

## V2-ESTB 2040 - Electrical Service Technician "B" Answer Schedule

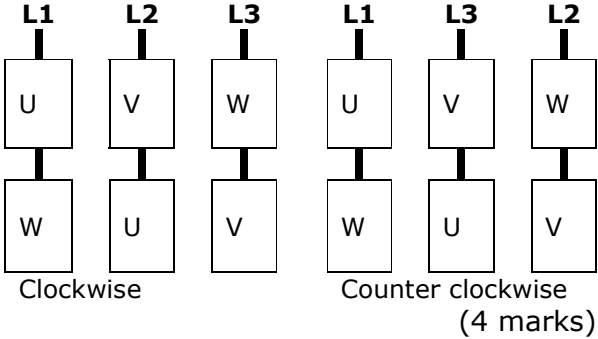
- Notes:1. (1 mark) means that the preceding statement/answer earns 1 mark.
2. This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.
3. Symbols and terms - alternatives  
 Power W or P  
 Voltage V or E or U  
 Phase Active

Question 1	Reference Marks	Marking notes
(a) (i) Phase failure relay	(1 mark)	
(ii) Phase reversal protection	(1 mark)	
(b) Any ONE of: <ul style="list-style-type: none"> <li>It switches the load on/off on timed basis.</li> <li>A heating element bends a bi-metal strip</li> </ul>	(2 marks)	
(c) <ul style="list-style-type: none"> <li>The words "double insulated"</li> <li>The symbol of a "square within a square"</li> </ul>	(2 marks)	
(d) Any TWO of: <ul style="list-style-type: none"> <li>Other equipment could fail or stop during an essential operation (lift or elevator control circuit)</li> <li>The motor intended to be disconnected is remains energised.</li> <li>The motor intended to be disconnected is remains energised, creating a mechanical hazard if restarted.</li> <li>Arc hazard from withdrawing fuses under load.</li> </ul>	(2 marks)	
(e) • = 230 - (230 x 5%)	ER53(3)(b) (1 mark)	
= 218.5 V	(1 mark)	
(f) (i) Any ONE of:	(1 mark)	
<ul style="list-style-type: none"> <li>The degree of protection of persons against live or moving parts inside the enclosure</li> <li>And protection of the fitting against ingress of solid foreign</li> </ul>	AS 1939 supplement 1 - 1990	

Question 1	Reference Marks	Marking notes
bodies		
<ul style="list-style-type: none"> <li>Protection against solid objects</li> </ul>	AS 60529	
<ul style="list-style-type: none"> <li>The degree of protection against solid objects</li> <li>Protection of persons against access to hazardous parts.</li> </ul>	AS/NZS 3000: 2000: 1.4.58	
<ul style="list-style-type: none"> <li>Protection of against ingress of solid objects.</li> </ul>	AS/NZS 3000: 2007: Table G1(a)	
(ii) Any ONE of:	(1 mark)	
<ul style="list-style-type: none"> <li>Protection of equipment against harmful ingress of water.</li> </ul>	AS 1939 supplement 1 – 1990	
<ul style="list-style-type: none"> <li>Protection against liquids</li> </ul>	AS 60529	
<ul style="list-style-type: none"> <li>A degree of protection against entry of water with harmful effects.</li> </ul>	AS/NZS 3000: 2000: 1.4.58	
<ul style="list-style-type: none"> <li>Protection of against harmful ingress of water.</li> </ul>	AS/NZS 3000: 2007: Table G1(b)	
(g) Any TWO of: <ul style="list-style-type: none"> <li>The wrong isolating switch has been operated.</li> <li>The appliance is being fed from two different sources.</li> <li>The isolating switch is switching the neutral conductor.</li> </ul>	(2 marks)	
(h) Isolate the machine and lock the isolator open	(2 marks)	
(i) $30 \times 2 = 60A$ (accept answers between 51A and 75A)	(2 marks)	
(j) (1) Before beginning the work, to check that any associated equipment and personal protective equipment to be used by that person is in good order and condition, and is safe for its intended use	ER 36(2)(a) (1 mark)	
(2) To use the associated equipment and	ER 36(2)(c)	

<b>Question 1</b>	<i>Reference Marks</i>	<i>Marking notes</i>
the personal protective equipment provided in a competent manner.	(1 mark)	

Question 2	Reference Marks	Marking notes
(a) Any THREE of: <ul style="list-style-type: none"> <li>• Loss of one phase</li> <li>• Imbalance in the winding resistance (damaged winding)</li> <li>• Mechanical damage in the motor (rotor or bearings)</li> <li>• Increase in load that the motor is driving.</li> </ul>	(3 marks)	
(b) (i) Any TWO of: <ul style="list-style-type: none"> <li>• Removal of ventilation fan or fan cowling.</li> <li>• Blocked ventilation ports</li> <li>• Additional covers that block ventilation ports</li> <li>• Fan blades broken</li> </ul>	(2 marks)	
(ii) <ul style="list-style-type: none"> <li>• The hold-in contacts are stuck in the open position</li> <li>• There is foreign matter preventing the core from closing.</li> </ul> <p style="text-align: right;">(2 marks)</p>	(2 marks)	
(iii) Any TWO of: <ul style="list-style-type: none"> <li>• Mechanical overload</li> <li>• Loss of one line or circuit</li> <li>• Seized motor</li> <li>• Open circuited rotor</li> <li>• Bearing fault (poling)</li> <li>• Open circuited rotor bars</li> <li>• One of the windings has been reversed when being connected</li> </ul>	(2 marks)	
(c) Any ONE of: <ul style="list-style-type: none"> <li>• Less mechanical strain put on motor shaft and bearings.</li> <li>• Reduced starting current and voltage drop</li> </ul>	(1 mark)	

Question 3	Reference Marks	Marking notes
(a) Detects loss of one phase. Coil is de-energised which opens the control circuit and disconnects the motor from the supply.	(2 marks)	
(b) (i) TWO of: <ul style="list-style-type: none"> <li>• Mechanical overload</li> <li>• Supply voltage insufficient</li> <li>• Loss of one line or circuit</li> <li>• Seized motor</li> <li>• Open circuited rotor</li> <li>• Bearing fault (poling)</li> <li>• Open circuited stator winding</li> </ul>	(2 marks)	
(ii) Any TWO of <ul style="list-style-type: none"> <li>• Loss of one line</li> <li>• Open circuited rotor bars</li> <li>• Open or faulty winding</li> <li>• Reversal of polarity of stator winding</li> <li>• Bearing fault (poling)</li> <li>• Supply voltage too low</li> <li>• Motor connected in delta, when it should be in star</li> </ul>	(2 marks)	
(c)	(4 marks)	
 <p style="text-align: center;">(4 marks)</p>		<ul style="list-style-type: none"> <li>• The clockwise direction must be entirely correct to gain the 2 marks.</li> <li>• The counter-clockwise direction must be entirely correct to gain the 2 marks.</li> </ul>

Question 4	Reference Marks	Marking notes
(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)	ER 2
(b) Any TWO of: <ul style="list-style-type: none"> <li>• Low resistance path to the star point at the distribution transformer</li> <li>• Parallel path to the star point at the distribution transformer</li> <li>• Ties the voltage between phase and earth to 230V (standard low voltage)</li> <li>• Minimises the potential difference between neutral and earth</li> </ul>	(2 marks)	
(c) <div style="text-align: center;"> <p>The diagram illustrates a Multiple Earthed Neutral (MEN) system. At the top, there are three phase lines labeled L1, L2, and L3, and a neutral line labeled N. The neutral line is connected to earth at two separate points, each labeled 'Earth electrode'. Below the supply lines, there are two consumer units. The first is a 'Single-phase consumer' with a 'Main switch' and an 'Earth bar' connected to the neutral bar and an 'Earth electrode'. The second is a 'Three-phase consumer' with three 'Main switch' units and an 'Earth bar' connected to the neutral bar and an 'Earth electrode'. Labels with arrows point to 'Neutral bar', 'Main switch', 'Earth bar', and 'Earth electrode' for both consumers.</p> </div>		
<ul style="list-style-type: none"> <li>• Supply lines</li> </ul>	(1 mark)	No marks can be awarded for part (c), if there are any of the following hazards: <ul style="list-style-type: none"> <li>• A phase connected to a</li> </ul>
<ul style="list-style-type: none"> <li>• Single-phase consumer:</li> </ul>		
<ul style="list-style-type: none"> <li>- main switch</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>- neutral bar connections.</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>- earth bar connections.</li> </ul>	(1/2 mark)	

Question 4	Reference Marks	Marking notes
<ul style="list-style-type: none"> <li>• Three-phase consumer</li> </ul>		<ul style="list-style-type: none"> <li>• neutral bar</li> <li>• No MEN link in either switchboard.</li> <li>• No main earth on either switchboard</li> </ul>
<ul style="list-style-type: none"> <li>- main switch</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>- neutral bar connections.</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>- earth bar connections.</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>• Earthing arrangements</li> </ul>		
<ul style="list-style-type: none"> <li>- electrodes</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>- links.</li> </ul>	(1 mark)	

Question 5	Reference Marks	Marking notes
(a) (i) • Use an insulation resistance tester	(½ mark)	
• Test voltage of 500V d.c	(½ mark)	
(ii) The testing procedure has to show:		
• Removing the links on the motor terminal block	(1 mark)	
• IR testing between each of the three windings and the motor framework	(1 mark)	
Each test result must be not less than 1 MΩ.	(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.	(½ mark)	
• Test between the motor frame and another known earth (e.g. the earth pin of a socket outlet).	(1 mark)	
• A test result of 1 ohm or less	(½ 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 6	Reference Marks	Marking notes
(a) (i) Reverse the connections to the start winding or Reverse the connections to the run winding.	(1 mark)	
(ii) Reverse the connections to the field windings or Reverse the connections to the armature windings.	(1 mark)	
(b) Power = 746 x 0.75	(1/2 mark)	
= 559.5 watts	(1/2 mark)	
$I = \frac{P}{V}$	(1/2 mark)	
= $\frac{560}{230}$	(1/2 mark)	
= 2.43A	(1 mark)	
<p>(c)</p>		
<ul style="list-style-type: none"> <li>• Correctly connected start winding</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>• Correctly connected centrifugal switch</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>• Correctly connected run winding</li> </ul>	(1/2 mark)	
<ul style="list-style-type: none"> <li>• Working circuit</li> </ul>	(1/2 mark)	

<b>Question 6</b>	<i>Reference Marks</i>	<i>Marking notes</i>
(ii) Any ONE of: <ul style="list-style-type: none"> <li>• An external current relay.</li> <li>• Timer</li> </ul>	(1 mark)	
(d) Any ONE of: <ul style="list-style-type: none"> <li>• It may create arcing in the switch causing possible damage.</li> <li>• Damage could occur to the motor drive assembly</li> </ul>	(2 marks)	

Question 7	Reference Marks	Marking notes
(a) The procedure has to cover:		
<ul style="list-style-type: none"> <li>• Removal of fuses</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>• Testing the circuit for isolation using the prove-test-prove method.</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>• Attaching a Danger tag to the circuit.</li> </ul>	(1 mark)	
(b) • The control circuit operates at 230V.	(½ mark)	
<ul style="list-style-type: none"> <li>• The control circuit is connected to the phase on which there is no fault.</li> </ul>	(½ mark)	
(c) The description has to include:		
<ul style="list-style-type: none"> <li>• An insulation resistance test.</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>• Using an insulation resistance tester.</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>• A test voltage of 500V d.c.</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>• Disconnecting the two elements on which the fuses blew</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>• Testing the wiring on the two phases on which the fuses blew:</li> </ul>		
<ul style="list-style-type: none"> <li>- between each phase and earth at the load side of the isolator.</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>- between each phase and earth on the load side of the contactor.</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>- If either of these cables are faulty, the test result will be much less than 1MΩ</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>• Any ONE of:</li> </ul>		
<ul style="list-style-type: none"> <li>* Testing each of the elements between the element and earth.</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>If either of the elements are faulty, the test result will be much less than 10,000Ω (0.01MΩ)</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>* Resistance test of each element</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>If either of the elements are faulty, the resistance will be much less than the element that operates</li> </ul>	(½ mark)	

Question 8	Reference Marks	Marking notes
(a) Test: No.1      Protective earthing conductor test Instrument      Ohmmeter or any instrument that can accurately read values of 1Ω or less Result              1Ω maximum	ASZS 3760: 2001: 2.3.3.1 2003: 2.3.3.1 (3 marks)	
Test No. 2      Insulation resistance test Instrument      Insulation resistance tester Result              1 MΩ minimum	AS/NZS 3760: 2001: 2.3.3.2 2003: 2.3.3.2 (3 marks)	
(b) (i) • Test between each phase	(1 mark)	
• Test between each phase and earth.	(1 mark)	
(ii) From AS/NZS 3000:2000: Table 3.5 • Any colour except green, green/yellow black and light blue (phases).	(1 mark)	To gain the marks for this question, all the colours must stated accurately
• Green or green/yellow (earth)	(1 mark)	
or From AS/NZS 3000:2007: Table 3.4 • Any colour except green, green/yellow black and light blue (phases). • Green/yellow (earth)		
or From AS/NZS 3000:2007: Figure 3.2 • Red, white, dark blue (phases). • Green (earth)		

Question 9	Reference Marks	Marking notes
(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: <ul style="list-style-type: none"> <li>• Safe working practices</li> <li>• Testing</li> <li>• Basic first aid</li> <li>• CPR</li> <li>• The technical content of problem areas identified by the Board</li> </ul>	ER Schedule 5 (2) (4 marks)	
(c) Any THREE of: <ul style="list-style-type: none"> <li>• Registered electricians</li> <li>• Registered line mechanics</li> <li>• Registered electrical inspectors</li> <li>• Registered electrical service technicians</li> <li>• Persons who are authorised to carry out such work under a provisional licence</li> <li>• Qualified engineers</li> </ul>	EA 108 (2) (3 marks)	