V2-CHANGES - IT 17 – 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

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

5. Those parts of an answer that are under-lined indicate the parts required to be covered by a candidate.

Question 1

(a)
- Low voltage is any voltage between 50 and 1000 volts.
- Standard low voltage is a nominal voltage of 230 volts between phase and earth

ER 2
(1 mark)

(b)
- The switching of electrical installations
- The rewinding of armatures

ER 17(2)(d) and (i)
(1 mark)

(c) (i) At intervals not exceeding 14 months

ER26(4)
(½ mark)

(ii) At intervals not exceeding 7 months

ER26(4)
(½ mark)

(d) (i) Section 6 of AS/NZS 3000:2000
or
Section 8 of AS/NZS 3000:2007

ER 37 (3)
(½ mark)

(ii) Section 3 of NZS 3019

ER 41(3)
(½ mark)

(e) The electrical Inspector

ER 40(3) and 42(1)

(f) 1 year

ER46(2)(g)
(1 mark)

(g) Any ONE of:

- The work does not involve any work on a switchboard

ER: 47(1)(a)

- They must be supplied by TPS cables

ER: 47(1)(d)

- Must not enter any enclosure where active conductors are likely to be present.

ER: 47(1)(e)(i)
(1 mark)

(h) (1) Advise the owner or occupier of the property where the danger exists
(2) Advise the Secretary of that danger

ER 50
(1 mark)

(i) A combined protective earthing and neutral (PEN) conductor shall not be isolated or switched.

AS/NZS 3000: 2000: 2.8.2.3
AS/NZS 3000:2007: 2.3.2.1.1(c)
(1 mark)

(j) (i) From AS/NZS 3000:2000: 2.9.8.4(e)

It must be outside or not above any zone

From AS/NZS 3000:2007: 2.9.2.5(e)

It must be outside or not above any classified zone

Note: As an alternative, the actual dimensions from one of the figures in AS/NZS 3000 can be quoted

(½ mark)

(ii) From AS/NZS 3000:2000: 2.9.8.4(h)

It must be suitably protected from the effects of the operation of the sprinkler system which may affect their operation.

From AS/NZS 3000:2007: 2.9.2.5 (j)

It must have a degree of protection of IPX4

(½ mark)

(k) Any TWO of:

- 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
AS/NZS 3000:2007: 3.9.4.4
(1 mark)

(l) From AS/NZS 3000:2000: 4.8.3.1

An alternative supply shall be so arranged that it cannot feed back into the normal supply system either directly or indirectly unless it complies with the requirements of the electricity distributor where the normal supply is provided by that body.

From AS/NZS 3000:2007: 7.3.3

An electricity generation system shall be arranged so that it cannot supply energy upstream of the point of connection to the installation either directly or indirectly. (2007 version)

(1 mark)

(m) The size can be determined in relation to the cross-sectional area of the minimum cable size required to carry the maximum demand.

AS/NZS 3000:2000: 5.5.1.2(c)(ii)
AS/NZS 3000:2007: 5.3.3.2(b)
(1 mark)

(n) $4mm^2$ Cu

AS/NZS 3000:2000: 5.8.3.2(a)
AS/NZS 3000:2007: 5.6.3.2(a)
(1 mark)

(o) (i) 500V d.c.
(ii) 500V d.c.

AS/NZS 3000:2000 6.3.3.1
AS/NZS 3000:2007: 8.3.6.1
(1 mark)

(p) Any TWO of:

- Shall not accept plugs of other voltage systems.
  AS/NZS 3000:2000: 7.7.11(b)
  AS/NZS 3000:2007: 7.5.10(b)
- Shall not have a contact for a protective earthing conductor.
  AS/NZS 3000:2000: 7.7.11(c)
  AS/NZS 3000:2007: 7.5.10(c)
- Shall have their voltage conspicuously marked
  AS/NZS 3000:2000: 4.9.1.3.1(a)
  AS/NZS 3000:2007: 4.4.1.2(a)
- 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)
  AS/NZS 3000:2007: 4.4.1.2(b)
  (1 mark)

(q) From AS/NZS 3000:2000: 7.7.9

The fuses or circuit-breakers shall be installed in all the active conductors.

From AS/NZS 3000:2007: 7.5.9.1

The fuses or circuit-breakers shall be installed in all unearthed conductors.
(1 mark)

(r) It shall be connected on the supply side of the pump motor controller.

AS/NZS 3000:2000: 7.10.9.1
AS/NZS 3000:2007: 7.2.9.1
(1 mark)

(s) Any ONE of:

- Thermistor
  The thermistor switches the control circuit via a control relay.
- Thermal overload
  The thermal overload directly switches the control circuit.

(1 mark)

(t) Any ONE of:

- A Type A RCD
- The RCD is sensitive to residual a.c. current and residual pulsating d.c. current

GK
(1 mark)

Question 2

(a) (i) 30 amps (Accept answers between 24A and 32A)

(1 mark)

(ii) Any ONE of:

- To ensure that the protective device will operate within 400ms
- To ensure the protection of persons or property from step and touch potentials
- To protect property from fire & heat damage

(1 mark)
GK

(b) (i) It has a fusing factor between 1.25 and 1.5

(½ mark)

(ii) gG type

(½ mark)
GK

(c) $I_{PSC} = \frac{V}{Z_L}$

(½ mark)

$= \frac{230V}{0.18\Omega}$

(½ mark)

= 1278A

(1 mark)
GK

(d) (i) 415 AC 80

- 415V is the maximum voltage the fuse can withstand without flashover.

(1 mark)

- AC 80 is the maximum prospective short circuit current the fuse can safely interrupt

(1½ marks)

(ii) 6kA is the maximum prospective short circuit current the circuit breaker can safely interrupt

(1½ marks)

(iii) 63A is the maximum current the fuse can continuously carry without deterioration.

(1 mark)

Question 3

Living Unit Calculations – 6 units

Load Group	Calculation	Load (A)	
Group A			
Lighting	(1500 ÷ 230) x 6	39.13	(½ mark)
Track	(8 x 2 x 60 ÷ 230) x 6	25.04	(½ mark)
Group B			
Socket outlets	15 + (3.75 x 6)	37.50	(1 mark)
Group C			
Range	6 x 2.8	16.80	(1 mark)
Group E			
Instantaneous hot water	6 x 6	36.00	(½ mark)
Group F			
Storage water heaters	6 x 6	36.00	(½ mark)
Total		190.47	(1 mark)

Communal Areas Calculation

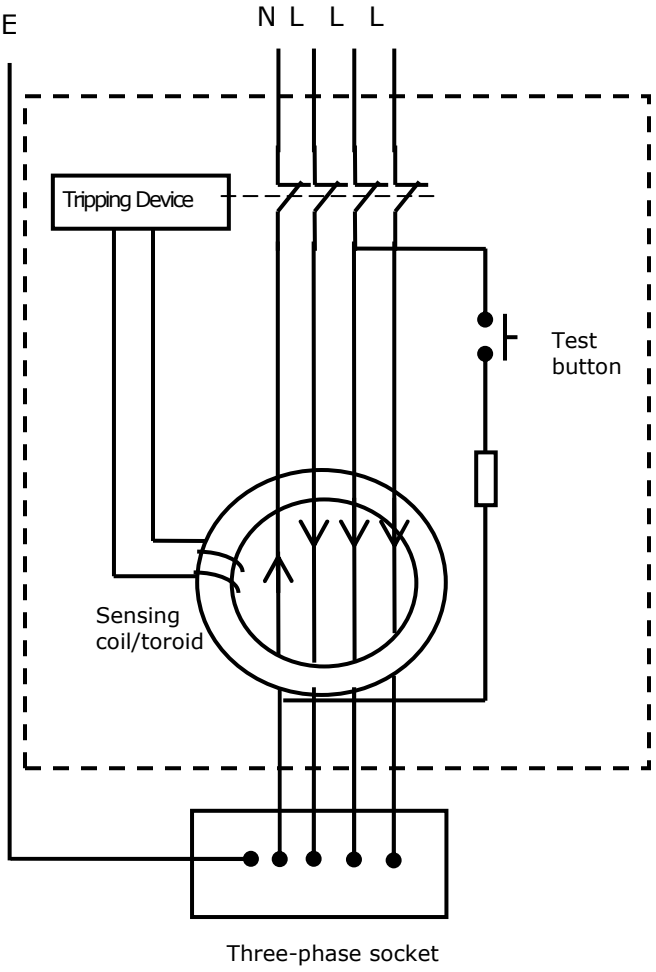
Load Group	Calculation	Load (A)	
Group H			
Lighting	(30 x 56) ÷ (3 x 230)	2.43	(1 mark)
Group I			
9 Socket outlets		15.00	(½ mark)
Group J(i)			
(i) Clothes dryers	(2000 ÷ 230)x 0.5	4.35	(½ mark)
(ii) Hot water cylinders	(2000 ÷ 230)x 0.5	4.35	(½ mark)
Group L			
Water pump	Name plate rating	10.8	(½ mark)
Total		36.93	(1 mark)

Load of heaviest loaded phase = 227.40A

(1 mark)

Question 4

(a)



- Correctly connected phases, neutral and earth. (1½ marks)
- Correctly connected test button and resistance (½ mark)
- Correctly connected sensing coil/toroid (½ mark)
- Correctly connected tripping circuit (½ mark)
- Correctly connected socket (½ mark)
- Working circuit (1½ marks)

(b) From NZS 3019:2004: B9.2.1 (Note 3)

Tests on three-phase units are carried out on each phase separately. In case of doubt, as the vector of the test current and the load leakage current is important, the load should be disconnected.

From AS/NZS 3019:2008

Tests on three or four pole RCDs, used on a three-phase supply, shall be tested with a three-phase supply connected. The tests shall be carried out individually on each phase in turn with all the load and neutral connections disconnected as any standing leakage current on the load side may add or subtract vectorially from the test current.

(4 marks)

(c) RCBO **R**esidual Current-Operated **C**ircuit **B**reaker with **O**vercurrent Protection

(1 mark)

Question 5

(a) (i)
- The impedance of the neutral and earth are equal.

(1 mark)

- Therefore, the neutral must have a high resistance joint

(2 marks)

(ii)
- It has taken half of the load, as the earth usually takes a small percentage of then load

(1 mark)

- The impedance of the circuit to earth is low.

(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

(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.)

AS/NZS 3001:2001: 3.2.2(a)
AS/NZS 3001:2008: 3.2.3
(1 mark)

(2) A suitable means of storage for the lead must be provided.

AS/NZS 3001:2001: 3.2.2(iii)
AS/NZS 3001:2008: 3.2.3
(1 mark)

(3) From AS/NZS 3001:2001: 3.2.2(iv)

The lead must be rated at not less than the maximum demand of the caravan.
From AS/NZS 3001:2008: 3.3.1.1

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
(1 mark)

(ii) (1) IEC 60309 16 A or 32 A single phase or AS/NZS 3112 3 pin flat pin 15 A or greater

(1 mark)

(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).

GK
(2 marks)

(b) If the RCD operates (or trips) total supply disconnection occurs to make all faulty equipment electrically safe.

(1 mark)

(c) The circuit breaker permitted has a maximum rating to protect the socket outlet, supply lead and fittings from overloading.

(1 mark)

(d) Any TWO of:

- Sockets outlets
- Air conditioning
- Heating equipment
- Water heaters

AS/NZS 3001: 2.6
(2 marks)

Question 7

(a) Transformer rating 50kVA.

$$= \frac{50000}{\sqrt{3} \times 400}$$

(½ mark)

$$= 72.17A$$

(1 mark)

(b) From Table 12 the minimum sized cable is 10 mm^2 Cu

(1 mark)

(c) Maximum volt drop is 2.5% of 400 = 10V

(½ mark)

From Table 42 the MV/A.m is 3.86 for a 10 mm^2 cable.

(½ mark)

$$V_d = \frac{mV/A.m \times I \times m}{1000}$$

(½ mark)

$$= \frac{3.86 \times 70 \times 125}{1000}$$

(½ mark)

$$= 33.78V$$

(½ mark)

From Table 42 the MV/A.m is 1.11 for a 35 mm^2 Cu cable.

(1 mark)

$$V_d = \frac{mV/A.m \times I \times m}{1000}$$

$$= \frac{1.11 \times 70 \times 125}{1000}$$

(½ mark)

$$= 9.71V$$

(1 mark)

Alternative solution

$$Vc = \frac{V_d \times 1000}{L \times I}$$

$$= \frac{10 \times 1000}{125 \times 70}$$

$$= 1.14 \text{ mV/A.m}$$

From Table 42 = 35 mm^2 Cu

(d) 10mm^2 Cu

AS/NZS 3000:2000: Table 5.1
AS/NZS 3000:2007: Table 5.1
(1 mark)

- It can be determined by the maximum sized cable that can supply the load.

(1 mark)

AS/NZS 3000:2000: 5.5.1.2(c)(ii)
AS/NZS 3000:2007: 5.3.3.2(b)

(½ mark)

Question 8

(a) Any THREE of:

- 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.
- Damage could occur because 400V is being supplied to 230V appliances, motors or fittings

(3 marks)

(b) (i)
- Use a voltmeter, remote earth and trailing lead.

(1 mark)

- Take a voltage test at the supply side of the main switch between each phase and the remote earth.

or

- Take a voltage test between the earth/neutral bar and the remote earth.
  or
  Take a voltage test between the metal enclosure of the meter box and the remote earth.
  or
  Take a voltage test between the earth electrode and the remote earth.

(1 mark)

(ii) If a transposition has taken place:

- The reading at the main switch for the transposed phase should be about 0V

(1 mark)

- The reading at the main switch for the two phases not transposed should be about 230 V

(1 mark)

- The reading between the neutral/earth bar and the remote earth should be about 230 V.

(1 mark)

(iii) If no transposition has taken place:

- The reading between the main switch and remote earth for each of the phases should be about 230 V

(1 mark)

- The reading between the neutral/earth bar and the remote earth should be about 0 volts.

(1 mark)

Note: The removal of the MEN link with the installation live is hazardous.
No marks for stating P-N=230V

Question 9

(a) (i) Regulation % = $\frac{V1 - V2}{V1} \times \frac{100}{1}$

(½ mark)

= $\frac{400 - 380}{400} \times \frac{100}{1}$

(½ mark)

= 5%

(1 mark)
GK

Short circuit fault MVA at the transformer secondary terminals

= $\frac{\text{Transformer kVA}}{\%\ Z \times 1000}$

(½ mark)

= $\frac{250 \times 1000}{0.05 \times 1000000}$

(½ mark)

= 5MVA

(1 mark)
GK

(ii) The voltage drop with 332 amps or full load flowing = 5%

(½ mark)

In short circuit conditions the voltage drop is 100%

(½ mark)

PSC current = %Regulation x I

(½ mark)

= $\frac{100 \times 332}{5}$

(½ mark)

= 6,640A

(1 mark)

or

Z = $\frac{20 \text{ volts}}{332A}$

= 0.0602407 Ω

I_{psc} = $\frac{400}{0.0602407}$

= 6,640A

(b) Any THREE of:

- Touch voltage in flats may rise to dangerous levels
- High current flow in main earth conductor
- Rise in the supply voltage
- Unstable supply voltage
- Current flow through the MEN system of adjacent installations

GK
(3 marks)