

## V3 – ET 32 - Electrician Theory Examination Marking 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) Any ONE of: <ul style="list-style-type: none"> <li>• They are easier to insulate from the iron core than the high voltage windings.</li> <li>• Lower voltage potential to the core</li> </ul>	(2 marks)	
(b) Any TWO of: <ul style="list-style-type: none"> <li>• Reduce system losses</li> <li>• Reduce voltage drop</li> <li>• Prevent premature failure of highest loaded phase</li> <li>• Minimise neutral current</li> <li>• Lower rated protective devices can be used</li> <li>• Smaller cable sizes can be used</li> </ul>	(2 marks)	
(c) • There is lower source impedance	(1 mark)	
• As the transformer is either close to the installation or on-site	(1 mark)	
(d) Any TWO of: <ul style="list-style-type: none"> <li>• Capacitor-start, capacitor-run</li> <li>• Shaded pole</li> <li>• Split phase (or resistance start)</li> <li>• Permanently split</li> </ul>	(2 marks)	A universal motor is not an induction motor
(e) (i) Earth leakage test	(1 mark)	
(ii) 5 mA	(1 mark)	
(f) 40 ms	(2 marks)	
(g) About 1800W Or $(218.5 \div 230)^2 \times 2000$	(2 marks)	

<b>Question 1</b>	<i>Reference Marks</i>	<i>Marking notes</i>
<p>= 1805W</p> <p>Or</p> <p><math>(0.95)^2 \times 2000</math></p> <p>= 1805W</p>		

<b>Question 1</b>	<i>Reference Marks</i>	<i>Marking notes</i>
<p>(h) Any ONE of:</p> <ul style="list-style-type: none"> <li>• The fault rating of the protection devices is adequate to safely interrupt a circuit.</li> <li>• To find the prospective short circuit current level of the installations</li> <li>• To determine the impedance at the switchboard under fault conditions.</li> </ul>	(2 marks)	
<p>(i) (i) The CT secondary must be short-circuited.</p>	(1 mark)	
<p>(ii) Any ONE of:</p> <ul style="list-style-type: none"> <li>• To prevent a high voltage developing in the circuit.</li> <li>• To prevent damage to the CT accuracy through core saturation</li> </ul>	(1 mark)	
<p>(j) It means that the motor must be connected in star.</p>	(2 marks)	

Question 2	Reference Marks	Marking notes
(a) Any THREE of: <ul style="list-style-type: none"> <li>• Any metal not normally live could be live.</li> <li>• If the earth fault path is of high impedance the main fuse may not blow</li> <li>• Fire hazard could occur through the main earth conductor carrying excessive current</li> <li>• The earth bar/neutral bar/MEN link could be live at up to 230V.</li> <li>• The neutral is being switched at the main switchboard.</li> <li>• 400V could be present at any socket outlet</li> <li>• Damage could occur to any appliance / motor</li> <li>• Lighting circuits could have 400V present at the light socket</li> </ul>	(3 marks)	No marks are awarded for the following statements: <ul style="list-style-type: none"> <li>• Fire hazard</li> <li>• Shock hazard</li> </ul>
(b) <ul style="list-style-type: none"> <li>• Insert temporary earth stake remote from main earth</li> </ul>	(½ mark)	<u>Hazardous</u> Removal of MEN link
<ul style="list-style-type: none"> <li>• Test in turn with voltmeter and trailing lead:</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>* between each phase and remote earth</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>* between the neutral/earth bar and remote earth</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>• If a transposition has taken place:</li> </ul>		
<ul style="list-style-type: none"> <li>* There will be 230V between two of the phases and the remote earth</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>* There will be 230V between the neutral/earth bar and the remote earth</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>* There will be 0V between one of the phases and the remote earth</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>• If no transposition has taken place:</li> </ul>		
<ul style="list-style-type: none"> <li>* There will be 230V between all phases and the remote earth</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>* There will be 0V between the neutral/earth bar and the remote earth</li> </ul>	(1 mark)	

Question 3	Reference Marks	Marking notes
(a) (i) (A) Any ONE of: <ul style="list-style-type: none"> <li>• The current increases</li> <li>• The motor slows</li> <li>• The motor temperature rises</li> </ul>	(1/2 mark)	
(B) Any ONE of: <ul style="list-style-type: none"> <li>• The thermal overload will operate.</li> <li>• The protection will operate</li> </ul>	(1/2 mark)	
(ii) (A) Any ONE of: <ul style="list-style-type: none"> <li>• The motor will stall</li> </ul>	(1/2 mark)	
(B) Any ONE of: <ul style="list-style-type: none"> <li>• The thermal overload will operate.</li> <li>• The protection will operate</li> </ul>	(1/2 mark)	
(b) (i) (A) Any ONE of: <ul style="list-style-type: none"> <li>• The motor will slow</li> <li>• Excess current will flow</li> <li>• Motor torque will reduce</li> </ul>	(1/2 mark)	
(B) Any ONE of: <ul style="list-style-type: none"> <li>• The thermal overload will operate.</li> <li>• The protection will operate</li> <li>• The no-volt protection will operate</li> </ul>	(1/2 mark)	
(ii) (A) Any ONE of: <ul style="list-style-type: none"> <li>• The motor will stall</li> <li>• A high current will flow</li> </ul>	(1/2 mark)	
(B) Any ONE of: <ul style="list-style-type: none"> <li>• The thermal overload will operate.</li> <li>• The protection will operate</li> <li>• The differential overload will operate.</li> </ul>	(1/2 mark)	
(c) • Motor slowing creates more slip	(1 mark)	
• Increase in rotor frequency	(1/2 mark)	
• Rotor voltage and current increase.	(1 mark)	
• Creates more rotor flux.	(1/2 mark)	
• This will reduce the back-emf in the stator windings	(1 mark)	

<b>Question 3</b>	<i>Reference Marks</i>	<i>Marking notes</i>
<ul style="list-style-type: none"> <li>• So the effective voltage applied to the stator windings increases</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>• So the stator current increases</li> </ul>	(1 mark)	

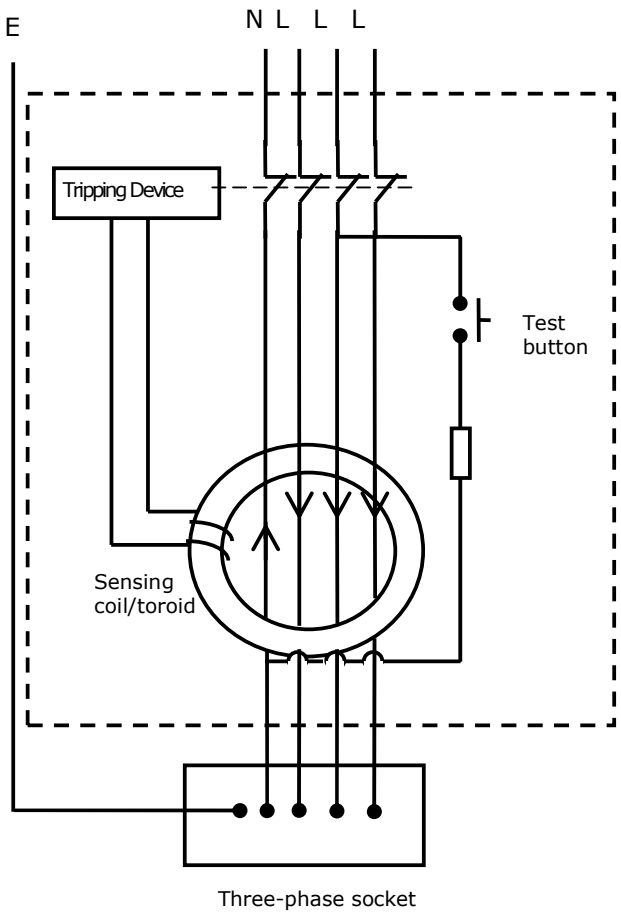
Question 4	Reference Marks	Marking notes
<p>The diagram illustrates the connection of an incoming supply (N, P, P, P) to two switchboards. The top switchboard is the MEN Switchboard, which contains a Main neutral bar, Main earth bar, MEN link, and Earth tag. The bottom switchboard contains a Neutral bar and Earth bar. An RCBO is connected to the P lines. An Earth electrode is connected to the MEN link via another Earth tag.</p>		
<ul style="list-style-type: none"> <li>Correctly connected incoming supply to main switch (MEN switchboard)</li> </ul>	(1 mark)	<p>No marks can be awarded for this question if there are any of the following hazards:</p> <p><u>MEN switchboard</u></p> <ul style="list-style-type: none"> <li>Phase/neutral transposition</li> <li>No MEN link</li> <li>No main neutral</li> <li>No main earthing lead or electrode</li> </ul> <p><u>Either switchboards</u></p> <ul style="list-style-type: none"> <li>Any short circuit</li> <li>Neutral switched (other than the</li> </ul>
<ul style="list-style-type: none"> <li>Correctly connected main neutral (MEN switchboard)</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>Correctly connected main earth (MEN switchboard)</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>Correctly connected MEN link (MEN switchboard)</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>Correctly connected Earth tags (MEN switchboard and earth electrode)</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>Correctly connected RCBO (MEN switchboard)</li> </ul>	(2 marks)	

Question 4	Reference Marks	Marking notes
<ul style="list-style-type: none"> <li>• Correctly connected main switch (Distribution switchboard)</li> </ul>	(½ mark)	RCBO) <u>Distribution Switchboard</u>
<ul style="list-style-type: none"> <li>• Correctly connected neutral bar (Distribution switchboard)</li> </ul>	(1 mark)	<ul style="list-style-type: none"> <li>• Phase/neutral transposition</li> <li>• Neutral/earth transposition</li> </ul>
<ul style="list-style-type: none"> <li>• Correctly connected earth bar (Distribution switchboard)</li> </ul>	(1 mark)	<u>RCBO</u>
<ul style="list-style-type: none"> <li>• Working diagram</li> </ul>	(1½ marks)	<ul style="list-style-type: none"> <li>• The RCBO is installed on the distribution switchboard but there is no circuit protection on the MEN switchboard.</li> <li>• The RCBO is supplied from the supply (incoming) side of the main switch on the MEN switchboard.</li> <li>• The distribution board is not protected by the RCBO</li> </ul>

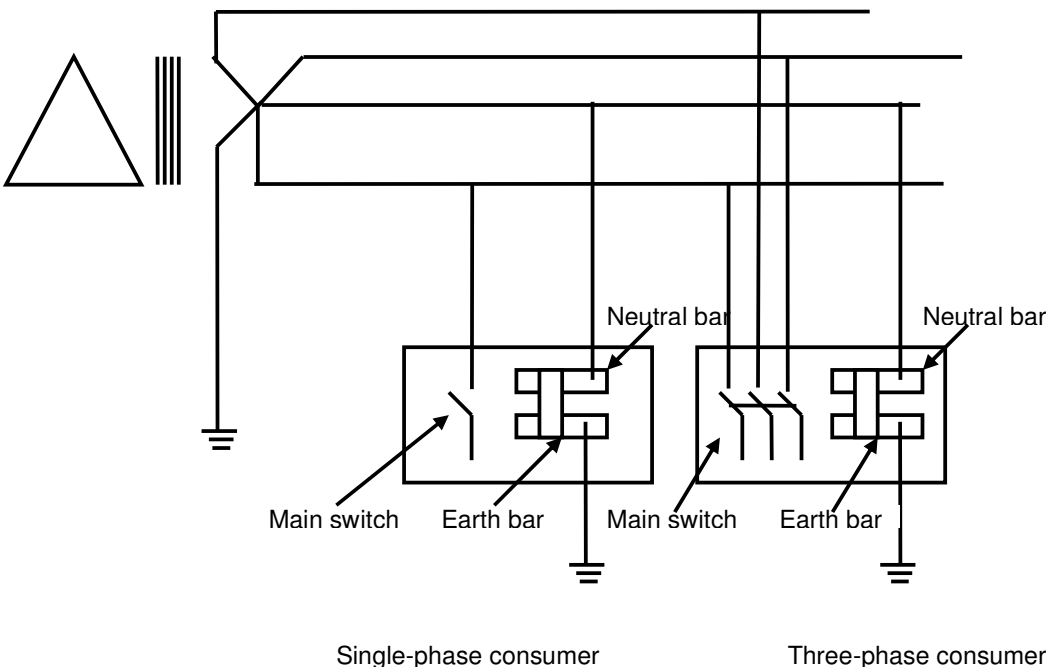
Question 5	Reference Marks	Marking notes
(a) (i) Where there is a possibility of personal danger through the supply being restored.	(1 mark)	
(ii) Where equipment is faulty or damaged and using that equipment would cause damage or injury.	(1 mark)	
(iii) Any THREE of: <ul style="list-style-type: none"> <li>• Make sure the correct isolating switch is tagged.</li> <li>• Make sure the switch is in the "OFF" position before it is tagged</li> <li>• Fasten the Danger Tag securely so that it will not come off.</li> <li>• Test to ensure isolation has taken place.</li> <li>• Appropriate details are entered on the tag</li> </ul>	(3 marks)	
(b) "Isolated" means that the motor has been: <ul style="list-style-type: none"> <li>• deliberately disconnected from the electricity supply and</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>• precautions taken to prevent reconnection</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>• "Switched off" means that the electricity ceases to be supplied to the motor</li> </ul>	(1 mark)	
(c) <ul style="list-style-type: none"> <li>• The test instrument is checked to be operating correctly on a known live source.</li> <li>• The equipment is tested to confirm (or otherwise) that it is isolated.</li> <li>• The test instrument is again checked on a known live source to ensure is still operates correctly.</li> </ul>	(1½ marks)	
(d) Test between each phase and earth.	(½ mark)	

Question 6	Reference Marks	Marking notes
(a) <ul style="list-style-type: none"> <li>• The socket outlet</li> <li>• The final subcircuit earth conductor</li> <li>• The MEN connection</li> <li>• The consumers main neutral</li> <li>• The distribution neutral</li> <li>• The distribution transformer</li> <li>• The distribution active (phase) conductor</li> <li>• The main switch</li> <li>• The switchboard cables</li> <li>• The protective device</li> <li>• The final subcircuit active conductor</li> </ul>	(5½ marks)	
(b) Any TWO of:- <ul style="list-style-type: none"> <li>• Determine the prospective short circuit current at the point in an installation</li> <li>• Determine that the correct type and fault current rating of circuit protection is installed</li> <li>• The impedance of the protective earthing conductor is low enough to operate the protective device</li> </ul>	(2 marks)	
(c) It is considered to be the path with the lowest impedance.	(½ mark)	
(d) To ensure the main earthing lead is able to safely carry the maximum fault current of the installation to enable protective devices to operate.	(2 marks)	

Question 7	Reference Marks	Marking notes
(a)		
<ul style="list-style-type: none"> <li>Correctly connected phases, neutral and earth.</li> </ul>	(1½ marks)	No marks can be awarded for part (a), if there are any of the following hazards: <ul style="list-style-type: none"> <li>A short circuit</li> <li>No test resistance.</li> <li>The socket outlet is not earthed</li> <li>The test button circuit is connected to the supply side of the tripping device</li> </ul>
<ul style="list-style-type: none"> <li>Correctly connected test button and resistance</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>Correctly connected sensing coil/toroid</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>Correctly connected tripping circuit</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>Correctly connected socket</li> </ul>	(½ mark)	
<ul style="list-style-type: none"> <li>Working circuit</li> </ul>	(1½ marks)	
(b)		
<ul style="list-style-type: none"> <li>Neutral current out of balance with the phase current.</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>A magnetic field is induced into the iron core.</li> </ul>	(1 mark)	



<b>Question 7</b>	<i>Reference Marks</i>	<i>Marking notes</i>
<ul style="list-style-type: none"> <li>The induced magnetic field induces a current in the sensing coil</li> </ul>	(1 mark)	
<ul style="list-style-type: none"> <li>The tripping coil is energised, opening the RCD contacts</li> </ul>	(1 mark)	
(c) RCBO <b>R</b> esidual <b>C</b> urrent-Operated <b>C</b> ircuit <b>B</b> reaker with <b>O</b> vercurrent Protection	(1 mark)	

Question 8	Reference Marks	Marking notes
(a) • Rewireable fuses are not rated for more than 1 kA or Rewireable fuses will not safely rupture under the stated fault conditions	(1 mark)	
• MCBs are rated up to 10kA or MCBs will safely open under the stated fault conditions	(1 mark)	
(b) (i) • A bi-metal strip heats up and distorts	(1 mark)	
• The distortion operates a trip mechanism that opens the breaker	(1 mark)	
(ii) • A strong magnetic field is created in the coil	(1 mark)	
• The field attracts a trip mechanism that operates and opens the breaker.	(1 mark)	
	<del>(1 mark)</del>	
(c)  <p>The diagram illustrates a star-point earthed distribution system. On the left, a three-phase supply is represented by a triangle symbol. This supply is connected to a main switchboard. The main switchboard contains a main switch and an earth bar connected to ground. It feeds two consumer switchboards: a single-phase consumer and a three-phase consumer. Both consumer switchboards have their own main switches and earth bars connected to ground. Neutral bars are also shown in both consumer switchboards.</p>		
• Star point earthed	(1 mark)	No marks can be awarded for part (c), if there are any
• For each switchboard - an earthing	(1 mark)	

<b>Question 8</b>	<i>Reference Marks</i>	<i>Marking notes</i>
conductor connected to the earth bar.		of the following hazards:
<ul style="list-style-type: none"> <li>• For each switchboard - an MEN link between the neutral bar and earth bar.</li> </ul>	(1 mark)	<ul style="list-style-type: none"> <li>• A phase connected to a neutral bar</li> </ul>
<ul style="list-style-type: none"> <li>• For each switchboard - a neutral conductor between the neutral bar and the distribution neutral.</li> </ul>	(1 mark)	<ul style="list-style-type: none"> <li>• No MEN link in either switchboard.</li> <li>• No main earth on either switchboard</li> <li>• The star point of the transformer is not earthed</li> </ul>

<b>Question 9</b>	<i>Reference Marks</i>	<i>Marking notes</i>
(a) AS/NZS 3000	(1 mark)	
(b) A Certificate of Compliance.	(1 mark)	
(c) (1) Insulation resistance test	(½ mark)	
• Insulation resistance tester	(½ mark)	
• Test between each phase and earth	(½ mark)	
• Test between neutral and earth	(½ mark)	
• 1 MΩ minimum	(½ mark)	
(2) Protective earthing conductor test	(½ mark)	
• Ohmmeter	(½ mark)	
• Test between the end of the protective earthing conductor at the switchboard and the earth pin on the socket outlet.	(½ mark)	
• 0.5Ω maximum Or Low enough for the protection to operate in the required time.	(½ mark)	
(3) Correct circuit connections test (or polarity)	(½ mark)	
• Ohmmeter	(½ mark)	
• Test between each cable conductor and corresponding pin on the socket outlet.	(½ mark)	
(d) • RCD trip-time test	(1 mark)	
• RCD tester	(1 mark)	