

IT 16 – 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)
- Suitable warning notices affixed at the means of disconnection
 - Locking of the means of disconnection
- ER34
(2 marks)
- (b) Any TWO of:
- 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)
(2 marks)
- (c) (i) 4 years (1 mark)
- (ii) AS/NZS 3551 (1 mark)
ER 46

(d) (i) 1 year (1 mark)

(ii) Any ONE of:

- A registered electrical inspector.
- A person authorized to carry out such inspections under an employer licence

(1 mark)
ER 46(2)(g)

(e) • Where the metal is not fully isolated from both live parts and earth.
• Where the metal is located within arm's reach.

ER 84(2)
(2 marks)

(f) Any TWO of:

- 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
AS/NZS 3000:2007: 1.5.4.4b
(2 marks)

(g) Any TWO of:

From AS/NZS 3000:2000: 5.6.1

- Earth electrode.
- Main earthing conductor.
- Main earthing terminal/connection or bar.
- MEN link.
- Protective earthing conductors.
- Equipotential bonding.

From AS/NZS 3000:2007: 5.3.1

- Protective earthing conductors connecting exposed conductive parts as required
- Main earthing terminal, connection or bar.
- Main earthing conductor.
- MEN connection between the main earthing terminal, connection or bar and the supply neutral bar
- Earth electrode.
- Equipotential bonding of extraneous conductive and other parts as required

(2 marks)

(h) Any TWO of:

- Electrical equipment complying with AS/NZS 3100 for double insulation.
- Where cables connecting electrical equipment having double insulation enter the electrical equipment in such a manner that they may come into contact with accessible external conductive parts of the electrical equipment, the cables shall be of a type affording double insulation.
- Conductors within electrical equipment having double insulation shall be protected, secured or insulated so that, if any one conductor becomes detached from its termination, neither the conductor nor its functional insulation can come into contact with accessible metal.
- Exposed conductive parts are not earthed for electrical equipment supplied in accordance with [Clause 1.7.4.5 (AS/NZS 3000:2000)] [Clause 7.4 (AS/NZS 3000:2007)]
- If electrical equipment is supplied by a SELV or PELV system
AS/NZS 3000:2000 5.7.2
AS/NZS 3000:2007: 5.4.1.1
(2 marks)

(i) • Protection by means of obstacles
• Protection by placing out of reach.

AS/NZS 3000:2000 7.4.3.2
AS/NZS 3000:2007 6.6.3.2
(2 marks)

(j) Any TWO of

- To ensure the protection can clear the earth fault current
- To ensure the protection operates within the required time.
- To check that the active (phase), earth and distribution system neutral connections are able to ensure correct operation of the protective device
GK
(2 marks)

Question 2

- (a)
- The socket outlet
 - The final subcircuit earth conductor
 - The MEN connection
 - The consumers main neutral
 - The distribution neutral
 - The distribution transformer
 - The distribution active (phase) conductor
 - The main switch
 - The switchboard cables
 - The protective device
 - The final subcircuit active conductor

(5½ marks)
GK

- (b) To ensure the main earthing lead is able to safely carry the maximum fault current of the installation to enable protective devices to operate.

(2 marks)
GK

- (c) It is considered to be the path with the lowest impedance.

(½ mark)
GK

- (d) Any ONE of:

- a prominent notice shall be provided at each main switchboard, indicating the presence of other supplies and the location of other main switchboards.

AS/NZS 3000:2000: 2.8.3.3(d)
AS/NZS 3000: 2007: 2.3.3.4(d)

- provided that the location of the other main switches is indicated on a prominent and indelible notice adjacent to each main switch or group of switches.

AS/NZS 3000:2000: 2.8.3.4.1(b)(ii)
AS/NZS 3000: 2007: 2.3.4.1(b)(ii)
(2 marks)

Question 3

(a) $400 \times 5\%$
 $= 20V$

ER 53(2)
(1/2 mark)

- (b) • The total of the connected load supplied through the circuit; or
• The maximum demand of the circuit; or
• The current rating of the circuit protective device.

AS/NZS 3000:2000: 3.6.2
AS/NZS 3000:2007: 3.6.2
(3 marks)

(c) Volt drop = $230 \times 2.5\%$
 $= \underline{5.75v}$

(1/2 mark)

Current = $\frac{6000}{230}$
 $= 26.09 \text{ amps}$

(1/2 mark)

From Table 9, column 4, 2.5 mm² twin & earth TPS can carry 30A

(1/2 mark)

From Table 27(1), the derating factor is 0.94 = $30 \times 0.94 = 28.2$

(1/2 mark)

From Table 42 the mV/A.m for 2.5 mm² is $15.6 \times 1.155 = 18.018$

(1/2 mark)

Vd = $\frac{\text{mV/A.m} \times \text{amps} \times \text{metres}}{1000}$

(1/2 mark)

= $\frac{18.018 \times 26.09 \times 15}{1000}$

(1/2 mark)

= 7.05V

(1 mark)

From Table 42 the mV/A.m for 4 mm² is 9.71 x 1.155 = 11.22 mV/A.m

$$V_d = \frac{\text{mV/A.m} \times \text{amps} \times \text{metres}}{1000}$$

$$= \frac{11.22 \times 26.09 \times 15}{1000}$$

(½ mark)

$$= 4.39V$$

(½ mark)

Therefore the minimum cable size is 4 mm².

(1 mark)

Question 4

(a) From AS/NZS 3000:2000: 2.5.3.4

Any TWO of:

- 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.

From AS/NZS 3000: 2007: 2.6.3.4

- 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

(4 marks)

(b) (i) A Type A RCD

GK
AS/NZS 3000:2007: 2.6.2.2
(1 mark)

(ii) From AS/NZS 3000:2000 2.5.2.2

A type where tripping is ensured for residual alternating current and residual pulsating direct current.

From AS/NZS 3000:2007 2.6.2.2

For which tripping is ensured for residual sinusoidal alternating currents and residual pulsating direct currents.

(2 marks)

- (c) • The imbalance between the neutral and active currents induces a magnetic field into the RCD sensing coil iron core. (1 mark)
- The induced magnetic field induces a current in the RCD sensing coil (1 mark)
- The RCD tripping coil is energised, isolating the circuit by opening the RCD contacts (1 mark)

Question 5

- (a) (i) Section 6 of AS/NZS 3000
ER 37 (3)
(1 mark)
- (ii) Section 3 of NZS 3019
ER 41(3)
(1 mark)
- (b) • Sight the certificate of compliance
• Ensure that the polarity and phase rotation of the supply is correct.
• Ensure that the protection of the supply is correctly rated.
• Verify the safety of revenue meters and associated load control fittings of mains; and
• Verify that there is a main earthing system.
ER 43A)
(2½ marks)
- (c) (i) All of the work
(½ mark)
ER 39(1)
- (ii) 1 day after the completion of the work.
ER 39(5)
(½ mark)
- (iii) The mains, main switchboard and main earthing system
ER 41
(1½ marks)
- (iv) Yourself.
ER 40
(½ mark)
- (d) • The new sub-main to the outbuilding.
• The new distribution board in the outbuilding.
• The final subcircuits of larger size are moved to a different location.
ER 39(1)
(1½ marks)
- (e) The replaced main and main switchboard of a larger size
ER 41
(1 mark)

Question 6

(a) (i) $V_{ph} = \frac{V_L}{\sqrt{3}}$ (1/2 mark)

$$\frac{400}{1.732}$$

(1/2 mark)

$$230.9V \text{ or } 230V.$$

(1/2 mark)

$$kVA = \frac{V_{ph} \times I}{1000}$$

(1/2 mark)

$$\frac{230 \times 145}{1000}$$

(1/2 mark)

$$\frac{33350}{1000}$$

(1/2 mark)

$$33.35kVA \text{ on Red phase.}$$

(1 mark)

(ii) For 3phase load = 33.35×3 (1/2 mark)

$$= 100kVA (100050VA)$$

(1 mark)

(b) $\frac{I_P}{I_S} = \frac{V_S}{V_P}$ (1/2 mark)

$$I_P = \frac{I_S \times V_S}{V_P}$$

(1/2 mark)

$$= \frac{145 \times 230}{11000}$$

(1/2 mark)

$$= 3.03A \text{ (phase current)}$$

(1 mark)

$$\begin{aligned}\text{Line current} &= IP \times \sqrt{3} \\ &= 3.03 \times 1.732 \\ &= 5.25\text{A}\end{aligned}$$

(1/2 mark)

(1/2 mark)

(1 mark)

Alternative solution

$$\begin{aligned}VA &= \sqrt{3} \times V_L \times I_L \\ I_L &= \frac{VA}{\sqrt{3} \times V_L} \\ &= \frac{100050}{\sqrt{3} \times 11000} \\ &= 5.251\text{A}\end{aligned}$$

Question 7

(a) (i) Sections 3 and 4 of NZS 3019.

(1 mark)

(ii) The fixed-wired appliances are:

- Correctly positioned and are suitable for the environment they are located in.
- Connections of conductors to electrical equipment are correct.
- Correctly mounted and protected against mechanical damage.
- Covers are in place preventing access to live parts or basic insulation
- Fixed wired appliances requiring earthing (Class I) are connected to earth.

NZS 3019: 3.4
(2½ marks)

- (iii)
- The main earthing conductor is of the correct size.
 - The main earthing conductor is connected to the earth electrode by a suitable corrosion resistant connection.
 - At the earth electrode position, the correct label is fitted.
 - The main earthing conductor terminations are readily accessible.

NZS 3019: 3.5
(2 marks)

- (iv)
- Insulation resistance
 - Polarity
 - Earth continuity
 - Earthing and equipotential bonding.

NZS 3019: 4.1
(2 marks)

(v) Certification of verification.

NZS 3019: 2.7
(½ mark)

(b) (i) The current in the cable between the switchboard and the motor reduces.
(1 mark)

(ii) The thermal overloads need to be reset to the reduced running current value.

(1 mark)
GK

Question 8

(a)

Load Group	Calculation	Load	Mark
<u>Group A</u>			
100% of Halide lighting - 100% 75W lights	$0.25 \times 1 \times 100\% = 2.5$ $15 \times 75 = 1.125$	3.625	(2 marks)
<u>Group B</u>			
20 x 10A outlets	$1 + (19 \times 0.75) = 15.25$	15.25	(1 mark)
5 x 15A outlets	$3.45 + (4 \times 0.75 \times 3.45) = 13.8$	13.8	(1 mark)
<u>Group D</u>			
100% of Chiller comp. 7.5 kW 75% of 1 dough machine 6 kW 50% of 1 dough machine 6 kW	$7.5 + 4.5 + 3.0 = 15.0$	15.0	(2 marks)
	Total	47.675	(1½ marks)

$$\text{Total inductive load} = \frac{47.675}{0.9}$$

$$= 52.972 \text{ kVA}$$

(½ mark)

(1 mark)

(b) The transformer size is 100 kVA

(1 mark)

Question 9

(a) (1) Full load current rating

(½ mark)

- This is the maximum current that can safely flow through the switchgear contacts, busbars and cables without causing overheating.

Gk

Or

- Each item of electrical equipment shall be suitable the design current, taking into account any capacitive, inductive, and harmonic effects.

AS/NZS 3000:2000: 2.2(b)(i)
AS/NZS 3000:2007: 2.2.4.3(a)
(2 marks)

(2) Prospective short-circuit rating (or breaking or rupturing capacity)

(½ mark)

- This is the maximum current that can be safely interrupted under short circuit conditions if the feeder cables were replaced by links of negligible impedance.

Gk

Or

- Each item of electrical equipment shall be suitable for the current likely to flow in abnormal conditions for such periods of time as are determined by the characteristics of the protective devices concerned.

AS/NZS 3000:2000: 2.2(b)(i)
AS/NZS 3000:2007: 2.2.4.3(bv v)
(2 marks)

(b) From AS/NZS 3000:2000

Any TWO of:

- The breaking capacity shall be not less than the prospective short-circuit current at the point of installation.
2.4.4.3(a)
- All currents caused by a short circuit occurring at any point of a circuit shall be interrupted before the temperature of the conductors reaches the admissible limit.
2.4.4.3(b)

- Protective devices shall be provided to interrupt any short-circuit current flowing in the conductors before such a current can cause danger due to thermal and mechanical effects produced in conductors and connections. 2.4.4.1
- Shall be capable of breaking any overcurrent up to and including the prospective short-circuit current at the point where the device is installed. 2.4.2

Or

From AS/NZS 3000:2007: 2.5.4.5

- The breaking capacity shall be not less than the prospective short-circuit current at the point where the devices are installed.
- All currents caused by a short circuit occurring at any point of a circuit shall be interrupted before the temperature of the conductors reaches the permissible limit.

(2 marks)

(c) (i) 50V

AS/NZS 3000:2000: 1.7.4.3.2
AS/NZS 3000:2007: 1.5.5.3 (b)
(1 mark)

- (d)
- 0.4s for final subcircuits that supply socket-outlets having rated currents not exceeding 63 A
 - 0.4s for final subcircuits that supply hand-held Class I equipment
 - 0.4s for final subcircuits that supply portable equipment intended for manual movement during use.
 - 5s for circuits including submains and final subcircuits supplying fixed or stationary equipment.

AS/NZS 3000:2000: 1.7.4.3.4
AS/NZS 3000:2007: 1.5.5.3 (d)
(2 marks)