

## MARKING SCHEDULE – IT 7

### IT 7 - ELECTRICAL INSPECTORS THEORY ANSWER SCHEDULE

Note: (1 mark) means that the preceding statement earns 1 mark.

This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall adequacy of any answer that is presented in the candidate's own words.

Key to abbreviated terms:

S	Section of the 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

#### Question 1

Each part is worth 1 mark

- (a) Section 95 S95
- (b) The Chief Executive of the Ministry of Economic Development or The Secretary. S101
- (c) At intervals not exceeding 14 months ER26(4)
- (d) Any TWO of:
- \* Near conductors or fittings of extra-low voltage
  - \* On a live electric line
  - \* On a live substation
- ER30(2)

- (e) One of:
- \* Suitable warning notices affixed at the means of disconnection
  - \* If locking facilities are available for disconnection, they must be used to lock the disconnection
- ER34
- (f) Six months from the date stamped on the form
- ER43
- (g) 1 year
- ER46(2)(g)
- (h) A fine not exceeding \$10,000
- ER51
- (i) 30 November 2006
- ER97(4)
- (j) None
- AS/NZS 3000: 2.9.8.4(e)
- (k) 4mm<sup>2</sup>
- AS/NZS 3000: 5.8.3.2(a)
- (l) IPX5.
- AS/NZS 3000: 7.5.4.1
- (m) The voltage drop shall not exceed 10% at any point on the installation when all live conductors are carrying the circuit operating current.
- AS/NZS 3000: 7.7.7
- (n) Any ONE of:
- \* A socket outlet shall not accept plugs of other voltages.
  - \* A socket outlet shall not have a contact for a protective earthing conductor.
- AS/NZS 3000: 7.7.11
- (o) IPX4
- NZS 3019: 6.1.4
- (p) 20 MΩ
- NZS 3019: 4.6.4

- (q) Any ONE of:
- \* Where the circuit is supplied from an isolating transformer complying with AS/NZS 3018
  - \* The source of current is so selected that the output is separated from the input by means of double insulation or equivalent.
- GK
- (r) \*
- \* The tester imposes a specific leakage/residual current on the RCD under test
  - \* and measures the time taken for the RCD to trip
- GK
- (s) The power factor.
- GK
- (t) To ensure that three-phase motors operated from any outlets will run in the same direction of rotation at the one installation.
- GK

## Question 2

(a)  $I_{(FL)} = \frac{P}{\sqrt{3} \times V}$  (1/2 mark)

$= \frac{60,000}{\sqrt{3} \times 400}$  (1/2 mark)

$= \mathbf{86.6 \text{ amps}}$

(1 mark)  
(Total - 2 marks)

- (b) From table 12, the minimum size cable is **25 mm<sup>2</sup>**. The cable is rated for 104 amps.

(1 mark)

The correction factor from table 27(1) is 0.94. The cable rating would need to be  $104 \times 0.94 = \mathbf{97.76 \text{ amps}}$ .

(1 mark)

(Total - 2 marks)

- (c) From table 42, a 25 mm<sup>2</sup> cable, with an operating temperature of 75 °C, has a 1.54 mV/A.m

(1/2 mark)

Voltage drop = mV/A.m x amps x metres

(1/2 mark)

$= 1.54 \times 10^{-3} \times 86.6 \times 45$

(1 mark)

$= \mathbf{6 \text{ V}}$

(1 mark)

(Total - 3 marks)

- (d) From regulation 53(2)(b) maximum voltage drop is 5%.

(1 mark)

$400 \times 5\% = 20 \text{ volts}$

(1 mark)

(Total - 2 marks)

- (e) Maximum permitted voltage drop is 10 volts (400 x 2.5%)

(1/2 mark)

From (c) above volt drop on 25 mm<sup>2</sup> cable is 6 V. Cable is acceptable.

(1/2 mark)

(Total - 1 mark)

### Question 3

(a) Any SIX of:

- \* The current rating, fusing factor and breaking capacity of the protective devices are appropriate for the circuits they protect.
- \* Switches and protective devices are clearly labeled showing the circuit type they control or protect;
- \* Live conductors are insulated or provided with a barrier requiring the use of a tool to gain access;
- \* Neutral bars are supported on insulated fittings;
- \* Earthing conductors are connected to the earth bar, and neutral conductors are connected to the neutral bar;
- \* The main earthing conductor from the earth electrode is correctly connected to the main switchboard;
- \* There is a MEN link between the neutral bar and the earth bar at the main switchboard. The link shall have a secure connection system at each end of the link (i.e. a stud with nut and locknut, or two screws);
- \* The switchboard is constructed of fire re-resistant materials, and is suitable for the environment for which it is installed
- \* Residual current devices installed for personal protection shall have a residual operating current of 30 mA or less. They shall also be of the type providing protection against residual alternating current, and residual pulsating direct current.

NZS 3019: 3.3  
(6 marks)

(b) From NZS 3019: 3.4:

- \* They are correctly positioned and are suitable for the environment they are located in;
- \* Connections of conductors to electrical equipment are correct. When this connection is via flexible cord, the cord shall be anchored at both the electrical appliance and the supply fitting;
- \* Electrical appliances are correctly mounted, and protected against mechanical damage
- \* All covers preventing access to live parts for basic insulation are in place.

From AS/NZS 3000: 6.2.2(e), any FOUR of:

- \* Isolation and switching devices for protection against injury from mechanical movement devices and motors.
- \* Isolation and switching devices for protection against thermal effects e.g. motors, room heaters, water heaters.
- \* Switching devices for particular electrical equipment e.g. socket outlets, cooking appliances.
- \* Particular installation conditions, e.g. locations affected by water, explosive atmospheres, extra-low voltage, high voltage.
- \* Compliance with required Standard.
- \* Connection, support and fixing.
- \* Protection against external influences.

From AS/NZS 3760: 2.3.2, any FOUR of:

- \* Check for obvious damage or defects in the accessories, connectors, plugs or extension outlet sockets.
- \* Check that flexible cords are effectively anchored to equipment, plugs and cord extension sockets.
- \* Check for damage to flexible cords -
  - the inner cores of flexible supply cords are not exposed or twisted;
  - the external sheaths are not cut, abraded, twisted, or damaged to such an extent that the insulation of the inner cores is visible; and(In) unprotected conductors or insulation tape are not in evidence.
- \* Check that any controls are in good working order i.e. they are secure, aligned and appropriately identified.
- \* Check that covers, guards and the like are secured in the manner intended by the manufacturer or supplier.
- \* Check that safety facilities and devices are in good working order.
- \* Check that ventilation inlets and exhausts are unobstructed.

(4 marks)

#### Question 4

##### Inductive Load

###### *Load Group A – Lighting*

100% of Halide lighting –  $0.25 \times 10 \times 100\%$

100% 15 x 75W lights

$$2.5 + 1.125 = 3.625 \text{ kW} \quad (1/2 \text{ mark})$$

(1/2 mark)

###### *Load Group B – Socket Outlets*

20 x 10A outlets

1 kW for the 1<sup>st</sup> and 0.75 kW/socket thereafter

$$1 + (19 \times 0.75) = 15.25 \text{ kW} \quad (1/2 \text{ mark})$$

(1/2 mark)

5 x 15A outlets

3.45 kW for the 1<sup>st</sup> and 75% full load/socket thereafter

$$3.45 + (4 \times 0.75 \times 3.45) = 13.8 \text{ kW} \quad (1/2 \text{ mark})$$

(1/2 mark)

###### *Load Group D – Motors*

100% of Chiller comp. 7.5 kW

75% of 1 dough machine 6 kW x 75%

50% of 1 dough machine 6 kW x 50%

$$7.5 + 4.5 + 3.0 = 15.0 \text{ kW} \quad (1/2 \text{ mark})$$

(1/2 mark)

$$\text{Total inductive load} = = \mathbf{47.675 \text{ kW}} \quad (1 \text{ mark})$$

(1 mark)

##### Non-inductive load

###### *Load Group C*

100% 15 kW oven

75% 15 kW oven

75% of 4kW instantaneous water heater

$$15 + 11.25 + 3 \text{ kW} = 29.25 \text{ kW} \quad (1/2 \text{ mark})$$

(1/2 mark)

Total inductive load = 47.675 kW

$$\text{pf} = 0.90$$

$$\theta = \cos^{-1} \times 0.9$$

$$= 25.8$$

(1/2 mark)

$$Q = P \tan \theta$$

$$= 47.65 \times \tan 25.8$$

(1/2 mark)

$$= 23 \text{ kVAr}$$

(1 mark)

$$\text{Total kW} = 47.675 + 29.25 =$$

**76.925 kW**

(1/2 mark)

$$\begin{aligned} \text{Total kVA} &= \sqrt{76.925^2 + 23^2} \\ &= \sqrt{5917.46 + 529} \end{aligned}$$

(1/2 mark)

$$= \mathbf{80.31 \text{ kVA}}$$

(1 mark)

(Total - 10 marks)  
AS/NZS 3000: Table C2

### Question 5

- (a) (i) High voltage electrical installations.  
\* Safety check interval: **5 years**  
\* Carried out by: **registered electrical inspector or person authorized to carry out such inspections under an employer licence**
- (ii) Carnivals or fairgrounds.  
\* Safety check interval: **1 year**  
\* Carried out by: **registered electrical inspector or person authorized to carry out such inspections under an employer licence**
- (iii) Earthing facilities of electro-medical locations.  
\* Safety check interval: **4 years**  
\* To which Standard: **AS/NZS 3003**

ER46  
(6 marks)

(b) Any FOUR of:

- \* Have personally carried out the work ER41(5)
  - \* Have supervised the carrying out of the work by another person ER41(5)
  - \* Have certified the work under regulation 39 ER41(5)
  - \* Are not competent to do that work ER25
- (4 marks)

### Question 6

(a) Any FOUR of:

- \* Heat dissipates in main neutral – causes fire
  - \* Earthed metal may rise above earth potential – shock hazard
  - \* Risk of over voltage due to floating neutral – damage to equipment
  - \* Risk of current flowing in adjacent earthing system of electrical installations at hazardous levels
  - \* The protection may not work fast enough – shock hazard
- GK  
(4 marks)

(b) Completed circuit must show:

- \* A transformer winding and the system neutral and transformer star point earthed
  - \* The fuses and the load
  - \* The metal frame of appliance connected to the earth bar
  - \* Neutral and earth busbars and link between earth and neutral bars
- (½ mark each – 2 marks total)

Fault path on drawing must show fault current:

- \* Flowing through protective earth (earth continuity) conductor
  - \* Split at earth and neutral bars
  - \* Flowing through earthing lead, electrode, ground, back to the transformer star point.
  - \* Flowing through earth-neutral link and neutral link back to the transformer star point
- (1 mark each – 4 marks total)

GK  
AS/NZS 3000: Appendix B4.3  
(6 marks)

## Question 7

- (a) (i) \* Full load current rating  
\* Prospective short-circuit rating or breaking or rupturing capacity.  
GK  
(1 mark)

- (ii) \* Full load current rating is the maximum current that will safely flow through the switchgear contacts, busbars and cables without causing overheating.  
\* Prospective short circuit current rating is the maximum current that can be safely interrupted under short circuit conditions of the feeder cables were replaced by links of negligible impedance.  
GK  
(3 marks)

- (b) (i) \* Fuse links of a current rating equal to or less than the cable rating and affording both overload and short-circuit protection.  
\* The term also is a classification for general purpose applications.  
GK  
(2 marks)

- (ii) Fuse links that:  
\* Will withstand motor surges, typically up to 7 times full load current, for the run-up period in the case of DOL motor starting.  
\* Also provide back-up protection for short-circuit protection  
GK  
(2 marks)

- (c) Any TWO of:

- \* A conductor where effective protection is afforded by a protective device located on the supply side of its origin or the point of reduction in current-carrying capacity.
- \* A conductor where short-circuit protection is provided in accordance with Clause 2.4.4, and there are no branch circuits or socket-outlets, and electrical equipment supplied by the conductor is not capable of causing overload currents.  
NOTE: A heating appliance is an example of such equipment.
- \* Installations for telecommunication, control, signaling, and the like.
- \* A conductor within a switchboard or busway that supplies one or more circuits that are individually protected against overload where:
  - (i) short-circuit protection of the conductor is provided in accordance with Clause 2.4.4, and
  - (ii) overload protection of the conductor is provided when the sum of the current ratings of the circuit protective devices is not more than the current-carrying capacity of the conductor.

*(the above accurately summarised is acceptable)*

(2 marks)

AS/NZS 3000: 2.4.3.4

## Question 8

- (a) (i) The Secretary or Chief Executive of the Ministry of Economic Development  
S119(3)(a)  
(1 mark)
- (ii) A Complaints Assessment Committee  
S119(3)(b)  
(1 mark)
- (b) Any TWO of:
- \* Limited to such work as the Board may specify, also the circumstance in which the person may do that work.
  - \* Limited to work only on approved premises
  - \* Limited to work only in the employ of an approved employer.
- S127(2)(d)  
(2 marks)
- (c) Any TWO of:
- \* The person has died
  - \* The person has been registered or granted a provisional licence by reason of any false or fraudulent representation or declaration made either orally or in writing.
  - \* The person is not entitled to be registered or, as the case may be, granted a provisional licence.
  - \* The person is no longer employed in the situation to which his or her registration applies.
  - \* His or her name is transferred to any such register on becoming entitled to the transfer.
- S90 (a), (b), (c), (d), (e)  
(2 marks)
- (d) "Supervision", in relation to any work, means that work is undertaken under such control and direction of a person authorized under this Act to do the work as is sufficient to ensure:
- (a) That the work is performed competently;
  - (b) That while the work is being undertaken, appropriate safety measures are adopted; and
  - (c) The completed work complies with the requirements of any regulations made under section 169 of this Act.
- (the above accurately summarised is acceptable)*
- S2  
(2 marks)
- (e) Where that connection or supply is solely for the purpose of carrying out any testing and inspection.
- S114(4)  
(2 marks)

## Question 9

- (a) (i) (1) Certificate of Verification  
ER43A(a)  
(1 mark)
- (2) Registered electrical inspector or a person authorised under an employer licence.  
ER43A(a)  
(1 mark)
- (3) \* NZS 3019 (Int): 2002 – Electrical Installations – In-service Testing  
\* Section 5  
GK  
(1 mark)
- (ii) \* 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  
\* Verify that there is a main earthing system, if the supply is from a MEN system.  
ER43A(c),(d),(e),(f)  
(4 marks)
- (b) \* The conductors or fittings on which the work was done are tested to ensure the operational safety of the completed work  
\* In the case of maintenance, alterations, or additions, the work does not reduce the safety of existing works or electrical installations  
\* During testing, all practicable steps are taken to ensure the safety of persons, property, and the works and electrical installations.  
ER37(a),(b),(c)  
(3 marks)