FINAL - ER 83 – 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.

Question 1	*Marks*	*Reference*	*Marking notes*
(a) Any ONE of:	(2 mark)		
• It has a maximum operated time of more than 0.5 seconds at its rated residual current.		ESR 24(4)(a)	
• It has a maximum operated time of more than 0.15 seconds at 5 times its rated residual current.		ESR 24(4)(a)	
• It has a rated residual current exceeding 300 milliamperes.		ESR 24(4)(b)	
(b) Minimum voltage 216.2V	(1 mark)	ESR 28(1)	
Maximum voltage 243.8V	(1 mark)	ESR 28(1)	
(c) Any ONE of:	(2 marks)		
• Falsely certifies any prescribed electrical work.		ESR 69(a)	
• Purports to certify prescribed electrical work when the certificate of compliance does not comply with the requirements of regulation 66(1).		ESR 69(b)	
• Issues a certificate of compliance that contains incorrect information.		ESR 69(c)	
• Issues a certificate of compliance in relation to particular prescribed electrical work when not authorised to certify that work.		ESR 69(d)	
(d) Any ONE of:	(2 marks)		
• Before permitting or authorising a connection for the supply of electricity		ESR 76 (1)	
• Where a person is supplying electricity to the caravan.		ESR 76 (1)	
• Where a person is hiring or leasing the caravan		ESR 77 (1)	

Question 1	*Marks*	*Reference*	*Marking notes*
(e) • 50V a.c. • 120V ripple-free d.c	(1 mark) (1 mark)	AS/NZS 3000 1.5.5.3(b) AS/NZS 3000 1.5.5.3(b)	
(f) Any ONE of: • Connections to, and joints in aluminum conductors shall be made using components specifically designed for the connection of aluminum conductors and techniques specified by the manufacturer. • Removal of the aluminum oxide film from the conductors. • The relative softness of aluminium. • The different coefficient of linear expansion of aluminium and other metals. • Avoiding contact with dissimilar metals that may initiate galvanic action.	(2 marks)	AS/NZS 3000: 3.7.2.1.2 AS/NZS 3000: 3.7.2.1.2(a) AS/NZS 3000: 3.7.2.1.2(b) AS/NZS 3000: 3.7.2.1.2(c) AS/NZS 3000: 3.7.2.1.2(d)	
(g) Any ONE of: • Shall have their voltage conspicuously marked. • Shall be of a form that will prevent insertion of an ELV plug into a socket outlet connected to a circuit of greater than extra-low voltage.	(2 marks)	AS/NZS 3000 4.4.1.2(a) AS/NZS 3000 4.4.1.2(b)	
(h) No connection, other than that made by an earthing conductor, shall be made between the primary and secondary windings.	(2 marks)	AS/NZS 3000 4.14.5	
(i) Any ONE of: • The exposed conductive part of any electrical equipment in the classified pool zones. • Any exposed conductive parts of electrical equipment that are not separated from live parts by double insulation and that are in contact with the pool water, including water	(2 marks)	AS/NZS 3000: 5.6.2.6.1(a) AS/NZS 3000: 5.6.2.6.1(b)	

Question 1	*Marks*	*Reference*	*Marking notes*
in the circulation of filtering system. ● Any conductive fittings within or attached to the pool, such as pool ladders and diving boards. ● Any fixed conductive material within arm's reach of the pool edge, such as conductive fences, lamp standards and pipework. ● Where electrical equipment situated in a classified zone is required to be earthed, all extraneous conductive parts in Zones 0, 1 and 2 shall be connected together by equipotential bonding conductors and connected to the protective earthing conductor of the electrical equipment, in accordance with clause 5.6.2.6. ● Where electrical equipment is in contact with pool water, failure of insulation may result in a hazardous voltage appearing across or through the pool water. Protective measures may include metal grids or barriers inserted in any plumbing connections between the electrical equipment and pool and connected to the equipotential bonding system.		AS/NZS 3000: 5.6.2.6.2(a) AS/NZS 3000: 5.6.2.6.2(b) AS/NZS 3000: 6.3.3.2 AS/NZS 3000: 6.3.3.3(b)	
(j) The selection and setting of adjustable protective devices for compliance with overcurrent protection, arc fault protection and discrimination requirements.	(2 marks)	AS/NZS 3000: 8.2.2(c)(ii)	

Question 2	*Marks*	*Reference*	*Marking notes*
(a) Any ONE of: ● Conductors with black or light blue insulation used as active conductors. ● Conductors with other than green, yellow, green/yellow, black or light blue insulation being used as neutral conductors. ● Conductors within multi-core cables with other than green, yellow or green/yellow insulation used as earthing conductors.	(2 marks)	AS/NZS 3000 3.8.2(a) AS/NZS 3000 3.8.2(b) AS/NZS 3000 3.8.2(c)	
(b) It shall be acceptable to identify the portion of the screen from the point of separation of the cores to the conductor termination as an earthing conductor.	(2 marks)	AS/NZS 3000 3.8.3.1(b)	
(c) (i) Any ONE of: ● The low voltage cables shall be of a type providing the equivalent of double insulation ● All cables shall be insulated for the highest voltage present. ● The low voltage cables shall be installed in a separate compartment having fixed and continuous barriers between compartments	(2 marks)	AS/NZS 3000 3.9.8.3(a) AS/NZS 3000 3.9.8.3(b) AS/NZS 3000 3.9.8.3(c)	
(ii) Any ONE of: ● Separation is required to ensure that faults occurring on the low voltage system are not transferred into the extra-low voltage system ● To avoid any detrimental effects arising between circuits of an electrical installation operating at different voltages.	(2 marks)	GK AS/NZS 3000: 3.9.8.1(c)	The answer must come from the preamble and part (c)
(d) Any ONE of: ● Of a type designed for such use. ● Painted with light-coloured water-based acrylic paint ● Where a wiring system is, or may be, exposed to direct sunlight,	(2 marks)	AS/NZS 3000 3.10.3.7(a) AS/NZS 3000 3.10.3.7(b) AS/NZS 3000 3.10.3.7(b)	

Question 2	*Marks*	*Reference*	*Marking notes*
either a wiring system suitable for the conditions, shall be selected and installed, or adequate shielding shall be provided, in accordance with clause 3.3.2.2.			

Question 3	*Marks*	*Reference*	*Marking notes*
(a) (i) 0.9 + 0.6 + 1	(½ mark)	AS/NZS 3000 2.9.2.2(i)	
= 2.5 m	(1 mark)		
(ii) 0.6 + 1	(½ mark)	AS/NZS 3000 2.9.2.2(i)	
= 1.6 m	(1 mark)		
(iii) 0.6 + 1	(½ mark)	AS/NZS 3000 2.9.2.2(i)	
= 1.6 m	(1 mark)		
(iv) 0.6 + 1	(½ mark)	AS/NZS 3000 2.9.2.2(i)	
= 1.6 m	(1 mark)		
(b) (i) 2.5 + 1.6 + 1.5	(½ mark)	AS/NZS 3000 2.9.2.2(i)	
= 5.6 m	(1 mark)		
(ii) 1.6 + 1.6 + 2.7	(½ mark)	AS/NZS 3000 2.9.2.2(i)	
= 5.9 m	(1 mark)		
(c) • 0.75m wide	(½ mark)	AS/NZS 3000: 2.9.2.2(c)(iii)	
• 1.98 m high	(½ mark)	AS/NZS 3000: 2.9.2.2(c)(iii)	

Question 4	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of: ● Access is restricted to competent persons ● Access is restricted to persons under the supervision of a competent person. ● Simultaneously accessible parts at different voltages shall not be within arms reach ● Where simultaneously accessible parts are more than 2.5 m apart	(2 marks)	AS/NZS 3000 1.5.4.6(a) AS/NZS 3000 1.5.4.6(b) AS/NZS 3000 1.5.4.6 Figure 1.1 AS/NZS 3000 1.5.4.6 Note 1	
(b) ● Insulation ● Obstacles	(1 mark) (1 mark)	AS/NZS 3000: 1.5.4.2(a) AS/NZS 3000: 1.5.4.2(c)	
(c) Any TWO of: ● A key or tool is required. ● An interlocking device is fitted. ● An intermediate barrier is provided	(2 marks)	AS/NZS 3000 1.5.4.4(b)(i) AS/NZS 3000 1.5.4.4(b)(ii) AS/NZS 3000 1.5.4.4(b)(iii)	
(d) (i) ● Full penetration of 12.5 mm sphere not allowed. ● The jointed test finger shall have adequate clearance form hazardous parts. (ii) ● Protected against water splashed from all directions ● Limited ingress permitted	(1 mark) (1 mark) (1 mark) (1 mark)	AS/NZS 3000 Figure G1a AS/NZS 3000 Figure G1a AS/NZS 3000 Figure G1b AS/NZS 3000 Figure G1b	

Question 5	*Marks*	*Reference*	*Marking notes*
(a) Where the number of RCDs exceeds one and more than one lighting circuit is installed, lighting circuits shall be distributed between RCDS.	(2 marks)	AS/NZS 3000 2.6.2.4(a)	
(b) Not more than three final subcircuits shall be protected by any one RCD and where there is more than one final subcircuit a minimum of two RCDs shall be installed.	(2 marks)	AS/NZS 3000 2.6.2.4(b)	
(c) ● 1. 2.5 mm^2 twin and earth TPS cable supplying permanently-connected hair-dryer in a bathroom	(1 mark)	AS/NZS 3000 2.6.3.1(c)	
● 5. 1.5 mm^2 twin and earth TPS cables supply lights	(1 mark)	AS/NZS 3000 2.6.3.1(b)	
● 14 2.5 mm^2 twin and earth TPS cables supplying socket outlets	(1 mark)	AS/NZS 3000 2.6.3.1(a)	
(d) ● RCCB 1 10A MCB 2 20A MCBs	(1 mark)	GK	
● RCCB 1 10A MCB 2 20A MCBs	(1 mark)	GK	
● RCCB 3 20A MCBs	(1 mark)	GK	

Question 6	*Marks*	*Reference*	*Marking notes*
(a) ● Starting and stopping the motor	(1 mark)	AS/NZS 3000: 4.13.1.1(a)	
● Emergency stopping in accordance with clause 2.3.5	(1 mark)	AS/NZS 3000: 4.13.1.1(b)	
● Isolating the motor for mechanical maintenance, in accordance with clause 2.3.6	(1 mark)	AS/NZS 3000: 4.13.1.1(c)	
(b) Any ONE of:	(2 marks)		
● The full load current of the motor		AS/NZS 3000: 4.13.1.2(a)	
● Shall be capable of safely interrupting the locked rotor or stall current of the motor.		AS/NZS 3000: 4.13.1.2	
● In the absence of any specific information supplied by the manufacturer, the locked rotor current or stall current shall be taken as eight times the full load current for a.c. motors.		AS/NZS 3000: 4.13.1.2(i)	
● In the absence of any specific information supplied by the manufacturer, the locked rotor current or stall current shall be taken as four times the full load current for d.c. motors.		AS/NZS 3000: 4.13.1.2(ii)	
(c) Any ONE of:	(2 marks)		
● For motors associated with a fire protection service		AS/NZS 3000: 4.13.3.2(a)	
● Where the opening of the motor circuit could create a hazard.		AS/NZS 3000: 4.13.3.2(b)	
● Overtemperature protective devices shall not be provided on fire-pump motors where the operation of such devices might reduce the operating time of the equipment under emergency conditions.		AS/NZS 3000: 7.2.9.3	
(d) Any ONE of:	(2 marks)		
● For single phase a.c. motors and d.c. motors supplied from a two-wire supply with one line earthed and single-phase a.c. motors, one		AS/NZS 3000 4.13.3.3(b)(i)	
● For three-phase a.c. motors and d.c. motors supplied from two		AS/NZS 3000 4.13.3.3(b)(ii)	

Question 6	*Marks*	*Reference*	*Marking notes*
unearthed lines, two.			
(e) Motors rated above 370 W	(1 mark)	AS/NZS 3000: 4.13.2	

Question 7	*Marks*	*Reference*	*Marking notes*
(a) ● Test between all live conductors and earth. ● Test between each conductor.	(1 mark) (1 mark)	AS/NZS 3000: 8.3.6.1 AS/NZS 3000: 8.3.6.1	
(b) Any ONE of: ● That the earthing system 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. ● That exposed conductive parts of electrical equipment do not reach dangerous voltages when such faults occur.	(2 marks)	AS/NZS 3000: 8.3.5.1	
(c) (i) (1) Earth resistance test of main earthing conductor (2) Earth resistance test of other earthed and equipotential bonded parts. (3) Insulation resistance test (4) Polarity test of consumers mains (5) Polarity test of submains (6) Polarity and correct connections test of final subcircuits (7) Earth fault-loop impedance test (8) Verification of operation of RCDS	(4 marks)	AS/NZS 3000: 8.3.4	Items 1 to 3 must be in order. Items 4 to 6 can be in any order Items 7 and 8 must be in order
(ii) If the electrical installation fails a test, that test and any preceding tests that may have been influenced by the fault indicated shall be repeated after the fault has been rectified.	(2 marks)	AS/NZS 3000 8.3.3	

Question 8	*Marks*	*Reference*	*Marking notes*
(a) (i) Any TWO of: ● HRC fuses ● Miniature circuit breakers ● RCDs ● Devices such as thermal overloads or thermistors.	(2 marks)	AS/NZS 3000 2.4.3	
(ii) Any ONE of: ● Verify the earth fault loop impedance value ensures that the protective device will operate to disconnect an earth fault current in the time and touch voltage requirements of clause 5.7. ● Use of test equipment that causes the RCD to operate under residual a.c current and residual pulsating d.c current and that verifies that the RCD is suitable for personal protection.	(2 marks)	AS/NZS 3000 8.3.9.1 AS/NZS 3000 8.3.10	
(b) (i) Equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions.	(2 marks)	AS/NZS 3000 1.4.28	
(ii) Any ONE of: ● Ensure that the double insulation is free from mechanical damage. ● Carry out an insulation resistance test between the insulation and any exposed metal to verify the integrity of the insulation	(2 marks)		
(c) A SELV or PELV system.	(2 marks)	AS/NZS 3000 7.5.1	

Question 9	*Marks*	*Reference*	*Marking notes*
(a) $I = \frac{P}{V \times pf}$	(½ mark)		
$= \frac{16000}{230 \times 0.95}$	(½ mark)		
$= 73.23$ A	(½ mark)		
From Column 7 Table 10 the rating for 25 mm^2 is 95A amps.	(½ mark)		
From Table 27(1), the-rating factor for 35^0C is 0.94	(½ mark)		
The maximum load can be carried by the 25 mm^2 cable is:	(½ mark)		
$= 95 \times 0.94$			
$= 89.3$A	(½ mark)		
A 25 mm^2 aluminium cable will satisfy the load requirements.	(1 mark)		
(b) Maximum volt drop permitted	(½ mark)		
$= 230 \times 1.5\%$			
$= 3.45$V	(½ mark)		
$V_d = \frac{mV/A.m \times A \times m}{1000}$	(½ mark)		
$mV/A.m = \frac{V_d \times 1000}{A \times m}$	(½ mark)		
$= \frac{3.45 \times 1000}{73.23 \times 40}$	(½ mark)		
$= 1.1778$ mV/A.m	(1 mark)		
From Table 45 the single-phase conversion factor is 1.155			
$= \frac{1.1778}{1.155}$			
$= 1.0198$			
From Table 45 - 1.0198 mV/A.m equates to a 70 mm^2 cable	(½ mark)		
A 70 mm^2 aluminium cable will satisfy the voltage drop requirements.	(½ mark)		
(c) A 70 mm^2 aluminium cable will satisfy the load and voltage drop requirements.	(1 mark)		