

## ESTB 2019 - 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) (i) Any ONE of:
- Phase failure relay
  - Thermal overload
- (1 mark)
- (ii) Phase reversal protection
- (1 mark)
- (b) Any one of:
- A sustained overload
  - The loss of one phase
- (2 marks)
- (c) • Resistance
- Cross-sectional area
- (2 marks)
- (d) (i) 1 Megohm
- (ii) 1 ohm
- (2 marks)

(e) Any TWO of:

- Attach a danger tag to the isolator.
- Lock the isolator in the off position.
- Open and lock the MCBs
- Disconnect the cables at the load side of the isolator

(2 marks)

(f) Any ONE of:

- A supervisor of electrical work whose registration allows that supervisor to do the work
- A registered person whose registration allows that person to do the work, where the registered person is under the supervision of a supervisor of electrical work whose registration allows that supervisor to do the work

ER 23(a),(b)

(2 marks)

(g) (i) Zero or nil

(1 mark)

(i) 230V

(1 mark)

(h) • A fault in the fixed wiring or socket outlet

(1 mark)

- A registered electrician must be called to fix it

(1 mark)

(i) Any ONE of:

- A symbol of a square within a square
- The words "double insulated"
- The words "Class II"

(2 marks)

(j) Any ONE of:

6kA The maximum prospective short circuit current the breaker can safely open under fault conditions.

16A Is the nominal current rating of the breaker in normal service.

(2 marks)

**Question 2**

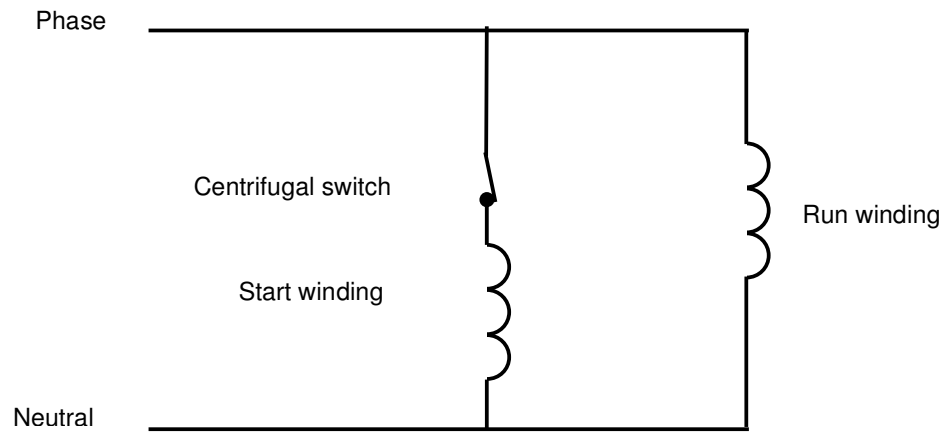
(a) (i) Reverse connections to either start winding or run winding. (2 marks)  
**(1 mark)**

(ii) Reverse connections to either the field windings or armature windings. (2 marks)  
**(1 mark)**

(b) Power = 746 x 0.75 (½ mark)  
 = 560 watts (½ mark)

I =  $\frac{P}{V}$  (½ mark)  
 =  $\frac{560}{230}$  (½ mark)  
 = 2.43A (1 mark)

(c) (i)



- Correctly connected start winding and centrifugal switch (1½ marks)
- Correctly connected run winding (½ mark)

(ii) An external relay.

(1 mark)

(d) Any ONE of:

- The back emf of the motor would create a flashover at the switching device.
- Damage could occur to the motor drive assembly

(2 marks)

### Question 3

- (a) • To protect the fixed wiring against excess current flow  
or  
• Safely interrupt and disconnect a faulty circuit (2 marks)
- (b) To provide personal protection to the user of an appliance that is connected to the circuit controlled by the RCD. (2 marks)
- (c) The maximum current that a fuse-link will carry continuously without deterioration or operating.

OR

- The maximum level of protection for the circuit (2 marks)
- (d) (i) • an overload causes a bi-metal to heat up and bend, (1 mark)  
• operating a trip mechanism (1 mark)
- (ii) • a short circuit causes a strong magnetic field in an armature circuit (1 mark)  
• which attracts a trip mechanism (1 mark)

#### Question 4

(a) AS: /NZS 3760

(1 mark)

(b)

Test	Instrument	Test value	Maximum or minimum
Protective earthing conductor test	Any instrument that can accurately read values of less than $1\Omega$	$1\Omega$	Maximum
Insulation resistance test	Insulation resistance tester	$10,000\Omega$	Minimum

(4 marks)

(c) Any **FIVE** of – from AS/NZS 3760:2001:

- Check for obvious damage or defects in the accessories or plugs.
- Check that flexible cords are effectively anchored to equipment and plugs.
- Check that the inner cores of flexible supply cords are not exposed or twisted;
- Check that the external sheaths are not cut, abraded, twisted, or damaged to such an extent that the insulation of the inner cores is visible
- Check that 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.

AS/NZS 3760: 2.3.2

(5 marks)

Or

Any **FIVE** of – from AS/NZS 3760:2003:

- Check for obvious damage or defects in the accessories or plugs and for discolouration that may indicate exposure to heat, chemicals and moisture.
- Check that flexible cords are effectively anchored to equipment, plugs and cord extension sockets.
- Check that the inner cores of flexible supply cords are not exposed or twisted;
- Check that the external sheaths are not cut, abraded, twisted, or damaged to such an extent that the insulation of the inner cores is visible
- Check that unprotected conductors or banding insulation tape are not in evidence.

- 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.
- The pins of insulated pin plugs should be inspected for damage to the insulation of the pins.

AS/NZS 3760: 2.3.2  
(5 marks)

## Question 5

- (a) A situation in which moisture is either permanently present, or intermittently present to such an extent as would be likely to impair the effectiveness or safety of an electrical installation which complies with this Standard for ordinary situations.

AS/NZS 3000: 1.4.37  
(2 marks)

- (b) Any ONE of:

- A degree of protection in accordance with AS 1939.  
AS/NZS 3000: 1.4.8
- A coding system to indicate the degree of protection provided by the enclosure  
AS 1939 supplement 1 – 1990
- Against access to live parts from solid objects, or the ingress of water or other liquids  
AS 1939 supplement 1 – 1990
- Degrees of enclosure protection of electrical equipment  
AS 60529  
(2 marks)

- (c) (i) • 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  
or  
Protection against solid objects

AS 60529

or

- degree of protection against solid objects
- degree of protection of persons against access to hazardous parts.  
AS/NZS 3000: 1.4.58  
(2 marks)

- (ii) The degree of protection of equipment against the ingress of water or other liquids

AS 1939 supplement 1 – 1990

Protection against liquids

AS 60529

or

degree of protection against entry of water with harmful effects  
AS/NZS 3000: 1.4.58  
(2 marks)

- (d) (i) Must have a minimum degree of protection of IPX4  
AS/NZS 3000: 7.1.4.1(b) or Table 7.1  
(1 mark)

- (ii) Must have a minimum degree of protection of IPX4  
AS/NZS 3000: 7.1.4.1(b) or Table 7.1  
(1 mark)

### Question 6

- (a) (i) Current flowing I =  $\frac{V}{R}$  (½ mark)  
=  $\frac{230}{20}$  (½ mark)  
= 11.5 A fault current would flow (1 mark)
- (ii) W = V x I (½ mark)  
= 230 x 11.5A (½ mark)  
= 2650 W (1 mark)
- (iii) • The minimum fusing current of the fuse =  $15 \times 1.25 = 18.8A$  (1 mark)  
• The fuse will not operate because the fault current is only 11.5A (1 mark)
- (b) • The neutral conductor was connected to the switch instead of the phase conductor  
• The phase and neutral can be transposed at the plug on the flexible cord  
• The phase and neutral can be transposed at the internal terminals in the appliance (other than at the switch) (3 marks)
- (c) Most of the internal wiring will be alive at 230V to earth with the switch in the "OFF" position. (1 mark)

### Question 7

- (a) "Multiple Earthed Neutral System" or "MEN System" means a system of supply of electricity in which the neutral is connected to earth
- (a) at the source of supply; and
  - (b) at points on the supply system; and
  - (c) at every electrical installation connected to that system.

(2 marks)

Ref: ER 2

- (b) • The final subcircuit neutral conductor provides the return path from the loads back to the distribution transformer for the resultant "out-of-balance" current from the three phases
- The neutral conductor is required to ensure that the potential across each single phase load is 230V with respect to earth.

(2 marks)

(2 marks)

- (c) Any ONE of:

- When the load on each phase is identical there is no resulting "out-of-balance" so a neutral is not required.
- Where the load is delta-connected (for example, a motor)

(2 marks)

- (d) In a.c. systems, a switching device shall interrupt all active conductors.

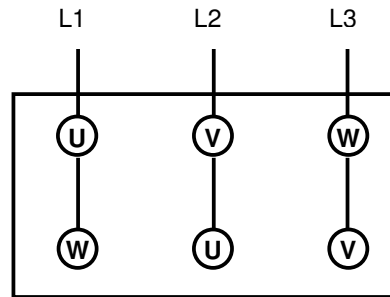
(2 marks)

Ref: AS/NZS 3000: 2.8.3.1

### Question 8

- (a) (i) With an ohmmeter set on the lowest scale, test between each set of terminals in turn until the three lowest resistances between pairs of terminals is known. (2 marks)

(ii)



(2 marks)

- (b) (i) Any TWO of:

- internal connections of one winding reversed
- mechanical overload
- supply voltage insufficient
- loss of one phase
- mechanical faults (bent rotor, excessive bearing wear)

(2 marks)

(ii) Any TWO of:

- Mechanical overload
- Winding fault
- Worn bearings causing contact between rotor and stator
- Fan not operational
- Ventilation holes blocked (restricted air flow)
- Wrong motor for application (ambient temperature too high)

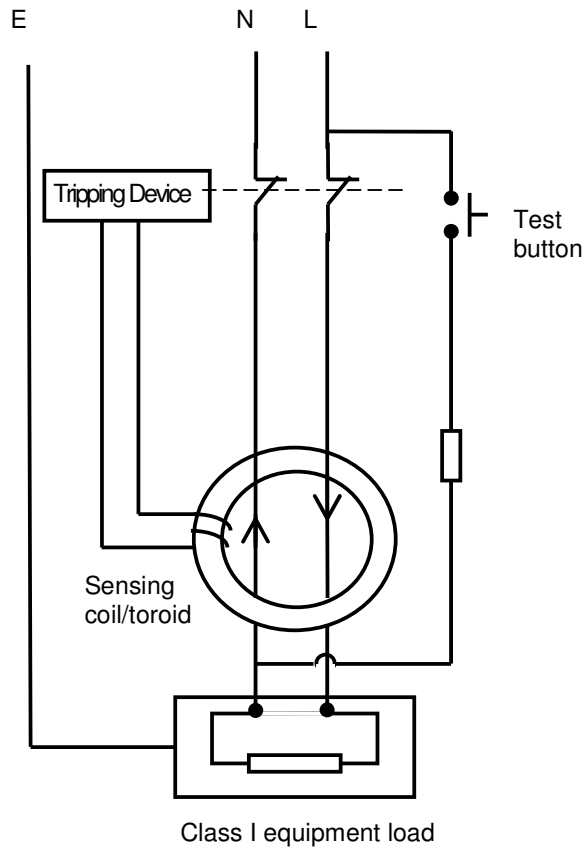
(iii) Any TWO of:

- Removal of ventilation fan or fan cowling.
- Blocked ventilation ports
- Additional of covers that block ventilation ports

(2 marks)

### Question 9

(a)



- Correctly connected test circuit and resistance (1 mark)
  - Correctly connected sensing coil/toroid (1 mark)
  - Correctly connected phase, neutral and earth. (1 mark)
  - Correctly connected tripping circuit (1 mark)
- (b) (i) 300ms or 0.3 seconds (1 mark)
- (ii) 40ms or 0.04 seconds (1 mark)
- (c)
- Neutral current out of balance with the phase current. (1 mark)
  - A magnetic field is induced into the iron core. (1 mark)
  - The induced magnetic field induces a current in the sensing coil (1 mark)
  - The tripping coil is energised, opening the RCD contacts (1 mark)