

## Version 2 - ESTB 2017 - Electrical Service Technician "B" Answer Schedule

- Notes:1. (1 mark) means that the preceding statement/answer 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 accuracy of any answer that is presented in the candidate's own words.
  - Symbols and terms - alternatives  
Power W or P  
Voltage V or E or U  
Phase Active
  - 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

### Question 1

- (a) (i) Decrease  
(ii) Decrease (2 marks)
- (b) Power output =  $746 \times 0.75$   
= 559.5 watts (2 marks)
- (c) Detects excessive current drawn and opens the control circuit and disconnects the motor from the supply. (2 marks)
- (d) The cross sectional area of the flexible cord conductors (conductor size) (2 marks)
- (e) Means an area in which an explosive atmosphere is present, or may be expected to be present, in quantities that require special precautions for the construction, installation, and use of electrical equipment  
ER 2  
(2 marks)

- (f) Class II – Equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions (2 marks)

AS/NZS 3000: 1.4.26  
(2 marks)

- (g) It can be any colour except Black, Light Blue , Green, or Green/Yellow

AS/NZS 3000: 3.8.1  
Table 3.5  
(2 marks)

- (h) Any ONE of:

- Divide the wattage by 230 volts to find the current, then  $R = V/I$

- $R = \frac{V^2}{P}$

- $I = \frac{P}{V}$

then

$$R = \frac{V}{I}$$

(2 marks)

- (i) Detects incorrect phase rotation or phase sequence and opens the control circuit which prevents motor from running in the wrong direction.

(2 marks)

- (j) (i) Zero or nil

(1 mark)

- (i) 230V

(1 mark)

## Question 2

(a) The motor's original direction of rotation will be reversed.

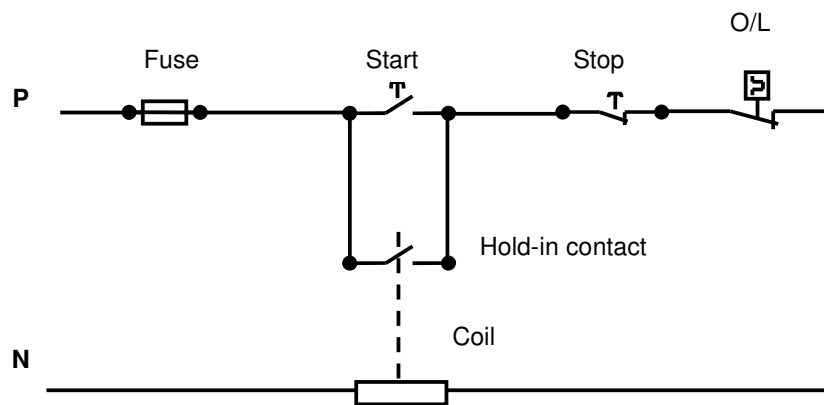
(1 mark)

(b) Any TWO of:

- Variable frequency drive
- Auto-transformer starter
- Soft starter
- Primary resistance
- Star-delta starter

(2 marks)

(c)



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

(d) • The excess line current cause by the mechanical overload causes heating in the thermal overload bi-metal strip. (1 mark)

- The bi-metal strip distorts and operates the contact in the overload unit. (1 mark)

- Which open-circuits the starter coil and de-energises the supply to the motor. (1 mark)

### Question 3

(a) The isolation method has to show:

- Identification of the correct fuses. (1 mark)
- Prove-test-prove to ensure circuit is isolated. (2 marks)
- No live terminals exposed (1 mark)
- Steps taken to prevent reconnection, that is, a danger tag applied or locking device used (2 marks)

Note: Nos 1 and 2 must occur first, No.s 3 and 4 can be in any order.

(b) The test method has to show:

#### Insulation resistance method

- The use of an insulation resistance tester (½ mark)
- Applying a test voltage of 500V d.c. (½ mark)
- Testing between motor winding and earth (1 mark)
- Testing between each motor winding (1 mark)

Note: The use of a 1000V d.c. test between each motor winding is acceptable.

#### Winding resistance method

- Use of ohmmeter (½ mark)
- Separation of windings (½ mark)
- Testing of the resistance of each winding to detect any difference. (2 marks)

(c) Any ONE of:

- Short to earth on one or more motor windings./
- A short between two active conductors supplying the motor.
- Two motor windings have shorted to earth.
- Two active conductors supplying the motor have shorted to earth. (1 mark)

#### Question 4

- (a) (i) The ratio of minimum fusing current to the current rating of the fuse.  
or  
Utilisation category (fusing factor) =  $\frac{\text{Minimum Fusing Current}}{\text{Current Rating}}$  (2 marks)
- (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)
- (b) 80kA The maximum prospective short circuit current the breaker can safely interrupt under fault conditions. (1 mark)
- 16A Is the nominal current rating of the breaker in normal service. (1 mark)
- (c) Any ONE of:
- To protect the fixed wiring against excess current flow
  - Safely interrupt and disconnect a faulty circuit
- (2 marks)

### Question 5

- (a) AS/NZS 3760 (1 mark)
- (b) AS/NZS 3760: 2001 or AS/NZS 3760: 2003
- (1) Visual Inspection (1 mark)  
Ref: Clause 2.3.2
- (2) Insulation Resistance (1 mark)  
Ref: Clause 2.3.3.2
- (3) Protective earthing conductor (PEC) continuity (1 mark)  
Ref: Clause 2.3.3.1
- (c) AS/NZS 3760: 2001 or AS/NZS 3760: 2003
- (i) Test Instrument Insulation resistance test  
Insulation resistance tester (1 mark)
- Test result Minimum of 1 Megohm  
or  
Minimum of 10,000 ohms or 0.01 Megohms  
Ref: Clause 2.3.3.2 (1 mark)
- (ii) Test Instrument Protective earthing conductor continuity  
Meter that can accurately read values of 1 ohm or less (1 mark)
- Test result Maximum of 1 ohm  
Ref: Clause 2.3.3.1 (1 mark)
- (d) • To ensure that the control switch is connected in the phase conductor. (1 mark)
- P – P terminal, N – N terminal, PEC – frame. (1 mark)

## Question 6

- (a) (i) Meter that can accurately read values of 1 ohm or less. (1 mark)
- (ii) • Check from machine frame to known good earth (not own protective earth conductor)  
• If above 0.5 ohm, check security of earth connections. (2 marks)
- (iii) A high protective earth conductor resistance could leave machine frame alive in a phase to frame fault. (2 marks)
- (b) (i) Insulation resistance tester (1 mark)
- (ii) The test method has to show:
- Testing between the supply circuit and earth and the motor windings and earth (1 mark)
  - Testing between each of the supply circuit conductors and between each motor winding (1 mark)
- (iii) An insulation resistance test of below 1 Megohm indicates insulation breakdown which could cause:
- A leakage current that could result in shock hazard.
  - An eventual breakdown of insulation – fault current.
- (2 marks)

### Question 7

- (a) • The motor will operate normally (1 mark)
- The neutral would be switched (1 mark)
- The motor circuitry would be live when the isolating switch is in the "off" position. (1 mark)
- (b) • The RCCB will trip.
- If the RCCB fails to operate, the PEC will carry the full load current for which it is not designed. (1 mark)
- (c) Any ONE of:
- - The MCB would not operate (1 mark)
- The motor will not operate (1 mark)
- Its framework will be alive at 230V to earth. (If the response is "an immediate and serious shock hazard exists" then award only 1 mark) (2 marks)
- The MCB would trip only if there was a fortuitous connection between the frame of the kiln and earth. (4 marks)
- (d) Any TWO of:
- Earth continuity test
- Polarity test
- Insulation resistance test between the phase conductor and the motor frame. (2 marks)

## Question 8

(a) (i) Purpose

The protective earthing conductor:

- Provides a safeguard against electric shock by maintaining the machine framework at earth potential.

Or

- Ensures the circuit protection devices operate in the event of a phase (active) to framework short circuit.

(2 marks)

(ii) Termination -

- Care in termination is necessary to ensure the minimum possible resistance (frame to earth) and the maximum current carrying capacity (avoid broken strands etc)

or

- To ensure that the resistance is not more than 1 ohm.

or

- Ensure that connections are tight and secure and there are no loose strands

(2 marks)

- (b) • When they are double insulated or Class II  
• When they are supplied from an isolating transformer

(2 marks)

(c) Any TWO of:

- Low resistance path to the star point
- Parallel path to the star point of the transformer.
- Ties the voltage between phase and earth to 230V (standard low voltage)

(2 marks)

(d) Any TWO of:

- If in normal use, or in the event of abnormal operation, it functions unsafely so as to cause danger to persons, property, or animals; or
- If it has inadequate protection against direct contact or indirect contact; or
- If its unearthed conductive parts are separated from live parts only by basic insulation.
- If the voltage at which the appliances operates is not adequately marked on the appliance; or
- If it is used for a use other than its normal use, and is not provided, or used in conjunction, with suitable safeguards; or
- If it is constructed that it is not safe under both normal and abnormal conditions of use.

ER76A)  
(2 marks)

### Question 9

- (a)
  - Completed such training as prescribed.
  - Has had such experience as prescribed.
  - Has completed training in resuscitation, safe working practices and testing.
  - Has passed the prescribed examinations.

EA 74  
(4 marks)

- (b) (i) A practising licence

EA 95(1)  
(1 mark)

- (ii) 30 June of the year it is stated to expire.  
(also accept 1 July)

EA 100(2)(b)  
Electricity Amendment Act 1997 4(2)(b)  
(1 mark)

- (iii) The Registrar

EA 96(1) or 100(4)  
(1 mark)

- (c) Any THREE of:

- Registered electricians
- Registered line mechanics
- Registered electrical inspectors
- Registered electrical service technicians
- Persons who are authorised to carry out such work under a provisional licence
- Trainees
- Qualified engineers

EA 108 (2)  
(3 marks)