 3
Protection against spraying water at up to 60^0 from the vertical

(1 mark)

AS 1939 Supplement 1:1990

Section 2

Question 18

(a)
- Shall be located within easy access of an entrance to the building.
- Shall not be located within any domestic electrical installation.

AS/NZS 3000: 2.9.8.2

OR

- Installed in suitable places, which shall be well ventilated and dry unless the switchboards are protected against moisture; and

- Located so that the switchboard and access thereto is not obstructed by the structure or contents of the building or by fittings and fixtures within the building.

AS/NZS 3000: 2.9.8.1
(2 marks)

(b) Any THREE of:

The main switchboard shall:

- Only be installed in an area set aside in the cupboard for the purpose.

AS/NZS 3000: 2.9.8.4(c)

- Be separated from other sections of the cupboard.

AS/NZS 3000: 2.9.8.4(c)(i)

- Be arranged so that access cannot be obstructed by the structure or the contents of the cupboard.

AS/NZS 3000: 2.9.8.4(c)(ii)

- Shall not be installed within a cupboard containing a fire-hose reel.

AS/NZS 3000: 2.9.8.4(g)
(3 marks)

(c) The doorway must be at least 0.75 m wide and 1.98 m high.

(1 mark)
AS/NZS 3000: 2.9.10(c)

Question 19

(a) (i) Must have a minimum degree of protection of IPX4

AS/NZS 3000: 7.1.4.1(b)
AS/NZS 3000 Amendment 3: 7.1.4.1(b) or Table 7.1
(1 mark)

(ii) Must have a minimum degree of protection of IPX4

AS/NZS 3000: 7.1.4.1(b)
AS/NZS 3000 Amendment 3: 7.1.4.1(b) or Table 7.1
(1 mark)

(b)
- Protected by a residual current device with a maximum rated residual current of 30 mA.
- Are enclosed in a cupboard provided that the enclosure is maintained during the normal operation of the connected equipment.

AS/NZS 3000 7.1.4.2(b)(i)(ii)
AS/NZS 3000 Amendment 3: 7.1.4.2(b)(ii)(iii) or Table 7.1
(2 marks)

(c) (i) Zone 3

AS/NZS 3000: 7.1.4.3
AS/NZS 3000 Amendment 3: 7.1.4.3 or Table 7.1
(1 mark)

(ii) 0.3 metres

AS/NZS 3000: 7.1.4.3
AS/NZS 3000 Amendment 3: 7.1.4.3 or Table 7.1
(1 mark)

Question 20

(a) (1) Separated extra-low voltage (SELV)
(2) Protected extra-low voltage (PELV)

AS/NZS 3000: 7.7.2
(1 mark)

(b) (1) Where the electrical equipment is specially designed for operation with a voltage drop greater than 10%.
(2) Where steady-state conditions are not applicable such as during motor starting, solenoid closing or other similar applications where high transient currents may be experienced.

AS/NZS 3000: 7.7.7(a),(b)
(2 marks)

(c)
- Plugs shall not be able to enter socket outlets of other voltage systems.
- Socket outlets shall not accept plugs of other voltage systems.
- Socket outlets shall not have a contact for a protective earthing conductor.

AS/NZS 3000: 7.7.11
(3 marks)

Question 21

(a) I_L = kW ÷ √3 V_L
= 15000 ÷ (√3 x 400)

(½ mark)

= 21.65A

(1 mark)

or

I_L = kW ÷ (3 x V_{ph})
= 15000 ÷ (3 x 230)
= 21.74A

(b) From Table 9, rating of 4mm^2 is 39A
From Table 27(1) derating factor is 0.94

(½ mark)

I_{max} = 39 x 0.94
= 36.6A
4 mm^2 cable is OK for loading

(1 mark)

(c) From Table 42, V_d/A.m = 9.71 for 4 mm^2 cable

Vd = (V_d/A.m x I x L) ÷ 1000

(½ mark)

= (9.71 x 21.65 x 20) ÷ 1000

(½ mark)

= 4.2 volts

(1 mark)

or

= (9.71 x 21.74 x 20) ÷ 1000
= 4.22 volts

Vd @ 400V = 400 x 2.5% = 10 volts
OR
Vd @ 230V = 230 x 2.5% = 5.75 volts

Vd within required limits – 4mm^2 cable OK

(1 mark)

Question 22

Any THREE of:

Test: Continuity of the earthing system

AS/NZS 3000: 6.3.3.1(a)
(½ mark)

Reason: Any ONE of:

- 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
(1½ marks)

Test Insulation resistance

AS/NZS 3000: 6.3.3.1(b)
(½ mark)

Reason: To ensure that the insulation resistance between all live conductors and earth, or, as the case may be, all live parts and earth is adequate to ensure the integrity of the insulation.

AS/NZS 3000: 6.3.3.3.1
(1½ marks)

Test Polarity

AS/NZS 3000: 6.3.3.1(c)
(½ mark)

Reason: Any ONE of:

- To ensure that no shock hazard arises from the incorrect connection of active, neutral and earthing conductors.
- To prevent the transposition of active and neutral conductors of the consumers mains or submains (with MEN connection at outbuilding or detached portion) resulting in the electrical installation earthing system becoming energized; and
- To prevent combinations of incorrect active, neutral and earthing conductor connections resulting in the exposed conductive parts of the electrical installation becoming energized; and
- To prevent the connection of switches in neutral conductors, resulting in parts of appliances, such as heating elements and lampholders, remaining energized when the switches are in the 'OFF' position.

AS/NZS 3000: 6.3.3.4.1
(1½ marks)

Test: Correct circuit connections

AS/NZS 3000: 6.3.3.1(d)
(½ mark)

Reason: Any ONE of:

- To ensure protective earthing conductors do not normally carry current.
- To ensure no short circuit exists, because a short-circuit current flowing between live conductors and through part of the earthing system can cause considerable fire damage or personal injury, particularly in high current locations.

AS/NZS 3000: 6.3.3.5.1
(1½ marks)

Test: Operation of RCDs

AS/NZS 3000: 6.3.3.1(e)
(½ mark)

Reason: To verify that the RCD operates to disconnect the designated circuit.

AS/NZS 3000: 6.3.3.6.1
(1½ marks)

Question 23

(a) (i) A certificate of compliance within one day of the completion of the work.

ER 39(1),(5)
(1 mark)

(ii)
- Inspection is required for the relocation of the main switchboard.
- Inspection required by ER 41(1)(c)(vii)

(2 marks)

(b) (i) AS/NZS 3760

ER 38
(1mark)

(ii)
- Protective earthing conductor resistance – maximum 1 Ohm

AS/NZS 3760:2001 : 2.3.3.1,
AS/NZS 3760:2003 : 2.3.3.1,

- Insulation resistance
  - minimum 1 Megohm

  or
  - 5 mA leakage current

AS/NZS 3760:2001 : 2.3.3.2
AS/NZS 3760:2003 : 2.3.3.2, Table 1 and Table 2
(2 marks)

Question 24

(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) Safe working practices, testing and basic first aid at intervals not exceeding 14 months, CPR at intervals not exceeding 7 months.

ER 26(4)(a), (b)
(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)

Question 25

(a) (i) (1) Identified by an orange marker tape positioned above the cable.

AS/NZS 3000: 3.11.3.4

(2) Marker signs where the cable enters or leaves the building

AS/NZS 3000 3.11.3.5

(2 marks)

(ii) 0.5 m

AS/NZS 3000: Table 3.7

(1 mark)

(iii) Shall be laid on a bed of not less than 50 mm of sand or friable soil free of sharp stone and covered by not less than 50 mm of the same material.

AS/NZS 3000: 3.11.3.2

(2 marks)

(b) Any ONE of:

- Sheathed and armoured and served cables.
- Neutral screen cable suitable for underground (3.2 mm sheath).

AS/NZS 3000: 3.11.2(f)
Table 3.6.

Question 26

- Insulation resistance tests carried out with a 500 Vd.c. insulation resistance tester.

(1 mark)

- Disconnect the water heater cylinder and the two ranges from the installation. Conduct an insulation resistance test on the water heating cylinder and each of the ranges. The resistance between live parts and earthed parts on each appliance must not be less than 10,000 Ω.

(2 marks)

- Conduct an insulation resistance test on the installation with the water heating cylinders and ranges disconnected. The resistance between live and earthed parts must not be less than 1 MΩ.

(2 marks)

- Reconnect the water heating cylinder and the two ranges to the installation and conduct an insulation resistance test on the installation. The resistance between live and earthed parts must not be less than 600,000Ω.

(1 mark)

GK
AS/NZS 3000: 6.3.3.3.2
(6 marks)

Question 27

Group A		**Total**
20 lighting points	3 A	
12 lighting points	2 A	5 A

(½ mark)

Group B		
20 socket outlets	10 A	
7 socket outlets	5 A	15 A

(½ mark)

Group C

10 kW electric range
50% of 10 kW
43.4 x 0.5 21.7 A

(1 mark)

3 kW clothes dryer
50% of 3 kW
13 x 0.5 6.5 A 28.2 A

(1 mark)

Group D

2.4 kW air conditioner
75% of 2.4 kW = 1.8 kW 7.8 A

(1 mark)

Group E

6.kW instantaneous water heater
33% of 6 kW = 2 kW 8.7 A

(1 mark)

Total **64.7 A**

(1 mark)

AS/NZS 3000: Appendix C, Table C1
(Total - 6 marks)

Question 28

(a) Any TWO of:

- Earthed and protected by a residual current device with a maximum rated residual current of 30 mA.
- Supplied at extra-low or low voltage through an isolating transformer complying with AS/NZS 3108 and not earthed.
- Supplied by other suitable measures that take account of the electrical equipment construction and installation methods.

(2 marks)
AS/NZS 3000: 7.6.2.1

(b) (i) Bare aerial conductors shall not be installed over Zones 0, 1 or 2

(1 mark)
AS/NZS 3000: 7.2.4.2 or Table 3.8

(ii)
- Specifically intended for use in a swimming pool.
- Supplied as an SELV or PELV in accordance with clause 7.7.
- Shall not be provided with a protective earthing conductor.

AS/NZS 3000: 7.2.4.5(a)
(3 marks)