

V3-ER 37 - Electrician Regulations Answer 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

Question 1	<i>Reference Marks</i>	<i>Marking notes</i>
(a) Any TWO of: <ul style="list-style-type: none"> • Where the work does not require inspection under regulation 41. • Where the work does not require certification under regulation 39(2). • To enable testing or certification to be carried out under regulation 45 	(2 marks)	
(b) 0.4 seconds (400 milliseconds)	ER 64 (3) (2 marks)	
(c) Any TWO of: <ul style="list-style-type: none"> • Water • Gas • Flammable liquids 	ER 86(3) (2 marks)	
(d) <ul style="list-style-type: none"> • Avoid danger and to minimise inconvenience in the event of a fault. • Facilitate safe operation, inspection, testing and maintenance. 	AS/NZS 3000: 2000: 1.8.5 2007: 1.6.5 (2 marks)	

Question 1	Reference Marks	Marking notes
<p>(e) From AS/NZS 3000:2000: 2.9.6</p> <p>Provided that the switchboard is installed in an area which is accessible only to authorized persons and the means of access to such areas is provided with facilities for locking.</p> <p>Or</p> <p>From AS/NZS 3000:2007: 2.9.3.1</p> <p>Provided that the switchboard is installed in an area which is accessible only to authorized persons and the means of access to such areas is provided with facilities for locking.</p>	(2 marks)	
<p>(f) The current carrying capacity of the neutral shall not be less than that of the largest associated active conductor.</p>	<p>AS/NZS 3000: 2000: 3.5.2(b)(i)(A) 2007: 3.5.2(b)(ii) (2 marks)</p>	
<p>(g) Any TWO of:</p> <ul style="list-style-type: none"> • The low voltage cables are of a type providing the equivalent of double insulation; or • All cables or each conductor of a multicore cable are insulated for the highest voltage present; or • The low voltage cables are installed in a separate compartment of a common cable trunking system and the compartment has fixed and continuous barriers. 	<p>AS/NZS 3000: 2000: 3.9.9.3 2007: 3.9.8.3 (2 marks)</p>	
<p>(h) No connection, other than that made by an earthing conductor, shall be made between the primary and secondary windings.</p>	<p>AS/NZS 3000: 2000: 4.5.5 2007: 4.14.5 (2 marks)</p>	
<p>(i) Precautions shall be taken to ensure the safety of persons and to avoid damage to property and the electrical installation equipment during inspection and testing.</p>	<p>AS/NZS 3000: 2000: 6.1 2007: 8.1.2 (2 marks)</p>	

Question 1	<i>Reference Marks</i>	<i>Marking notes</i>
(j) It shall be connected on the supply side of the pump motor controller.	AS/NZS 3000: 2000: 7.10.9.1 2007: 7.2.9.1 (2 marks)	

Question 2	Reference Marks	Marking notes
<p>(a) From AS/NZS 3000:2000: 5.2.5</p> <ul style="list-style-type: none"> • The value of earthing resistance is in accordance with the protective and functional requirements of the electrical installation and expected to be continuously effective. • Earth-fault currents and earth-leakage currents can be carried without danger, particularly from thermal, thermo-mechanical and electromechanical stresses; and • It is adequately robust or has additional mechanical protection appropriate to the assessed conditions of external influence in accordance with Clause 3.3. 	(3 marks)	
<p>From AS/NZS 3000:2007: 5.1.2</p> <p>Any THREE of:</p> <ul style="list-style-type: none"> • Enable automatic disconnection of supply in the event of a short-circuit to earth fault or excessive earth leakage current in the protected part of the installation through protective earthing arrangements. • Enable equipment requiring an earth reference to function correctly through functional earth arrangements. • Mitigate voltage differences appearing between exposed conductive parts of equipment and extraneous conductive parts through equipotential bonding arrangements. • Provide an effective and reliable low impedance fault path capable of carry earth fault and earth leakage current without danger or failure. • Provide measures for the connection of exposed conductive parts and extraneous conductive parts. 		

Question 2	Reference Marks	Marking notes
(b) Any ONE of	(1 mark)	
<ul style="list-style-type: none"> • 6mm² Cu 	AS/NZS3000: 2000: Table 5.1 2007: Table 5.1	½ mark for the size ½ mark for the type
<ul style="list-style-type: none"> • 16 mm² Al 	AS/NZS3000: 2000: 5.5.6(b) 2007: 5.3.2.1.2	½ mark for the size ½ mark for the type
(c) 48 metres	AS/NZS 3000: 2000: Table B5.1 2007: Table B1 (1 mark)	
(d) Any ONE of:	(2 marks)	
<ul style="list-style-type: none"> • The earthing conductor shall be determined in relation to the cross-sectional area of the largest active conductor to be protected. 	AS/NZS 3000: 2000 5.5.1.2(a)(i) 2007 5.3.3.2	
<ul style="list-style-type: none"> • The minimum size of the main earthing conductor may be determined in relation to the cross-sectional area of the largest active conductor of the largest outgoing submain or final subcircuit. 	AS/NZS 3000: 2007 5.3.3.2(a) (2 marks)	
(e) (i) $kVA = \frac{100 \times 100}{5}$	(½ mark)	
= 2000 kVA	(1 mark)	
(ii) $ISC = \frac{2000}{\sqrt{3} \times 400}$	(½ mark)	
= 2887A	(1 mark)	

Question 3	Reference Marks	Marking notes
(a) (i) In Zone 2 or Zone 3 of the shower.	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.9 (1 mark)	If Zone 0 or Zone 1 is given as an answer for (i) or (ii) no marks are awarded for part (a).
(ii) Zone 2 The switch must be rated IPX 4 Zone 3 No IP rating required	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b) (1 mark)	
(iii) The switch must be at least 0.3m above the floor.	AS/NZS 3000: 2000: 7.1.4.3 2007: 6.2.4.3 (½ mark)	
(b) (i) In Zone 2 or Zone 3 of the shower.	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.9 (1 mark)	If Zone 0 or Zone 1 is given as an answer for (i) or (ii) no marks are awarded for part (b).
(ii) Zone 2 The towel rail and permanent connection unit must be rated IPX 4 Zone 3 No IP rating required	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b) (1 mark)	
(iii) The permanent connection unit must be at least 0.3m above the floor.	AS/NZS 3000: 2000: 7.1.4.3 2007: 6.2.4.3 (½ mark)	
(c) (i) In Zone 2 or Zone 3 of the shower.	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.9 (1 mark)	If Zone 0 or Zone 1 is given as an answer for (i) or (ii) no marks are awarded for part (c).
(ii) Zone 2 The wall heater and wall switch unit must be rated IPX 4 Zone 3 No IP rating required	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b) (1 mark)	
(iii) The wall switch must be at least 0.3m above the floor.	AS/NZS 3000: 2000: 7.1.4.3 2007: 6.2.4.3 (½ mark)	

Question 3	Reference Marks	Marking notes
(d) (i) Any ONE of: <ul style="list-style-type: none"> • In Zone 3 of the shower • Outside Zone 2 of the basin. 	AS/NZS 3000: 2000: Figure 7.1A(e) 2007: Figure 6.9 (½ mark)	If Zone 0 or Zone 1 is given as an answer for (i) or (ii) no marks are awarded for part (d).
(ii) Zone 3 No IP rating required	AS/NZS 3000: 2000: 7.1.4.1(b) 2007: 6.2.4.1(b) (½ mark)	
(iii) • RCD protected supply	AS/NZS 3000: 2000: 7.1.4.2(c) 2007: 6.2.4.2(c) (½ mark)	No marks can be awarded for (iii) if any one of the following statements are made: <ul style="list-style-type: none"> • PELV supply • SELV supply • Shaver socket outlet
• An isolated supply	AS/NZS 3000: 2000: 7.1.4.2(c) 2007: 6.2.4.2(c) (½ mark)	
(iv) It must be at least 0.3m above the floor.	AS/NZS 3000: 2000: 7.1.4.3 2007: 6.2.4.3 (½ mark)	

Question 4	Reference Marks	Marking notes
(a) (i) <ul style="list-style-type: none"> • The main neutral • The MEN link • The oven circuit neutral. • The neutrals to the RCDs protecting the final subcircuits 	GK (2 marks)	
(ii) <ul style="list-style-type: none"> • The out-going neutral from RCBO No.1 • The neutrals of the final subcircuits protected by RCBO No. 1 	GK (1 mark)	
(iii) <ul style="list-style-type: none"> • The out-going neutral from RCBO No.2 • The neutrals of the final subcircuits protected by RCBO No. 2 	GK (1 mark)	
(b) (i) The main neutral bar	GK (1 mark)	
(ii) Neutral bar No. 1	GK (1 mark)	
(iii) Load side of the main switch	GK (1 mark)	
(iv) Supply side of MCB bank No.1	GK (1 mark)	
(c) (i) The main neutral bar	GK (1 mark)	
(ii) Neutral bar No. 2	GK (1 mark)	

Question 5	Reference Marks	Marking notes
(a) $I = \frac{P}{400 \times \sqrt{3}}$	(1/2 mark)	
$= \frac{12000}{400 \times \sqrt{3}}$	(1/2 mark)	
$= 17.32A$	(1/2 mark)	
The allowance for load = $17.32 \times 50\% = 25.98A$	(1/2 mark)	
From Table 12, current rating for a 2.5 mm ² cable is 25 amps	(1/2 mark)	
From Table 27(1) the rating for 25°C is 1.06	(1/2 mark)	
$= 25 \times 1.06$	(1/2 mark)	
$= 26.5A$	(1/2 mark)	
The 2.5 mm ² cable will satisfy the load current requirements	(1 mark)	
(b) Maximum permitted voltage drop = $400 \times 2.5\% = 10V$	(1/2 mark)	
From Table 42 the mV/A.m For a 2.5 mm ² cable is 15.6	(1/2 mark)	
$V_d = \frac{mV/A.m \times A \times m}{1000}$	(1/2 mark)	
$= \frac{15.6 \times 25.98 \times 30}{1000}$	(1/2 mark)	
$= 12.16V$	(1 mark)	
Therefore a 4 mm ² cable will satisfy the voltage drop requirements.	(1 mark)	
(c) A 4 mm ² copper cable will satisfy the load and voltage drop requirements	(1 mark)	

Question 6

Solution 1

For load group A(i) – Diversity factors from column 2, including the lighting track assessed as per note (d)

Load Group	Calculation	Load (A)	
<u>Group A(i)</u>			
32, 75W indoor lighting points 6 metres of lighting track	$32 + (6 \times 2) = 44$ points $3 + 2 + 2$	7	(1½ marks)
<u>Group A(ii)</u>			
15, 75W outdoor lighting points	$15 \times 75 \times 0.75 = 843.75$ $843.75 \div 230 =$	3.67	(1½ marks)
<u>Group B</u>			
10, Single 10A socket outlets 10, Double 10A socket outlets	$10 + 20 = 30$ outlets	15	(1 mark)
<u>Group C</u>			
10kW range	$(10000 \times 0.5) \div 230 =$	21.74	(1½ marks)
<u>Group F</u>			
3kw controlled water heater	$3000 \div 230 =$	13.04	(1 mark)
<u>Group G</u>			
6kw spa pool	$(6000 \times 0.75) \div 230 =$	19.56	(1½ marks)
Total maximum demand		80.01	(2 marks)

AS/NZS 3000:2000: Table C1
AS/NZS 3000:2007: Table C1

Solution 2

For load group A(i) – The calculation of the connected load from note (f)

Load Group	Calculation	Load (A)	
<u>Group A(i)</u>			
32, 75W indoor lighting points 6 metres of lighting track	$32 \times 75 = 2400\text{W}$ $2400 \div 230 = 10.43\text{A}$ $0.5 \times 6 = 3\text{A}$	13.43	(1½ marks)
<u>Group A(ii)</u>			
15, 75W outdoor lighting points	$15 \times 75 \times 0.75 = 843.75$ $843.75 \div 230 =$	3.67	(1½ marks)
<u>Group B</u>			
10, Single 10A socket outlets 10, Double 10A socket outlets	$10 + 20 = 30$ outlets	15	(1 mark)
<u>Group C</u>			
10kW range	$(10000 \times 0.5) \div 230 =$	21.74	(1½ marks)
<u>Group F</u>			
3kw controlled water heater	$3000 \div 230 =$	13.04	(1 mark)
<u>Group G</u>			
6kw spa pool	$(6000 \times 0.75) \div 230 =$	19.56	(1½ marks)
Total maximum demand		86.44	(2 marks)

AS/NZS 3000:2000: Table C1
AS/NZS 3000:2007: Table C1

Question 7	Reference Marks	Marking notes
(a) Any THREE of:	(3 marks)	
<ul style="list-style-type: none"> To ensure that no shock hazard arises from the incorrect connection of active, neutral and earthing conductors 	AS/NZS 3000: 2000: 6.3.3.4.1 2007: 8.3.7.1	
<ul style="list-style-type: none"> 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 	AS/NZS 3000: 2000: 6.3.3.4.1 2007: 8.3.7.1	
<ul style="list-style-type: none"> To prevent combinations of incorrect active, neutral and earthing conductor connections resulting in the exposed conductive parts of the electrical installation becoming energized; and 	AS/NZS 3000: 2000: 6.3.3.4.1 2007: 8.3.7.1	
<ul style="list-style-type: none"> 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: 2000: 6.3.3.4.1 2007: 8.3.7.1	
<ul style="list-style-type: none"> There is no transposition of conductors that could result in the electrical equipment becoming unsafe when it is connected to supply, particularly where appliances are connected by socket-outlets; and 	AS/NZS 3000: 2000: 1.11.2.4(a)	
<ul style="list-style-type: none"> Switches do not operate independently in a neutral or protective earthing conductor 	AS/NZS 3000: 2000: 1.11.2.4(a)	
(b) • Insert temporary earth stake remote from main earth	(½ mark)	<u>Hazardous</u>
• Test in turn with voltmeter and trailing lead:	(½ mark)	No marks can be awarded for part (b) if the following is stated:
* between each phase and remote earth	(½ mark)	
* between the neutral/earth bar and remote earth	(½ mark)	
		<ul style="list-style-type: none"> Lifting the MEN link Disconnecting the main neutral Disconnecting the main earth

Question 7	Reference Marks	Marking notes
<ul style="list-style-type: none"> ● If a transposition has taken place: 		
<ul style="list-style-type: none"> * There will be 230V between two of the phases and the remote earth 	(1 mark)	
<ul style="list-style-type: none"> * There will be 230V between the neutral/earth bar and the remote earth 	(1 mark)	
<ul style="list-style-type: none"> * There will be 0V between one of the phase and the remote earth 	(1 mark)	
<ul style="list-style-type: none"> ● If no transposition has taken place: 		
<ul style="list-style-type: none"> * There will be 230V between all phases and the remote earth 	(1 mark)	
<ul style="list-style-type: none"> * There will be 0V between the neutral/earth bar and the remote earth 	(1 mark)	

Question 8	Reference Marks	Marking notes
<p>(a) Any FOUR of:</p> <ul style="list-style-type: none"> • A touch voltage hazard between conductive parts and the mass of earth. • Protective devices may not operate under fault conditions. • Fire hazard at any high resistance joint in the main neutral. • Fire hazard because the main earthing conductor is carrying a higher current than it can safely carry continuously. • Over or under voltage could damage equipment – particularly on three phase installations. • Damage could occur on neighbouring electrical installation due to load current passing through the earth. • Risk of shock in neighbouring properties 	Gk (4 marks)	
<p>(b) Any TWO of:</p>	(2 marks)	
<p>From AS/NZS 3000:2000:</p>		
<ul style="list-style-type: none"> • A cooking applianceshall be provided with a functional switch, operating in all active conductors, mounted near the appliance in a visible accessible position. 	4.3.11.1	
<ul style="list-style-type: none"> • The switch should be mounted within 2 m of the cooking appliance, but not on the cooking appliance in such a position that the user does not have to reach across the open cooking surface. 	4.3.11.1: Note 1	
<ul style="list-style-type: none"> • It is recommended that switches, particularly those in domestic installations, be marked to identify the appliance controlled. 	4.3.11.1: Note 3	
<ul style="list-style-type: none"> • A cooking appliance shall be connected to the electrical installation wiring by a socket-outlet, that has a suitable current rating 	4.3.11.2	

Question 8	Reference Marks	Marking notes
From AS/NZS 3000:2007		
<ul style="list-style-type: none"> A cooking applianceshall be provided with a switch, operating in all active conductors, mounted near the appliance in a visible and readily accessible position. 	4.7.1	
<ul style="list-style-type: none"> The switch should be mounted within 2 m of the cooking appliance, but not on the cooking appliance in such a position that the user does not have to reach across the open cooking surface. 	4.7.1: Note 1	
<ul style="list-style-type: none"> It is recommended that switches, particularly those in domestic installations, be marked to identify the appliance controlled. 	4.7.1: Note 3	
<ul style="list-style-type: none"> A free-standing cooking appliance shall be connected to the electrical installation wiring by a socket-outlet or an installation coupler 	4.7.2	
(c) Any TWO of:	(2 marks)	
<p>From AS/NZS 3000:2000: 4.9.2.2</p> <ul style="list-style-type: none"> Where installed in a floor or other horizontal surface, socket-outlets shall be arranged or of such design that dust or water cannot accumulate therein. Where installed within 75 mm of a floor, socket-outlets shall be installed so that any plug used with the socket-outlet is withdrawn in the horizontal plane or complies with Item (a). Socket-outlets shall be so installed that a plug is not likely to become loose or malfunction due to gravity, vibration or the weight of the flexible cord or cable. 		

Question 8	Reference Marks	Marking notes
<p>From AS/NZS 3000:2007: 4.4.2.2</p> <ul style="list-style-type: none"> • Where installed in a floor or other horizontal surface, socket-outlets shall be arranged or of such design that dust or water cannot accumulate therein. • Where installed within 75 mm of a floor, socket-outlets shall be installed so that any plug used with the socket-outlet is withdrawn in the horizontal plane or complies with Item (a). • Socket-outlets shall be so installed that a plug is not likely to become loose or malfunction due to gravity, vibration or the weight of the flexible cord or cable. • Where installed for the connection of a fixed or stationary appliance or a luminaire that is not readily accessible, the socket outlet shall be securely fixed to a structure or support. • The use of socket outlet is restricted in a number of particular locations, including damp situations. • Where socket outlets are installed in building surfaces that are required to provide fire-resistance or acoustic properties, measures shall be taken to ensure these properties are maintained. 		
<p>(d) Any TWO of</p> <ul style="list-style-type: none"> • The gM fuse links will withstand motor starting currents. • Starting currents up to 7 times full load current. • The fusing factor (utilisation category) is typically between 1.6 and 2.5 	<p>) Gk (2 marks)</p>	

Question 9	Reference Marks	Marking notes
(a) (i) • Yes,	(1 mark)	
• AS/NZS 3000: 2000: 2.5.3.1 or AS/NZS 3000:2007: 2.6.3.1.	(1 mark)	
(ii) • No. AS/NZS 3000:2000: 2.5.3.2 does not require such circuits to be RCD protected. Or • Yes. AS/NZS 3000:2007: 2.6.3.1(c) requires such circuits to be RCD protected.	(1 mark)	
(b) (i) • No.	(1 mark)	
• NZECP 54: 2.1.2(b) does not permit this.	(1 mark)	
(ii) • They can be installed provided the lampholder of the luminaire	NZECP 54: 2.3.2 3.4.2 (1 mark)	A reference (2.3.2 or 3.4.2) must be included in one of the answers – otherwise 0.5 marks lost
• is a least 500 mm from any building element.	NZECP 54: 2.3.2 3.4.2 (1 mark)	
(iii) Any ONE of:		
• It can be modified by the installation of a heat dispersal cover	NZECP 54: Table 1 and 3.5.3 (1 mark)	
that is rated CA or CS is accordance with the manufacturer's instructions	NZECP 54: Table 1 and 3.5.3 (1 mark)	
• It must be physically enclosed or sealed and rated suitable for use in moist areas	NZECP 54: 3.7(a) (2 marks)	

Question 9	<i>Reference Marks</i>	<i>Marking notes</i>
(iv) Any ONE of:	(1 mark)	
<ul style="list-style-type: none"> • They can be installed if a purpose built box or structure is mounted over the luminaire. 	NZECP 54: 2.6.3	
<ul style="list-style-type: none"> • When the fitting is fire-rated (has a FR rating) c 	NZECP 54: 3.3	
<ul style="list-style-type: none"> • When the fitting is rated to be abutted to thermal insulation (has an A rating) c 	NZECP 54: 3.3	