

## ESTB 2022 - Electrical Service Technician "B" Answer Schedule

- Notes:
1. (1 mark) means that the preceding statement/answer earns 1 mark.
  2. This schedule sets out the accepted answers to the examination questions. A 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) Any TWO of:

- Current rating
- Voltage rating
- Category of duty (Rupturing Capacity)
- Utilisation category (fusing factor) (Class)

(2 marks)

- (b) (i) ONE of:
- A degree of ingress protection in accordance with AS 1939.  
AS/NZS 3000: 1.4.58
  - A coding system to indicate the degree of protection provided by the enclosure  
AS 1939 supplement 1 – 1990
  - Degrees of enclosure protection of electrical equipment  
AS 60529  
(1 mark)
- (ii) Any ONE of:
- The degree of protection against solid objects and the protection of persons against access to hazardous parts.  
AS/NZS 3000: 1.4.58
  - The degree of protection of persons against live or moving parts inside the enclosure and protection of the equipment against ingress of solid objects  
AS 1939 supplement 1 – 1990
  - Protection against solid objects  
AS 60529  
(1 mark)
- (c) • Phase failure relay.  
• Thermal overload  
(2 marks)
- (d) (i) A practising licence  
(1 mark)
- (ii) 12 months  
(1 mark)
- (e) (i) Reverse the connections of the start winding or the run winding.  
(1 mark)
- (ii) Reverse connections to the field windings or armature windings (or brush-holder connections).  
(1 mark)
- (f) • Testing to ensure safety before/during and after completion of the work.  
• CPR  
ER 26(2)  
(2 marks)

(g) Any TWO of:

- Resistance
- Current
- Length
- Cross-sectional area

(2 marks)

(h) Any TWO of:

- The appliance is fixed wired and connected through a continuous flexible cord to a supply of electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts:

ER 77(3)(a)

- The appliance is supplied with electricity from a safety extra-low voltage source:

ER 77(3)(b)

- The appliance is double-insulated and is supplied with electricity through a residual current device.

ER 77(3)(c)

- The appliance is supplied with electricity from a monitored earth circuit where the supply to the appliance is automatically disconnected if the earth to the appliance is broken or disconnected:

ER 77(4)(b)

- The appliance is supplied with electricity from a source connected to earth so that the voltage to earth will not be greater than 55 volts a.c.:

ER 77(4)(c)

- The appliance is supplied with electricity through a residual current device:

ER 77(4)(d)

- The appliance is supplied with electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts

ER 77(4)(e)

- The appliance is double insulated.

ER 77(4)(f)

(2 marks)

(i) A nominal voltage of 230 volts between phase and neutral.

ER 2

(2 marks)

(j) Class I – Equipment in which protection against electric shock does not rely on basic insulation only, but in which includes an additional safety precaution in that accessible exposed conductive parts are connected to the protective earthing conductor in the fixed wiring of an electrical installation in such a way that accessible parts cannot become live in the event of failure of the basic insulation.

AS/NZS 3000: 1.4.25

(2 marks)

## Question 2

- Carry out the protective earthing conductor test first. (1 mark)  
To ensure that the protective earthing conductor resistance is low (or 1 ohm or below) so no false insulation resistance test reading is obtained. (2 marks)
- Protective earthing conductor test
  - Use an instrument that can read values of less than 1 ohm (1/2 mark)
  - Test between the end of the screen and the frame of the motor (1 mark)
  - The acceptable test result is 1 ohm - maximum. (1 mark)
- Insulation resistance test
  - Use an insulation resistance tester (1/2 mark)
  - A test voltage of 500v d.c. (1 mark)
  - Test between each winding and earth (1 mark)
  - Test between each winding (1 mark)
  - The acceptable test result is 1 M $\Omega$ , minimum (1 mark)

### Question 3

- (a) • Attach an out-of-service tag to the isolator.  
• Insulate the bare end of each conductor of the flexible cable.  
• Mechanically protect the cable.  
• Make provision to prevent access to the cable. (4 marks)
- (b) • To ensure that the test meter/instrument - is operating correctly.  
• To ensure that the circuit has been isolated before it is worked on. (2 marks)
- (c) Any FOUR of:
- Withdrawal of fuses supplying the current plus attaching safety warning tag
  - Locking open of appliance or circuit isolating switch plus attaching safety warning tag
  - Opening and locking open of supply circuit breaker, plus attaching safety warning tag
  - Removal of appliance plug from socket, plus attaching safety warning tag to appliance
  - Access permit or "hold card" system. (4 marks)

#### Question 4

- (a) • If correctly threaded, prevents fuse element from bulging out the side of the carrier and being accessible to touch.  
or  
If incorrectly threaded, contact could be made with the fuse element.
- If correctly threaded, under overload conditions the heat produced in the element is confined to the tunnel area.  
or  
If incorrectly threaded, the arc or molten metal may escape under overload conditions.
- If correctly threaded, under fault conditions the arc and molten element is confined within the fuse carrier and base.  
or  
If incorrectly threaded, the arc or molten metal may escape under fault conditions.

(3 marks)

- (b) (i) The ratio of minimum fusing current to the current rating of the fuse.

or  
Utilisation category (fusing factor) =  $\frac{\text{Minimum Fusing Current}}{\text{Current Rating}}$

(1 mark)

- (ii) For a given fault current, a fuse with a lower the utilisation category (fusing factor) will operate in a shorter time than a fuse with a higher utilisation category.

(2 marks)

- (iii) To ensure that the replacement fuse link will safely interrupt the prospective short circuit current level for that circuit.

(2 marks)

(c) Current rating =  $\frac{\text{Minimum fusing current}}{\text{Utilisation category (fusing factor)}}$

(½ mark)

$$= \frac{30}{1.5}$$

(½ mark)

$$= 20A$$

(1 mark)

### Question 5

- (a) • The supply and/or the appliance would be short-circuited. (2 marks)
- Meter protection would operate,  
or  
The circuit protection would operate.  
or  
A personal hazard – flash burns.  
or  
Meter and/or appliance components could be damaged. (1 mark)
- (b) Any THREE of:
- The instrument prevents the appliance from operating.
  - A 230 volt reading indicates only that the appliance is turned on.
  - A 230 volt reading indicates only that the appliance element is OK.
  - A 230 volt reading indicates only the supply voltage.
  - A 0 volt reading can lead to the false conclusion that the circuit is dead.
  - A 0 volt reading will be obtained if the appliance load is open circuited (by a switch or element) (3 marks)
- (c) Any FOUR of:
- Inspect instrument, clips, leads and probes to ensure they are in good condition.
  - Don't energise circuit until all connections have been completed.
  - Don't make any changes to circuit while power is on.
  - Avoid personal contact with either live conductors or earth when using instruments on live circuits.
  - Ensure correct range is selected on the instrument.
  - Ensure leads are correctly connected. (4 marks)

## Question 6

(a) Any FOUR of:

- Number of cores
- Colour Coding
- Mechanical strength if weight is to be supported?
- Sheath suitable for the environment
- Cord shape

(4 marks)

(b) (i) Voltage is dropped as the load current passes through the conductor resistance

(1 mark)

(ii) • Use a flexible cord with an increased cross-sectional area

(1 mark)

- Reduce the length of the cord

(1 mark)

(c) It is the maximum current that a flexible cord is designed to carry safely

(1 mark)

(d)

<b>COLOURS OF CABLE CORES</b>		
<b>Function</b>	<b>Identifying colours</b>	
	<b>Recommended</b>	<b>Alternative</b>
Earth/bonding	<b><i>Green/yellow</i></b>	<b><i>Green</i></b>
Active	<b><i>Red</i></b>	<b><i>Any colour except green/yellow, green, black, light blue</i></b>

(2 marks)

Ref: AS/NZS 3000: Table 3.5

**Question 7**

- (a) • AS: /NZS 3760  
 • Regulation 38

(1 mark)

(b)

<b>Test using test instruments</b>	<b>Type of instrument required</b>	<b>Acceptable test result</b>
Protective earthing conductor test	Meter that can accurately read values of less than 1 ohm	1 Ω - maximum
Insulation resistance test	Insulation resistance tester	1 MΩ – minimum
Or Earth leakage test	Earth leakage tester	5 mA - maximum

AS/NZS 3760: 2.3.3  
(4 marks)

(c) (i) Any TWO of:

- The flexible cord is effectively anchored.
- The inner cores 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
- Unprotected conductors or insulation tape are not in evidence.

AS/NZS 3760: 2.3.2  
(2 marks)

(ii) Any THREE of:

From AS/NZS 3760:2001

- 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.

AS/NZS 3760: 2.3.2

Or

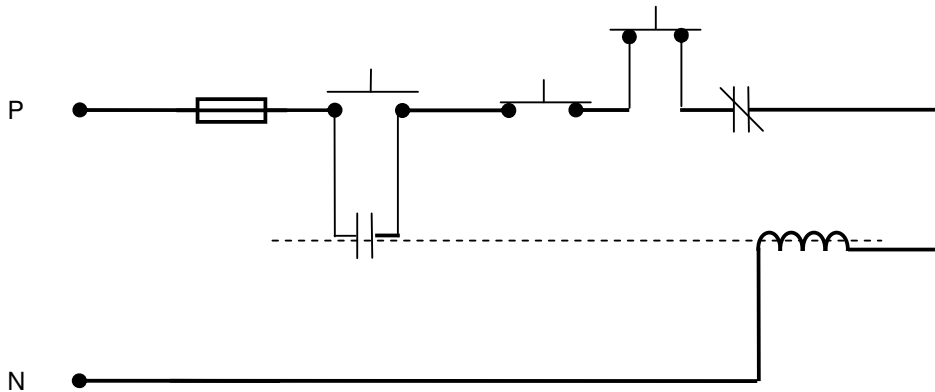
From AS/NZS 3760:2003

- Check that any operating 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 ventilation inlets and exhausts are unobstructed.

AS/NZS 3760: 2.3.2  
(3 marks)

### Question 8

(a)



- Correct supply (phase and neutral) (½ mark)
- Fuse protecting circuit (½ mark)
- Stop/start station correctly connected (½ mark)
- Remote stop/start station correctly connected (2 marks)
- Hold-in contacts and coil correctly connected (2 marks)
- Thermal overload contacts correctly connected (½ mark)

(b) (i) Thermistor (1 mark)

(ii) In the motor stator or the motor winding (1 mark)

(c) Any TWO of:

- Removal of ventilation fan or fan cowling.
  - Blocked ventilation ports
  - Additional of covers that block ventilation ports
- (2 marks)

## Question 9

- (a) For the sewing machine and flexible cord: (1 mark)
- Insulation resistance test between active and neutral, active and earth and neutral and earth. (1 mark)  
Insulation resistance tester - 1 M $\Omega$  minimum (1 mark)
  - Protective earthing conductor test from machine frame to the "free-end" of the flexible cord. (1 mark)  
Low reading ohmmeter or multi meter – maximum 1 $\Omega$  (1 mark)
- (b)
- Check and prove isolation using Prove-Test-Prove method. (1 mark)
  - Add your own Danger Tag to the isolator. (1 mark)
- (c)
- Ensure the connections are correct (1 mark)
  - Check all screens and guards are in place. (1 mark)
  - Ensure the machine is effectively earthed (1 mark)