

V2 – IT 19 – ELECTRICAL INSPECTOR EXAMINATION 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"> • Registered electrical service technician • Registered line mechanic • Registered electrician • Registered electrical inspector 	EA2 (1 mark)	
(b) Any ONE of: <ul style="list-style-type: none"> • Suitable warning notices affixed at the means of disconnection • Locking of the means of disconnection 	ER34 (1 mark)	
(c) Any ONE of: <ul style="list-style-type: none"> • The repair or replacement of a faulty conductor: • The repair or replacement of a damaged conductor: • The replacement of a fuse carrier with a circuit breaker appropriate to the rating of the electrical circuit in which the replacement is being made: • The replacement of any fitting with a fitting of an appropriate size, type, and rating for the electrical circuit: • The installation of revenue meters and associated load control fittings of mains. 	ER 39(2) (1 mark)	
(d) No. Refer to regulation 41(5)(a)	(1 mark)	
(e) <ul style="list-style-type: none"> • The Secretary • The owner or occupier of the property. 	ER 50 (1 mark)	

Question 1	Reference Marks	Marking notes
(f) \$10,000	ER51(a) (1 mark)	
(g) Declared articles	ER 101 (1 mark)	
(h) 0.4s	AS/NZS 3000: 2000: 1.7.4.3.4(a) 2007: 1.5.5.3(d) (1 mark)	
(i) Any ONE of: <ul style="list-style-type: none"> • The use of a key or tool is required. • An interlocking device is fitted. • An intermediate barrier is provided. 	AS/NZS 3000: 2000: 1.7.3.4.2 2007: 1.5.4.4b (1 mark)	
(j) Any TWO of: <ul style="list-style-type: none"> • Where the electrical equipment operates under conditions of fluctuating or intermittent loading, or a definite duty cycle • Where the electrical installation is large and complex • Where special types of occupancy exist. 	AS/NZS 3000: 2000: 1.8.3.3 2007: 2.2.2(b) (1 mark)	
(k) A combined protective earthing and neutral (PEN) conductor shall not be isolated or switched.	AS/NZS 3000: 2000: 2.8.2.3 2007: 2.3.2.1.1(c) (1 mark)	
(l) Any TWO of: <ul style="list-style-type: none"> • Provided with adequate mechanical protection to prevent damage. • Provided with an earthed metallic armouring. • Provided with an earthed metallic, screen. • Provided with an earthed metallic covering. • Provided with an earthed metallic enclosure. • Protected by an RCD with a maximum rated residual current of 30 mA. 	AS/NZS 3000: 2000: 3.9.4.6 2007: 3.9.4.4 (1 mark)	

Question 1	Reference Marks	Marking notes
(m) 0.3 metres	AS/NZS 3000: 2000: 7.1.4.2 2007: 6.2.4.2 (1 mark)	
(n) Any ONE of: <ul style="list-style-type: none"> • Protection by means of obstacles • Protection by placing out of reach. 	AS/NZS 3000: 2000 7.4.3.2 2007 6.6.3.2 (1 mark)	
(o) Any ONE of:	(1 mark)	
<ul style="list-style-type: none"> • Electrical equipment permitted to be installed within the classified zone shall have a degree of protection of at least IPX5. 	AS/NZS 3000: 2000: 7.5.4.1	
<ul style="list-style-type: none"> • Does not provide pockets or channels in which moisture might accumulate or through which it might pass into electrical equipment 	AS/NZS 3000: 2000: 7.5.4.2	
<ul style="list-style-type: none"> • Does not provide pockets or channels in which moisture might accumulate or through which it might pass into electrical equipment 	AS/NZS 3000: 2000: 7.5.4.2	
<ul style="list-style-type: none"> • Electrical equipment permitted to be installed within the classified zone shall have a degree of protection of at least IPX5 where low or medium pressure hosing is used. 	AS/NZS 3000: 2007: 6.7.4.2(a)	
<ul style="list-style-type: none"> • Electrical equipment permitted to be installed within the classified zone shall have a degree of protection of at least IPX6 where high pressure hosing is used. 	AS/NZS 3000: 2007: 6.7.4.2(b)	
<ul style="list-style-type: none"> • Will not be affected by the method of hosing, materials used, temperature and pressure of the hosing medium. 	AS/NZS 3000: 2007: 6.7.4.3	
<ul style="list-style-type: none"> • Is protected against moisture that might accumulate. 	AS/NZS 3000: 2007: 6.7.4.3	
<ul style="list-style-type: none"> • Does not provide pockets or channels in which moisture might accumulate or through which it might pass into electrical equipment 	AS/NZS 3000: 2007: 6.7.4.3	
(p) Any ONE of:		

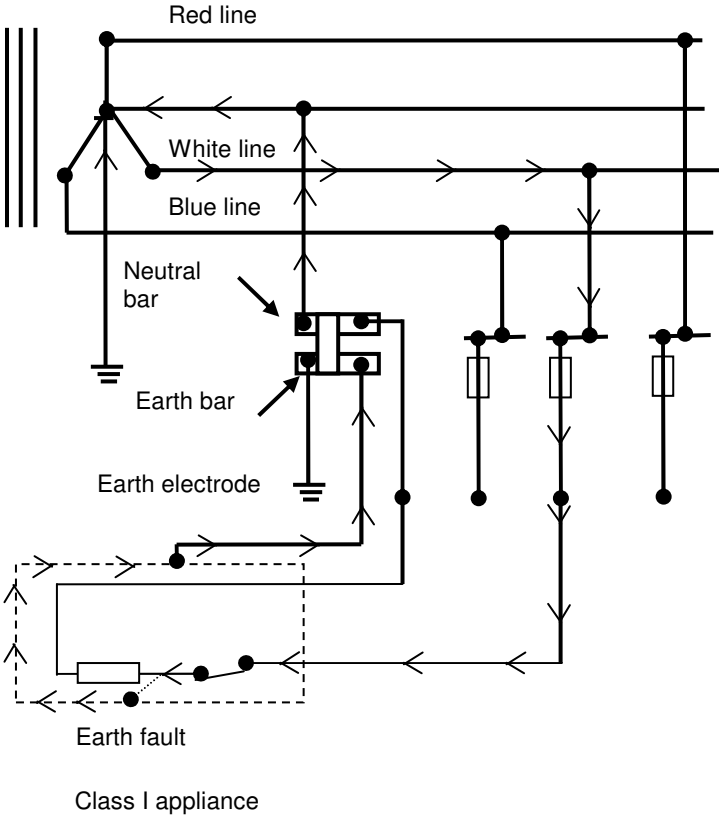
Question 1	Reference Marks	Marking notes
<p>From AS/NZS 3000:2000: 7.7.7</p> <ul style="list-style-type: none"> • Where electrical equipment is specially designed for operation with a voltage drop greater than 10%. • Where steady-state conditions are not applicable such as during motor starting, solenoid closing or other similar applications where high transient currents may be experienced. 	(1 mark)	
<p>From AS/NZS 3000:2007: 7.5.7</p> <ul style="list-style-type: none"> • Where electrical equipment is specially designed for operation with a voltage drop greater than 10%. • Motor starting, solenoid closing or other similar applications where high transient currents may be experienced that can significantly increase voltage drop. 		
(q) Any TWO of:	(1 mark)	
<ul style="list-style-type: none"> • Shall not accept plugs of other voltage systems. 	AS/NZS 3000: 2000: 7.7.11(b) 2007: 7.5.10(b)	
<ul style="list-style-type: none"> • Shall not have a contact for a protective earthing conductor. 	AS/NZS 3000: 2000: 7.7.11(c) 2007: 7.5.10(c)	
<ul style="list-style-type: none"> • Shall have their voltage conspicuously marked 	AS/NZS 3000: 2000: 4.9.1.3.1(a) 2007: 4.4.1.2(a)	
<ul style="list-style-type: none"> • Shall be of a form that will prevent insertion of an extra-low voltage plug into a socket-outlet connected to a circuit of greater than extra-low voltage. 	AS/NZS 3000: 2000: 4.9.1.3.1(b) 2007: 4.4.1.2(b)	
(r) 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	
(s) To ensure that a three-phase motor operated from any of the outlets will run in the same direction of rotation:	(1 mark)	GK

Question 1	<i>Reference Marks</i>	<i>Marking notes</i>
(t) <ul style="list-style-type: none">• To avoid heating due to eddy currents.• To avoid a shock hazard due to induced voltage.	(1 mark)	GK

Question 2

(a) Maximum demand calculation						
Equipment	Load Group	Calculation	Line 1	Line 2	Line 3	
Halide lamps	A	$25 \times 1.09 = 27.17$	27.17	27.17	27.17	(1 mark)
10A socket outlets	B(i)	$1 \times 4.35 = 4.35$ $11 \times 4.35 \times 0.75 = 35.89$		40.24		(1½ marks)
15A socket outlets	B(iii)	$1 \times 15 = 15$ $11 \times 15 \times 0.75 = 123.75$	138.75			(1½ marks)
Drill presses	D	$2 \times 3.1 \times 50\%$	3.1	3.1	3.1	(1 mark)
Lathes	D	$1 \times 10.89 = 10.89$ $1 \times 10.89 \times 0.75 = 8.17$ $4 \times 10.89 \times 0.5 = 21.78$	40.84	40.84	40.84	(2 marks)
Hot water heater	G	$1 \times 13.04 = 13.04$			13.04	(1 mark)
			209.86	111.35	84.15	
(b) Heaviest loaded phase = 209.86 on line 1						(2 marks)
AS/NZS 3000: Table C2						

Question 3	Reference Marks	Marking notes
(a) Any FOUR of:		
(1) Hazard - Touch voltage in flats may rise to dangerous levels	GK (1/2 mark)	
Danger Shock	GK (1/2 mark)	
(2) Hazard - High current flow in main earth conductor	GK (1/2 mark)	
Danger Shock or fire	GK (1/2 mark)	
(3) Hazard - Rise in the supply voltage	GK (1/2 mark)	
Danger Equipment damage or fire or shock	GK (1/2 mark)	
(4) Hazard - Unstable supply voltage	GK (1/2 mark)	
Danger Shock or fire	GK (1/2 mark)	
(5) Hazard - Current flow through the MEN system of adjacent installations	GK (1/2 mark)	
Danger Shock or fire	GK (1/2 mark)	
(b) <ul style="list-style-type: none"> • Where the metal is not fully isolated from earth • Where the metal is located within arms reach. 	ER 84(2) (2 marks)	

Question 3	Reference Marks	Marking notes
<p>(c) Figure B4.1 MEN system (simplified) showing fault (Ia) path</p> 		
<p>The path showing:</p>		
<ul style="list-style-type: none"> From the fault through the protective earthing conductor, (PE), main earthing terminal bar and MEN link. 	<p>AS/NZS 3000: Appendix B4.3 (1 mark)</p>	<p><u>Hazardous answers</u></p> <ul style="list-style-type: none"> No MEN link
<ul style="list-style-type: none"> The neutral-return path, consisting of the neutral conductor, (N), between the main neutral terminal or bar and the neutral point at the transformer. 	<p>AS/NZS 3000: Appendix B4.3 (1 mark)</p>	<ul style="list-style-type: none"> Any short-circuit Phase/neutral transposition
<ul style="list-style-type: none"> The path through the neutral point of the transformer and the transformer winding. 	<p>AS/NZS 3000: Appendix B4.3 (1 mark)</p>	<ul style="list-style-type: none"> Star point of the transformer not earthed
<ul style="list-style-type: none"> The active conductor as far as the point of the fault. 	<p>AS/NZS 3000: Appendix B4.3 (1 mark)</p>	

Question 4	Reference Marks	Marking notes
<p>(a) (i) (1) The supply lead must be connected to the line terminals of an overcurrent circuit breaker. (Also accept: A junction box which provides a connection to the line terminals of an overcurrent circuit breaker.)</p>	<p>AS/NZS 3001:2001: 3.2.2(a) 2008: 3.2.3 (1 mark)</p>	
<p>(2) A suitable means of storage for the lead must be provided.</p>	<p>AS/NZS 3001:2001: 3.2.2(iii) 2008: 3.2.3 (1 mark)</p>	
<p>(3) From AS/NZS 3001:2001: 3.2.2(iv)</p> <p>The lead must be rated at not less than the maximum demand of the caravan.</p> <p>From AS/NZS 3001:2008: 3.3.1.1</p> <p>The maximum rating of this circuit breaker shall not exceed the maximum current rating of the supply lead, or supply lead fittings, which ever is the smaller. AS/NZS 3001:2008 3.3.1.1</p>	<p>(1 mark)</p>	
<p>(ii) (1) IEC 60309 16 A or 32 A single phase or AS/NZS 3112 3 pin flat pin 15 A or greater</p>	<p>GK (1 mark)</p>	
<p>(2) To provide a very limited range of standard types of socket outlets and supply lead plugs for the easy and safe connection of connectable installations (or transportable structures).</p>	<p>GK (2 marks)</p>	<p>GK</p>
<p>(b) If the RCD operates (or trips) total supply disconnection occurs to make all faulty equipment electrically safe.</p>	<p>GK (1 mark)</p>	
<p>(c) The circuit breaker permitted has a maximum rating to protect the socket outlet, supply lead and fittings from overloading.</p>	<p>GK (1 mark)</p>	<p>GK</p>

Question 4	<i>Reference Marks</i>	<i>Marking notes</i>
(d) Any TWO of: <ul style="list-style-type: none"> • Sockets outlets • Air conditioning • Heating equipment • Water heaters 	AS/NZS 3001: 2.6 (2 marks)	

Question 5	Reference Marks	Marking notes
(a) (i) • The impedance of the neutral and earth are equal.	GK (1 mark)	
• Therefore, the neutral must have a high resistance joint	GK (2 marks)	
(ii) • Yes	(½ mark)	
• It has taken half of the load, as the earth usually takes a small percentage of then load	GK (½ mark)	
• The impedance of the circuit to earth is low.	GK (1 mark)	
(b) • The earth is now carrying current from another installation.	(1 mark)	
• The other installations, distribution or service lines may have faulty neutral connection(s) and under fault conditions there are many parallel paths back to the transformer earth.	(2 marks)	
(c) (1) The MEN system ensures that the voltage between P/E and P/N never rises above a nominal 230V under fault conditions.	(1 mark)	
(2) The MEN systems ensure that between the general mass of earth and any earthed metal there will always be nearly 0V potential.	(1 mark)	

Question 6	Reference Marks	Marking notes
<p>(a) Any THREE of:</p> <ul style="list-style-type: none"> • Any metal not normally live could be live. • If the earth fault path is of high impedance the main fuse may not blow • Fire hazard could occur through the main earth conductor carrying excessive current • The earth bar/neutral bar/MEN link could be live at up to 230V. • The neutral is being switched. • 400V could be present at any socket outlet • Damage could occur to any 400V appliance / motor • Lighting circuits could have 400V present at the light socket • With the main switch in the "off" position, equipment downstream of that switch could be live. 	GK (3 marks)	
<p>(b) • Insert temporary earth stake remote from main earth electrode</p>	(½ mark)	<u>Hazardous</u>
<p>• Test in turn with voltmeter and trailing lead:</p>	(½ mark)	Lifting the MEN link with the installation live
<p>* between each phase and remote earth</p>	(½ mark)	
<p>* between the neutral/earth bar and remote earth</p>	(½ mark)	
<p>• If a transposition has taken place:</p>		
<p>* There will be 230V between two of the phases and the remote earth</p>	(1 mark)	
<p>* There will be 230V between the neutral/earth bar and the remote earth</p>	(1 mark)	
<p>* There will be 0V between one of the phase and the remote earth</p>	(1 mark)	
<p>• If no transposition has taken place:</p>		
<p>* There will be 230V between each phase and the remote earth</p>	(1 mark)	

Question 6	<i>Reference Marks</i>	<i>Marking notes</i>
* There will be 0V between the neutral/earth bar and the remote earth	(1 mark)	

Question 7	Reference Marks	Marking notes
<p>(a) Any TWO of:</p> <p>From AS/NZS 3000:2000: 2.5.3.4</p> <ul style="list-style-type: none"> • Where socket-outlets are added to a final subcircuit, provided that the existing subcircuit is not RCD protected. • Where socket-outlets are added to a final subcircuit, provided that the existing socket-outlets on the circuit are not RCD protected. • Where socket-outlets that are not RCD protected are replaced. • Where all points on a new final subcircuit are protected by an RCD installed at the first point of that new final subcircuit. <p>From AS/NZS 3000: 2007: 2.6.3.4</p> <ul style="list-style-type: none"> • Where socket outlets that are not RCD protected are replaced • Where lighting points that are not RCD protected are replaced • The replacement of a single socket outlet with a multiple socket outlet assembly. • Extensions to final subcircuits supplying lighting pints only, providing the existing final subcircuit is not RCD protected., including the 	<p>(4 marks)</p>	
<p>(b) (i) A Type A RCD</p>	<p>GK AS/NZS 3000: 2007: 2.6.2.2 (1 mark)</p>	

Question 7	Reference Marks	Marking notes
<p>(ii) From AS/NZS 3000:2000 2.5.2.2</p> <p>A type where tripping is ensured for residual alternating current and residual pulsating direct current.</p> <p>From AS/NZS 3000:2007 2.6.2.2</p> <p>For which tripping is ensured for residual sinusoidal alternating currents and residual pulsating direct currents.</p>	(2 marks)	
<p>(c) • The imbalance between the neutral and active currents induces a magnetic field into the RCD sensing coil iron core.</p>	(1 mark)	
<p>• The induced magnetic field induces a current in the RCD sensing coil</p>	(1 mark)	
<p>• The RCD tripping coil is energised, isolating the circuit by opening the RCD contacts</p>	(1 mark)	

Question 8	Reference Marks	Marking notes
(a) $I_{(FL)} = \frac{P}{V}$	(1/2 mark)	
= $\frac{11,000}{230}$	(1/2 mark)	
= 47.83 A	(1 mark)	
(b) From table 9, a 6 mm ² is rated for 50 amps.	(1/2 mark)	
From table 27(1), the derating factor is 0.88.	(1/2 mark)	
Applying the derating factor = 50 x 0.88 = 44A.	(1/2 mark)	
Therefore a 10 mm ² cable will satisfy the load requirements.	(1 mark)	
(c) Maximum volt drop permitted = 230 x 0.015 = 3.45V	(1/2 mark)	
From table 42, a 10 mm ² cable, with an operating temperature of 75 °C, has an mV/A.m of 3.86 x 1.155 = 4.4583	(1 1/2 marks)	
Voltage drop = $\frac{V/A.m \times \text{amps} \times \text{metres}}{1000}$	(1/2 mark)	
= $\frac{4.4583 \times 16.5 \times 47.83}{1000}$	(1/2 mark)	
= 3.52V	(1/2 mark)	
Therefore, a 16 mm ² cable will satisfy the voltage drop requirements.	(1 mark)	
(d) (i) A 16 mm ² copper cable will satisfy both the load and voltage drop requirements.	(1/2 mark)	
(ii) Yes AS/NZS 3000:2000: Table B5.1 AS/NZS 3000:2007: Table B1	(1/2 mark)	

Question 9	Reference Marks	Marking notes
(a) (i) Fit a barrier (curtain or door)	(½ mark)	
To the shower	(½ mark)	
(ii) To limit the extent of Zone 1 of the shower	(1½ marks)	
(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)	No marks can be awarded for part (b) if Zone 0 or Zone 1 is given as an answer for (b)(i)
(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)	
(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)	No marks can be awarded for part (c) if Zone 0 or Zone 1 is given as an answer for (c)(i)
(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) Both 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 9	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)	No marks can be awarded for part (d) if Zone 0 or Zone 1 is given as an answer for (d)(i)
(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 or supplied from an isolated supply	AS/NZS 3000: 2000: 7.1.4.2(c) 2007: 6.2.4.2(c) (1 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)	