

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## PARTICIPANT CONFIRMATION:

By signing below, I confirm that:

- I have enrolled to undertake the assessments indicated above; and
- The assessment criteria has been explained to me and I am aware that I will be assessed against the criteria outlined within the attached assessment documents.
- I have been given fair notice of the date, time & venue for this assessment, and I am aware of my rights and obligations in relation to the assessment process
- I am satisfied that the assessment was fair and valid.

<b>STUDENT NAME (PLEASE PRINT):</b>			
<b>STUDENT SIGNATURE:</b>		<b>DATE:</b> .....	..... / .....
<b>STUDENT IDENTIFICATION PLEASE PROVIDE PHOTO ID FOR VERIFICATION BY THE ASSESSOR</b>	<b>DRIVERS LICENCE STATE OF ISSUE:</b>	<b>NUMBER:</b>	
	<b>HIGH RISK LICENCE STATE OF ISSUE:</b>	<b>NUMBER:</b>	
<b>ESI Network Authorisations:</b>	<input type="checkbox"/> AUSGRID	<input type="checkbox"/> ENDEAVOUR ENERGY	<input type="checkbox"/> ESSENTIAL ENERGY

## UEENEEG158A– CONDUCT ELECTRICAL TESTS ON HV MACHINES: (ASSESSOR USE ONLY)

ASSESSMENT COMPONENT	ASSESSMENT OUTCOME	
UEENEEG158A - THEORY/KNOWLEDGE ASSESSMENT	<input type="checkbox"/> <u>SATISFACTORY</u>	<input type="checkbox"/> <u>NOT SATISFACTORY</u>
<u>OVERALL ASSESSMENT OUTCOME – UEENEEG158A</u>	<input type="checkbox"/> <u>COMPETENT</u>	<input type="checkbox"/> <u>NOT COMPETENT</u>
<b>TRAINER/ASSESSOR NAME (PLEASE PRINT):</b>		
<b>TRAINER/ASSESSOR SIGNATURE:</b>		
<b>DATE OF ASSESSMENT:</b>		

### 1. ASSESSMENT RESOURCE - VERSION AND PUBLICATION:

<b>Title</b>	UEENEEG158A– Conduct Electrical Tests On HV Machines		
<b>Publication Authorised By</b>	Nicholas Blanch	<b>Issued Version Number</b>	V1.0
<b>Date Issued</b>	29/09/2016	<b>Date for Review</b>	09/10/2017
<b>Document Repository</b>	HTTP://TEAMSITES.HUNTER.TAFENSW.EDU.AU/INR/COMMERCIAL/INR COMMERCIAL/ETSU COURSES/COURSES/1 ESI COURSES/UEENEEG158A V1 09.10.16.DOCX		

### 2. ASSESSMENT RESOURCE - PUBLICATION HISTORY:

Previous Versions	Current Version	Date	Author	Description of change
	V1.o	09/10/2016	Nicholas Blanch	Initial Version

#### COPYRIGHT

Hunter TAFE, Faculty of Industry & Resources. 2016.

Copyright in this material is reserved to Hunter TAFE and the Crown. Reproduction or transmittal in whole, or in part, other than for the purposes of and subject to the provision of the Copyright Act, is prohibited without the written authority of Hunter TAFE and the Crown.

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## **ASSESSMENT INSTRUCTIONS:**

TO SUCCESSFULLY COMPLETE THIS ASSESSMENT AND BE “DEEMED” COMPETENT PARTICIPANTS MUST:

- ANSWER ALL KNOWLEDGE ASSESSMENT QUESTIONS CONTAINED WITHIN THE WRITTEN ASSESSMENT RESOURCE TO THE SATISFACTION OF THE ASSESSOR.
- ACHIEVE A MINIMUM MARK OF 75% (IE ALL ANSWERS MUST BE CORRECT). EACH UN-ANSWERED QUESTION IS TO BE MARKED AS INCORRECT).

**ASSESSMENT PARTICIPANTS MAY NOT ACCESS ANY REFERENCE MATERIAL DURING THIS PART OF THE ASSESSMENT**

**NOMINAL ASSESSMENT DURATION: 120 MINUTES**

### **QUESTION 1: (Tick the box/boxes next to the most correct answer – 2 Marks)**

**The basic safety rule for work on or near High Voltage exposed electrical apparatus states that:**

- a) *The exposed HV conductors or electrical apparatus must be regarded as alive until advised to the contrary by an Authorised Person*
- b) *The exposed HV conductors or electrical apparatus must be regarded as alive until isolated, proved de-energised and earthed*
- c) *The exposed HV conductors or electrical apparatus must be regarded as alive until a clear and visible break, signifying isolation, has been established*
- d) *The exposed HV conductors or electrical apparatus must be regarded as alive until isolated, proved de-energised, earthed and short-circuited by an approved means*

### **QUESTION 2: (Tick the box/boxes next to the most correct answer – 8 Marks)**

**In the spaces provided below write down the definition for each if the terms**

A) De-energised .....

.....

B) Isolated .....

.....

.....

**QUESTION 3: (Tick the box/boxes next to the most correct answer – 2 Marks)**

From the items listed below select the most appropriate definition for “authorised person”

- a) *A person who has acquired through training, qualification, experience, or a combination of them, the knowledge and skills to carry out the task.*
- b) *A person who has attained a relevant nationally recognized qualification, and who has been licensed by the NSW Department of Fair Trading*
- c) *A person with technical knowledge or sufficient experience who has been approved, or has the delegated authority to act on behalf of the Network Operator, to perform the duty concerned.*
- d) *LV or HV overhead conductors which are protected by physical barriers to prevent persons encroaching within the relevant Safe Approach Distances (SAD’s)*

**QUESTION 4: (Tick the box/boxes next to the most correct answers – 3 Marks)**

From the list below, select the item/s which the Access Permit/Access Authority issuer must advise the Access Permit/Access Authority Recipient (and preferably all persons working on equipment or job for which the Authority is being issued):

- a) *a confirmation of the description of the work to be carried out;*
- b) *the time and date of issue of the access permit/access authority.*
- c) *the locations where electrical apparatus has been earthed and short-circuited*
- d) *warnings of adjacent live exposed conductors or electrical apparatus (if applicable)*
- e) *any screens, tapes / barriers that are erected to define the Work Area*

**QUESTION 5: (Tick the box/boxes next to the most correct answer – 2 Marks)**

Given that resistance is proportional to the length and the diameter of the conductor being used in a circuit, identify the correct statements from the items listed below

- a) *Long conductors have a greater resistance than short conductors*
- b) *Short conductors have a greater resistance than long conductors*
- c) *If the cross sectional area or diameter of a conductor is halved its resistance becomes doubled*

**QUESTION 6: (Tick the box/boxes next to the most correct answer – 2 Marks)**

From the list below, select the circumstances where an access permit/access authority would be required to perform testing on a HV AC induction motor

- a) *Electrical maintenance work upon the HV motor which will require those performing the work to be within the safe approach distances for the voltage concerned.*
- b) *General maintenance work being conducted where uninsulated tools/equipment being used may encroach the safe approach distances for the voltage concerned.*

**QUESTION 7: (Tick the box/boxes next to the most correct answer – 2 Marks)**

Given that resistance is proportional to the temperature, length and the diameter of the conductor being used in a circuit, identify the correct statements from the items listed below

- a) *Long conductors have a greater resistance than short conductors*
- b) *Short conductors have a greater resistance than long conductors*
- c) *A conductors resistance increases as its temperature increases*
- d) *Conductors with smaller cross sectional area or diameter have lower resistance values compared to conductors with larger smaller cross sectional area or diameter*

**QUESTION 8: (Tick the box/boxes next to the most correct answer – 6 Marks)**

From the list of materials below, identify those that you would consider to be conductive by ticking the box

Material	Conductive
Porcelain,	<input type="checkbox"/>
Free Air	<input type="checkbox"/>
Copper	<input type="checkbox"/>
Fiberglass /Epoxy	<input type="checkbox"/>
Hair/Clothing	<input type="checkbox"/>
Water	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Dry Wood/timber	<input type="checkbox"/>

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

**QUESTION 9:** (Tick the box/boxes next to the most correct answer – 6 Marks)

From the list of materials below, identify those that you would consider to be non-conductive or insulators by ticking the box

Material	Non Conductive/Insulator
Porcelain,	<input type="checkbox"/>
Free Air	<input type="checkbox"/>
Copper	<input type="checkbox"/>
Fiberglass /Epoxy	<input type="checkbox"/>
Hair/Clothing	<input type="checkbox"/>
Water	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Dry Wood/timber	<input type="checkbox"/>
Ground/Earth	<input type="checkbox"/>
Damp or wet wood/timber	<input type="checkbox"/>
The human body	<input type="checkbox"/>

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## QUESTION 10: (Tick the box/boxes next to the most correct answer – 6 Marks)

From the list below, select the items that the Access Permit/Access Authority recipient/holder has a responsibility to confirm after receiving an access permit/access authority:

- a) *The recipient must ensure that every person signing on to the access permit is aware of the mains and apparatus which are covered by the access permit, the work to be done and the precautions in place.*  True  False
- b) *The recipient must instruct and give face-to-face demonstration to all people who will sign on the permit of the safety requirements of the access permit.*  True  False
- c) *The recipient must ensure that all those required to sign on the access permit do so before they start work.*  True  False
- d) *The recipient must ensure that every person signing on the permit is aware of their obligations to notify the recipient when leaving and returning to the worksite*  True  False

## QUESTION 11: (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below, briefly describe who can issue an Permit To Work/Access Permit/Access Authority under the requirements of your organisations HV electrical safety rules

.....

.....

.....

.....

.....

.....

.....

.....

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## QUESTION 12: (Tick the box/boxes next to the most correct answer – 6 Marks)

From the list below, select the item/s which the Access Permit/Access Authority issuer must advise the Access Permit/Access Authority Recipient (and preferably all persons working on equipment or job for which the Authority is being issued):

- e) a confirmation of the description of the work to be carried out;
- f) the time and date of issue of the access permit/access authority.
- g) the locations where electrical apparatus has been earthed and short-circuited
- h) warnings of adjacent live exposed conductors or electrical apparatus (if applicable)
- f) any screens, tapes / barriers that are erected to define the Work Area

## QUESTION 13: (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below write down the two (2) general types of rotor constructions primarily used within polyphase AC induction motors:

- a) .....
- b) .....

## QUESTION 14: (Tick the box/boxes next to the most correct answer – 6 Marks)

From the following equation, identify each of the quantities, and briefly explain what they represent

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

- a) I = .....
- b) E = .....
- c) R = .....

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

**QUESTION 15:** (Tick the box/boxes next to the most correct answer – 2 Marks)

What would the value of current flow (in amperes) through a person who is in contact with a 6.6 kV HV uninsulated conductor if we assume that the total resistance of the circuit through the person's body and to earth is 24 000 Ohms?::

Answer: .....

**QUESTION 16:** (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below describe the definition of High Voltage (HV) in terms of a voltage level:

.....

.....

.....

.....



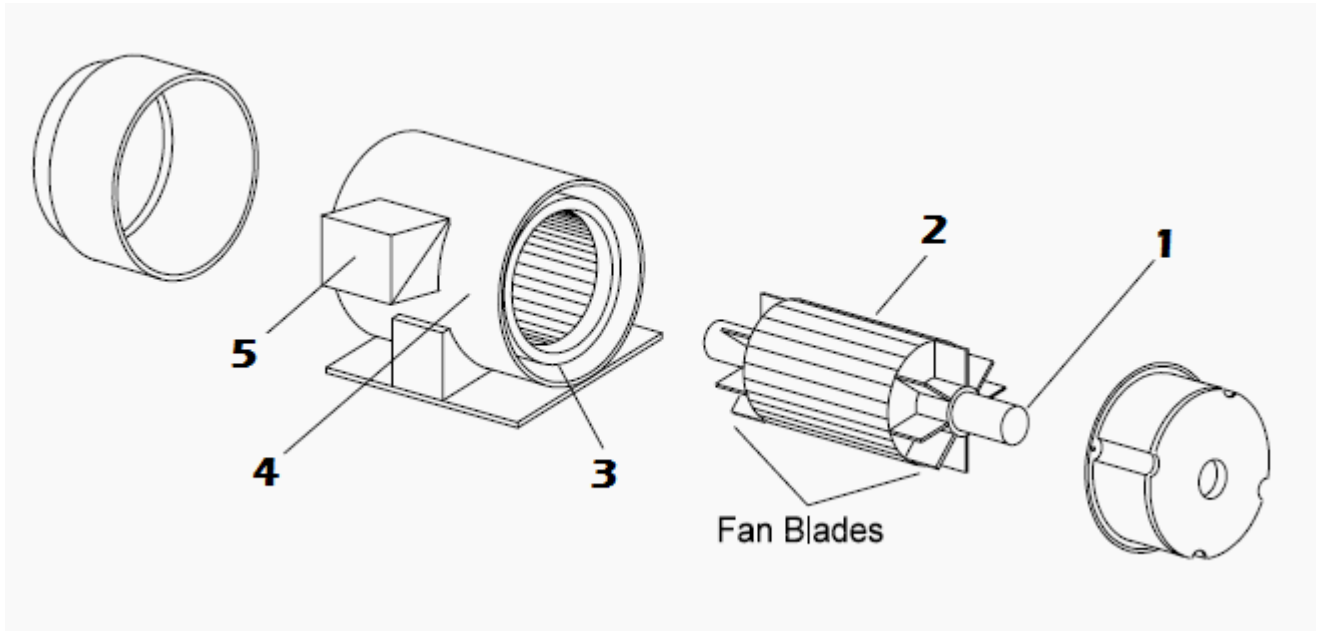
QUESTION 17: (Tick the box/boxes next to the most correct answer – 6 Marks)

Correctly name each of the electrical circuit diagrammatic symbols illustrated below:

	Symbol	Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

**QUESTION 18:** (Tick the box/boxes next to the most correct answer – 2 Marks)

With reference to the simplified diagram of a AC induction motor below, identify the components labelled 1 to 5 in the table below



Component Number	Description	Component Number	Description
1		3	
2		4	
5			

QUESTION 19: (Tick the box/boxes next to the most correct answer – 2 Marks)

Given that the synchronous speed of an AC induction motor (in RPM) can be calculated by the following equation

$$N_s = \frac{120 (f)}{p}$$

Complete the table below by entering the calculated speed (in RPM) of for each of the given AC induction motor pole and frequency combinations (show your calculations)

Number of poles	Supply frequency	Calculated synchronous speed
2	50 Hz	
4	50 Hz	
6	50 Hz	
8	60 Hz	
10	75 Hz	
12	50 Hz	

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines



## QUESTION 20: (Tick the box/boxes next to the most correct answer – 6 Marks)

It is very important that the resistance offered by the insulation, maintains a high value for achieving the purpose for which the electrical equipment is intended. Hence the majority of tests performed on electrical equipment are related to the verification of the quality of the insulation, which is basically the measurement of insulation resistance.

Given the above, select the scenarios for which insulation testing of a HV AC induction motors would be generally recommended:

- a) Before an HV motor is approved for dispatch from a manufacturing place
- b) Before the HV motor is commissioned and placed into service
- c) When the motor is to be put back into service after a maintenance shutdown or a repair.
- d) To monitor the quality of motor insulation over its operation cycle to predict life time that indirectly provides information on the possible remaining life of the insulation/equipment based on the life of similar equipment.
- e) When the motor is to be put back into service after a prolonged shutdown.
- f) After the motor has been subject to adverse fault or environmental conditions

## QUESTION 21: (Tick the box/boxes next to the most correct answer – 6 Marks)

When applying an insulation resistance test, three (3) types of current components are present during the testing process.

In the spaces provided below name each of these current components:

- 1. ....
- 2. ....
- 3. ....

## QUESTION 22: (Tick the box/boxes next to the most correct answer – 6 Marks)

Complete the statements below by inserting the missing words:

- 1. .... current is made up of up to ..... components, which decay at a decreasing rate to a value close to zero over a period of several minutes.
- 2. .... current is constant with time and depends on the degree of ionization present, which is itself dependent on temperature.
- 3. .... Can be described as a small essentially steady current flowing both through and over the insulation.

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines



**QUESTION 23:** (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below, briefly describe the five (5) basic principles associated with assessing the quality of insulation by performing insulation resistance testing

In the spaces provided below name each of these current components:

1. ....  
.....  
.....

2. ....  
.....  
.....

3. ....  
.....  
.....

4. ....  
.....  
.....

5. ....  
.....  
.....



**QUESTION 24:** (Tick the box/boxes next to the most correct answer – 6 Marks)

Complete the table below by inserting the recommended insulated test voltages for each of the rated AC induction motor voltages:

Induction motor winding rated voltage	Recommended IR Test Voltage
< 1000 v	
1000 – 5000 v	
2501 – 5000 v	
5001 – 12 000 v	
➤ 12 000 v	

**QUESTION 25:** (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below briefly describe the basic principle of a Short Time or Spot-Reading insulation resistance test:

.....

.....

.....

**QUESTION 26:** (Tick the box/boxes next to the most correct answer – 6 Marks)

As a “rule of thumb” guide the insulation resistance returned by a short Time or Spot-Reading insulation resistance test should be in the vicinity of:

- g) 1 megohm for each 1,000 volts of operating voltage, with a minimum value of 10 megohm.
- h) 1 megohm for each 1,000 volts of operating voltage, with a minimum value of 1 megohm.
- i) 10 megohm for each 1,000 volts of operating voltage, with a minimum value of 1 megohm.
- j) 100 megohms regardless of the operating voltage.

# Knowledge Assessment Resource:

## UEENEEG158A– Conduct Electrical Tests On HV Machines

**QUESTION 27:** (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below briefly describe the basic principle of a Time Resistance Method insulation resistance test:

.....

.....

.....

**QUESTION 28:** (Complete the statements by entering True or False)

When performing a Time Resistance Method insulation resistance test:

	True/False
Good insulation generally shows a continual increase in resistance over a period of time (in the order of 5 to 10 minutes)	
This method is fairly independent of temperature and often can give you conclusive information without records of past tests.	
The test is based on the absorption effect of good insulation compared to that of moist or contaminated insulation.	
If the insulation being tested contains an appreciable level of moisture or contaminants, the absorption effect is masked by a high leakage current which stays at a fairly constant value, keeping the resistance reading low	
If the insulation under test held a steady spot reading of 10 megohms over a period of 60 seconds, you could classify that the insulation was in “good” condition (ie no appreciable contamination from moisture of other contaminants)	
If the insulation under test held returned readings which showed a gradual increase of resistance between checks conducted at 30 seconds and 60 seconds, you could classify that the insulation was in “good” condition (ie no appreciable contamination from moisture of other contaminants)	

# Knowledge Assessment Resource:

## UEENEEG158A– Conduct Electrical Tests On HV Machines

**QUESTION 29:** (Tick the box/boxes next to the most correct answer – 2 Marks)

Polarisation Index (PI) is the ratio of the IR measured after voltage has been applied for 10 minutes (R10) to the IR measured after one minute (R1), and that it is calculated using the fomula below

$$PI = R10/R1$$

Complete the table below by entering the calculated polarization index for each of the given AC induction motor pole IR test readings given below (show your calculations)

IR reading (At 1 minute)	IR Reading (At 10 Minutes)	Polarisation Index (PI)
10 Megohm	10 Megohm	
10 Megohm	100 Megohm	
15 Megohm	100 Megohm	
15 Megohm	75 Megohm	



**QUESTION 30:** (Tick the box/boxes next to the most correct answers – 6 Marks)

**A recognized step voltage IR test:**

- a) *Uses a process where the IR test voltage is increased in five equal steps at one minute intervals and recording the IR value at the end of one minute before going to the next voltage level.*
- b) *Uses the principle that application of increased voltage creates electrical stresses on internal insulation and and potential insulation defects.*
- c) *Can reveal aging and physical damage even in relatively dry and clean insulation which would not have been apparent at lower voltages*
- d) *Is a useful test process for tests that are carried at 2.5 kV and above.*

**QUESTION 31:** (Tick the box/boxes next to the most correct answer – 2 Marks)

Complete the table below by entering the most correct remarks which can be made from the Step Voltage IR Test observations given:

Step Voltage IR Test Observation	Remarks (eg: Insulation OK, Insulation requires thorough inspection, insulation likely to fail if put into service)
No appreciable difference in IR test readings taken over the duration of the test	
Failure (less tha minimum IR value as per specifications) at 2.5 kV	
Appreciable (>25%) difference in IR test readings taken over the duration of the test	

**QUESTION 32:** (Tick the box/boxes next to the most correct answer – 2 Marks)

From the items listed below, choose the most correct definition for the term “Hazard”:

- a) *Anything or action that could cause harm or injury to persons at the work site.*
- b) *The likely hood of an accident happening*
- c) *The potential for harm or injury to occur*

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines



**QUESTION 33:** (Tick the box/boxes next to the most correct answer – 6 Marks)

In the spaces provided below, briefly describe the five (5) basic faults associated with HV AC induction motors which can be identified by comparison of data obtained by electrical signature analysis:

1. ....
2. ....
3. ....
4. ....
5. ....

**QUESTION 34:** (Complete the statements by entering True or False)

When performing a Time Resistance Method insulation resistance test:

	True/False
Electrical signature analysis uses the measurement of either voltage or current waveform from a motor to determine whether there is a fault.	
Electrical signature analysis testing has proven to be the most successful method of detecting broken rotor bars, rotor winding asymmetry and air gap eccentricity.	
Electrical signature analysis data traces can analyze the driven load, the power supply, and perform inrush testing on motors	

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## QUESTION 35: (Tick the box/boxes next to the most correct answer – 2 Marks)

From the items listed below, choose the most correct definition for the term “Risk”:

- a) *The likely hood of any harm or Injury happening*
- b) *The potential for harm or injury to occur at the worksite*
- c) *Anything that could cause harm or injury to persons at the work site.*

## QUESTION 36: (6 Marks)

In the spaces provided below write down the seven (7) general types of faults that a AC induction motor may experience in its operational lifecycle:

- a) .....
- b) .....
- c) .....
- d) .....
- e) .....
- f) .....
- g) .....

## QUESTION 37: (6 Marks)

In the spaces provided below write down the three (3) general examples of types of ELECTRICAL related faults that AC induction motor may experience in its operational lifecycle::

- .....
- .....
- .....

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## QUESTION 38: (6 Marks)

In the spaces provided below write down the three (3) general examples of types of MECHANICAL related faults that AC induction motor may experience in its operational lifecycle::

- a) .....
- b) .....
- c) .....

## QUESTION 39: (6 Marks)

In the spaces provided below write down the three (3) general examples of types of ENVIROMENTAL related faults that AC induction motor may experience in its operational lifecycle:

- a) .....
- b) .....
- c) .....

## QUESTION 40: (6 Marks)

In the spaces provided below write down the two (2) general examples of types of stator related faults that AC induction motor may experience in its operational lifecycle:

- a) .....
- b) .....



**QUESTION 41: (6 Marks)**

In the spaces provided below list and briefly describe six (6) general types of stator winding faults that a AC induction motor may be subject to in its operational lifecycle:

- a) .....
- b) .....
- c) .....
- d) .....
- e) .....
- f) .....
- g) .....

**QUESTION 42: (Tick the box/boxes next to the most correct answer – 5 Marks)**

From the items listed below, identify those that could be are considered to be electrical stresses which can potentially generate a stator winding fault within an AC induction motor:

Item	
<ul style="list-style-type: none"> <li>• Supply voltage transients, due to lightning, opening, or closing of circuit breakers or due to variable frequency drives</li> </ul>	<input type="checkbox"/>
<ul style="list-style-type: none"> <li>• Coil movement due to the stator current loosening the top sticks and also may cause damage to the copper conductor and its insulation.</li> </ul>	<input type="checkbox"/>
<ul style="list-style-type: none"> <li>• Supply under-voltage or over-voltage conditions</li> </ul>	<input type="checkbox"/>
<ul style="list-style-type: none"> <li>• Stator lamination failure</li> </ul>	<input type="checkbox"/>
<ul style="list-style-type: none"> <li>• Stator winding slot insulation failure</li> </ul>	<input type="checkbox"/>

# Knowledge Assessment Resource: UEENEEG158A– Conduct Electrical Tests On HV Machines

## QUESTION 43: (6 Marks)

In the spaces provided below write down two (2) general types of mechanical stresses which may create potential for a stator winding fault:

- a) .....
- b) .....

## QUESTION 44: (6 Marks)

In the spaces provided below write briefly describe three (3) examples of the types of thermal stresses placed on AC induction motors may create potential for a stator winding fault:

- a) .....
- b) .....
- c) .....

## QUESTION 45: (Tick the box/boxes next to the most correct answer – 2 Marks)

Under your organisations HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an Authorised PERSON must maintain from any uninsulated part of their body to any exposed conductor with voltage of between 1 000 volts and 11 000 volts ac.

..... mm

## QUESTION 46: (Tick the box/boxes next to the correct answers – 3 Marks) – All Sections of This Question MUST be Answered Correctly

Under your organisations HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an HV Aware (Instructed) PERSON must maintain from any uninsulated part of their body to any exposed conductor with voltage of up to 1 000 volts ac.

..... mm

## QUESTION 47: (Insert the missing words in the spaces provided – 3 Marks)

Under your organisations HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an HV Aware (Instructed) PERSON must maintain from any uninsulated part of their body to any exposed conductor with voltage of up to 1 000 volts dc.

..... mm