

## VERSION 2 - ESTB 2014 - 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 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

### Question 1

- (a) Effectively connected to the general mass of Earth (2 marks)  
ER2
- (b) (1) CO<sub>2</sub>  
(2) Dry powder, or similar (2 marks)
- (c) 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)  
(2 marks)
- (d) (i) Brown (1 mark)  
(ii) Light blue or blue (1 mark)

- (e) • To ensure that the control switch is connected in the phase conductor.  
• P – P terminal, N – N terminal, PEC – frame. (2 marks)

(f)  $P = \frac{V^2}{R}$  (2 marks)

- (g) Any TWO of - (2 marks)
- The wiring is damaged, faulty or wrongly installed.
  - The wrong isolating switch has been operated.
  - The isolating switch is damaged or faulty
  - The appliance is supplied from two sources
  - There is a conductive path still present owing to humidity, dust, dirt allowing “tracking” across contacts.

- (h) (i) • An MEN switchboard has an MEN link between the neutral and earth busbars  
or  
• A distribution switchboard does not have an MEN link between the neutral and earth busbars.  
or  
• The MEN switchboard has the connection to the earth electrode (1 mark)

(ii) MEN switchboard (1 mark)

(i)  $I = \frac{W}{V}$  (1/2 mark)

$= \frac{2000}{230}$  (1/2 mark)

$= \mathbf{8.69A}$  (1 mark)

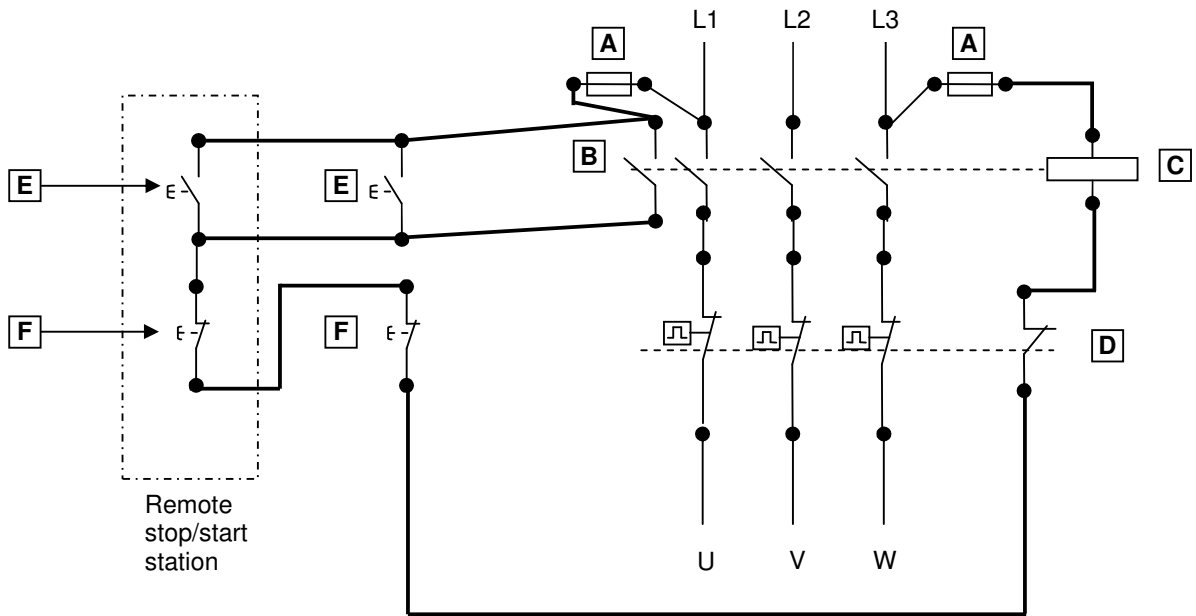
- (j) • When they are double insulated or Class II  
• When they are supplied from an isolating transformer (2 marks)

## Question 2

- (a) (i) The Electrical Workers Registration Board  
ER 12(1)  
(1 mark)
- (ii) When working for payment or reward.  
ER 12(4)  
(1 mark)
- (b) (i) Within 2 years  
ER Schedule 5 (2)  
(1 mark)
- (ii) Any FOUR of:
- Safe working practices
  - Testing
  - Basic first aid
  - CPR
  - The technical content of problem areas identified by the Board
- ER Schedule 5 (2)  
(4 marks)
- (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
  - Qualified engineers
- EA 108 (2)  
(3 marks)

**Question 3**

(a) (i)



- *1/2 mark for each of the 9 wires added.*
- *4 1/2 marks for an operation (and safe) circuit.*

(9 marks)

(b) Any ONE of:

- Less mechanical strain put on motor shaft and bearings.
- Reduced starting current and voltage drop

(1 mark)

#### Question 4

- (a) (i)
  - To protect the fixed wiring against excess current flow
  - or
  - Safely interrupt and disconnect a faulty circuit (2 marks)
- (ii) To provide personal protection to the user of an appliance that is connected to the circuit controlled by the RCD. (2 marks)
- (b)
  - Combined thermal/magnetic breakers have both a bimetal strip and an armature coil.
  - The bimetal protects and will operate on the occurrence of a sustained overload.
  - The armature circuit will protect and act on the occurrence of a short circuit or sudden increase in current. (3 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) The phase failure relay detects the loss of voltage and trips out the entire circuit. (1 mark)

### Question 5

- (a) (i)
  - International Protection Code
  - or
  - Ingress Protection
  - or
  - A degree of protection in accordance with AS 1939.AS/NZS 3000: 1.4.58  
(2 marks)
- (ii)
  - The degree of protection against solid objects
  - Protection of persons against access to hazardous parts.AS/NZS 3000: 1.4.58  
(2 marks)
- (iii) A degree of protection against entry of water with harmful effects.  
AS/NZS 3000: 1.4.58  
(2 marks)
- (b) 6 Complete protection against entry of dust  
AS 1939 supplement 1  
(1 mark)
- or  
Totally protected against dust  
IEC 60529
- 5 Protection against a low pressure jet of water from all practicable directions  
AS 1939 supplement 1  
(1 mark)
- or  
Protected against a low pressure jet of water from all directions – limited ingress permitted  
IEC 60529  
(1 mark)
- (c) Must have a minimum degree of protection of IPX4  
AS/NZS 3000: 7.1.4.1(b)  
AS/NZS 3000 Amendment 3: 7.1.4.1(b) or Table 7.1  
(2 marks)

### Question 6

- (a) Phase to Phase = 400V or alternatively L1-L2, L1-L3, L2-L3 = 400V  
Phase to Neutral = 230V or alternatively L1-N, L2-N, L3-N = 230V  
Phase to Earth = 230V or alternatively L1-E, L2-E, L3-E = 230V  
Neutral to Earth = 0 V (4 marks)
- (b) Any TWO of:  
• Low resistance path to the star point  
• Parallel path to the star point.  
• Ties the voltage between phase and earth to 230V (standard low voltage) (2 marks)
- (c) When the load on each phase is identical there is no resulting “out-of-balance” so a neutral is not required. (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 7

- (a) (i) • Use an insulation resistance tester (½ mark)  
• Test voltage of 500V d.c (½ mark)
- (ii) • Test between each of the three windings. (1 mark)  
• Test between each of the three windings and the motor framework (1 mark)  
• Each test result must be not less than 1 Megohm. (1 mark)
- (iii) Failure of the insulation causes a leakage to the frame of the motor which causes the MCB to trip. (2 marks)
- (b) (i) • Use an ohmmeter or a multimeter with a low reading ohms scale. (1 mark)  
• Test between the protective earthing conductor and the frame of the motor. (1 mark)
- (ii) • A resistance of 1 ohm or less indicates that the conductor is continuous and of low resistance.  
• The protection would operate  
Or  
The frame of the motor would be held at earth potential. (2 marks)

### Question 8

(a) Any TWO of:

- Mechanical overload
- Supply voltage insufficient
- Loss of one line or circuit
- Seized motor
- Open circuited rotor
- Bearing fault (poling)
- Open circuited stator winding

(2 marks)

(b) Any TWO of

- Loss of one line
- Open circuited rotor bars
- Open or faulty windings
- Reversal of polarity of stator winding
- Bearing fault (poling)
- Mechanical overload

(2 marks)

(c) Any TWO of:

- The pole faces of the contactor iron circuit are not making correctly – excessive dirt or dust
- Insufficient voltage to close the iron circuit.
- Broken or missing shading ring in the laminated iron core of the contactor
- Pole face is cracked or core laminations are loose.

(2 marks)

(d) Any TWO of:

- The maintaining circuit is open-circuited.
- The maintaining contact across the start button is incomplete.
- Incorrectly wired circuit

(2 marks)

(e) 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) • 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.
  - Make sure environment is safe.
  - Ensure supply is through and isolating transformer or RCD.
  - Work on rubber mats *or use rubber apron or use safety glasses.*
  - 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.
  - Have competent assistance.
  - Work with one hand in pocket
  - Remove jewellery (watches, rings etc.)
  - **Use the prove-test-prove method** (4 marks)