10

TLE - Electrical Installation and Maintenance (EIM)

Quarter I – Module 5

Installing and Replacing GFCI Devices

(Week 5)

What I Need to Know

In this module, you will be trained to replace regular breakers and ordinary outlets with GFCI devices. Here, you will be dealing with 3 GFCI devices, GFCI breaker, GFCI receptacle outlet, and GFCI Combo switch.

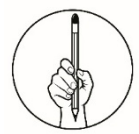
The activity comprises the following:

- Installing or Replacing Regular Breaker with GFCI Breaker
- Installing or Replacing Ordinary Outlet with GFCI Outlet
- Installing or Replacing Ordinary Single Switch with GFCI Combo
- Preparing Electrical Tools and Materials
- Preparing PPE

After going through different activities, you are expected to:

1. install or replace regular breaker with GFCI breaker,
2. install or replace ordinary outlet with GFCI receptacle outlet,
3. install or replace ordinary switch with GFCI combo, and
4. prepare electrical tools, materials, and PPE for the specific job.

Though this training needs actual electrical materials, you are not required to buy new ones. Use what is only available in your area or ask your trainer to provide it for you. An equivalent extra activity will cater to your performance skills that would provide an opportunity for you to learn.



What I Know

Use a separate sheet in answering the test. Be sure to write the following:
Name: _____ Year & Section: _____
Module Title: _____ Quarter: _____ Module #: _____ Week #: _____

Directions: Read each statement carefully and write the letter and word/s of your answer on a separate sheet.

1. GFCI device that is used to control the entire house circuit.
   A. GFCI combo B. GFCI receptacle C. GFCI cord D. GFCI breaker
2. A ground fault interrupter device with 2 input and output terminals with an additional built-in switch.
   A. GFCI receptacle outlet C. GFCI combo switch
   B. GFCI breaker D. GFCI cord
3. A measuring equipment used to measure volt, current, and resistance.
   A. Light indicator tester B. Tape rule C. VOM D. Ruler

4. In electrical terms, the wire/conductor with flowing electricity is called _____.
A. Live wire B. Hot wire C. Electric wire D. Active wire
5. The white wire attached to the GFCI breaker is called _____.
A. Neutral wire B. Hot wire C. Ground wire D. Line terminal
6. A wire connecting material made in plastic which can enclose 2 or more twisted smaller wires.
A. Wire splitter B. Wire crimper C. Wire nut D. Adhesive tape
7. A personal protective equipment used to protect your eyes during regular electrical works.
A. Hard hat B. Face mask C. Hand gloves D. Goggles
8. The green wire running through the house circuit should be connected/attached to a _____.
A. House ceiling B. Ground stone C. Ground rod D. House ground
9. The purpose of replacing regular electrical devices with GFCI is to protect the person from _____.
A. Ground fault B. Short circuit C. Open circuit D. Ground circuit
10. The GFCI breaker must carry the proper _____ rating of the circuit it will protect.
A. Timer B. Current & voltage C. Weight D. Resistance & Wattage

What's In

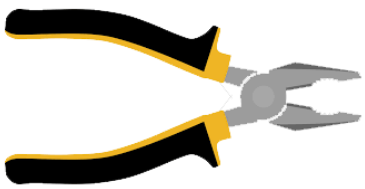
To replace electrical devices, you need to prepare the following:

A. **TOOLS**

Philip and Flat Screwdriver

Wire Stripper

Side cutting pliers



Lineman's pliers

Longnose pliers

V
O
M

B. **Electrical Materials/Devices**

GFCI combo switch with plate

GFCI Receptacle

Plug-in type single pole GFCI breaker

GFCI Outlet Tester

Wire nuts

Single stranded wires #14, #12, and

Electrical tape

C. **PPE**

Safety goggles

Hard hat

Rubberized gloves

What's New

As discussed in the first module, the PEC requires all 125-volt and/or 250 volts, single-phase, 15- and 20-ampere receptacles installed in bathrooms, garages, outdoors, crawl spaces, unfinished basements, kitchens, laundry and other utility wet bar sinks, boathouses, and other areas where there is a great possibility of wet shall have ground-fault circuit-interrupter protection for personnel.

PEC ensures that the Filipino people will be protected from electrical accidents. The compliance in the requirements of electrical wiring installation in the Philippines is strictly implemented but in most cases of the average Filipino people, GFCIs were

not installed in the typical houses. Often, Filipino will build their houses little by little until such time when they have enough money to finish it. In a situation like this, planning was not properly done. For this reason, GFCI devices were not installed at first and time will come these houses will be renovated and some of the ordinary breaker and outlets will be replaced by a GFCI.

Safety Precautions When Working with Electricity

In working electricity related jobs, it is very important to take safety precautions in order not to hurt yourself or others. The common tips listed below will help safeguarding yourself in working with electrical task:

1. Clear your working area with water. If you are to work outside, never do it under the rain.
2. Check your tools, equipment, and PPE before using them. Never use any frayed or damaged.
3. Check the devices for functionality before installing them to avoid wasting time and frustration. If it is a GFCI, Test and Reset checking is important before installation.
4. Always turn-off the main breaker and remember to put a signage that has a notice "UNDER REPAIR! DO NOT TURN THE BREAKER ON"
5. You are working with electricity, DO NOT WORK ALONE!
6. Always wear appropriate PPE and use properly insulated tools only.
7. Double check first the devices before replacing them. And once the installation is complete, always check the unit to make sure it is working.
8. Always clean the area after working.
9. Do the job only if you are personally prepared and confident. Don't mess with the outlet or breaker if you are unsure of what to do.

What is It

How to Replace or Install GFCI Breakers?

Panels and breakers are not always compatible since they are made by different manufacturers. When replacing ordinary breakers with a GFCI, you must see to it that the breaker you want to install is compatible with the existing panel. You may bring the old breaker or take a picture to both breaker and panel and show it to the store for identification.

Another significant thing to remember is that, the new GFCI breaker must be the same current and voltage rating with the old one. This is very important for the breaker to give efficient protection to the circuit.

Here are the detailed steps in installing or replacing a regular breaker with GFCI.

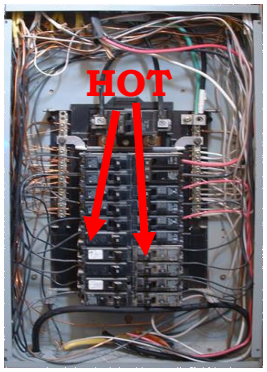
1. Turn-off the main breaker in the main distribution panel or sub-panel.

https://tinyurl.com/yd9nvdmh

2. Cover the main breaker of the main panel with a caution sign “UNDER REPAIR DO NOT TURNED ON”

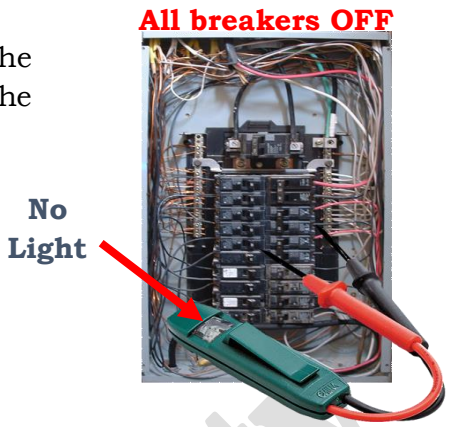
3. To be sure that there is already no electricity, check the outlets in the house using a Multimeter or light indicator tester.

4. Unscrew the sub-panel and open it. Be sure to return the screws to where they were in order not to lost them



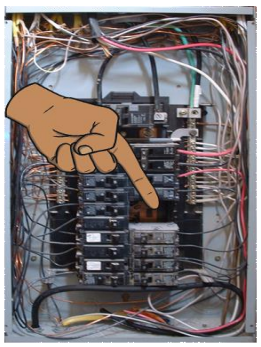
WARNING: If there is No MAIN PANEL that means the panel you are to insert the GFCI breaker with serves as the main panel. Be cautious of the two BIGGER wires connected to a lug terminal above the breakers since it is the source of the power. There is no way to turn it off inside your house that means it is always HOT even if you already turned the main breaker off.

5. To be sure, turn off all breakers and verify the presence of electricity in each output terminal of the breaker using Multimeter or test light

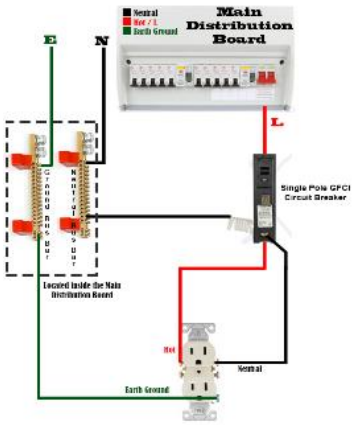


6. If possible, check the functionality of the GFCI breaker first by Testing and Resetting it. Follow the steps discussed in the previous module. Then switch it off before installation

7. Remove the ordinary breaker to be replaced.



8. Connect the breaker to the circuit. Follow the diagram in Fig. 2.5 (installing single pole GFCI breaker) in week 2 of this module. Detailed procedures are shown below

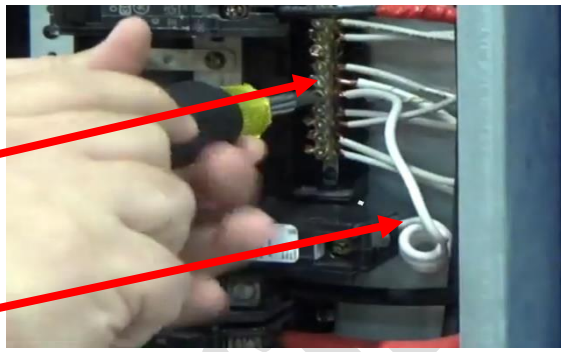


NOTE: Pictures from 8.1 to 8.5 and 10 are screen shots taken from the YouTube video tutorial of **Craig Michaud – Electrical Instructor** entitled "Installing GFCI Circuit breaker" with a website address **https://tinyurl.com/yagtf3z5.**

8.1 Connect the input Neutral wire (white wire attached to the breaker) of the GFCI breaker to the Neutral bus bar

Neutral bus bar

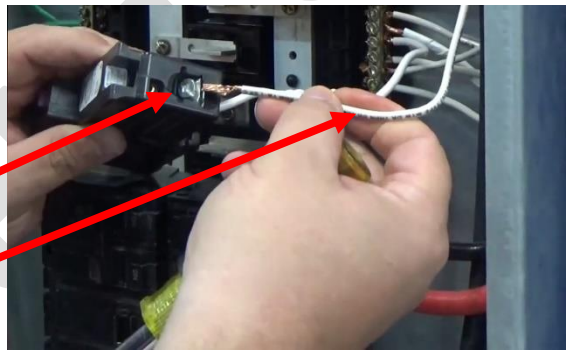
GFCI input Neutral wire



8.2 Connect the Neutral wire coming from the branch circuit to the output Neutral terminal (Silver color) of the GFCI breaker

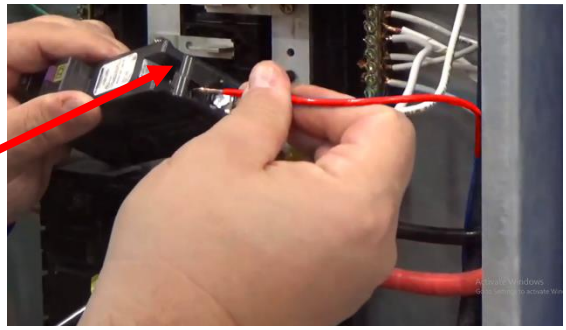
GFCI output Neutral terminal

Neutral wire down to branch circuit

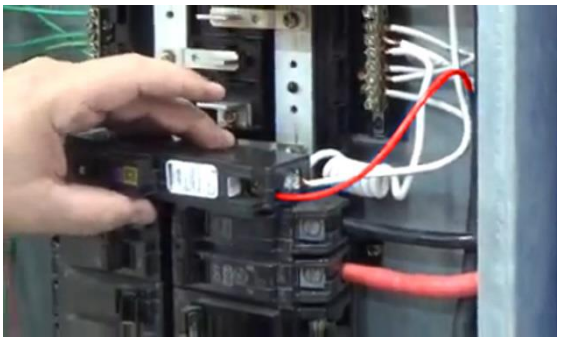


8.3 Connect the Line 1/Hot wire coming from the branch circuit to the output Line 1/Hot terminal (Gold color) of the GFCI breaker.

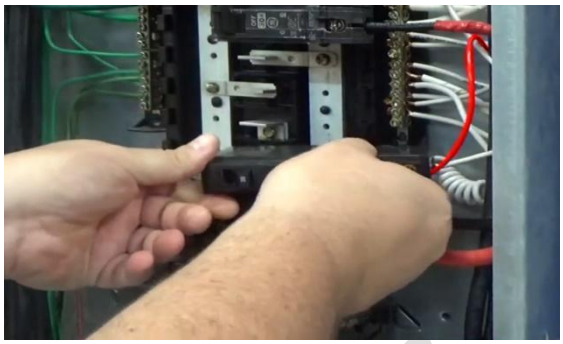
GFCI output Hot/Line 1 terminal
(inside compartment)



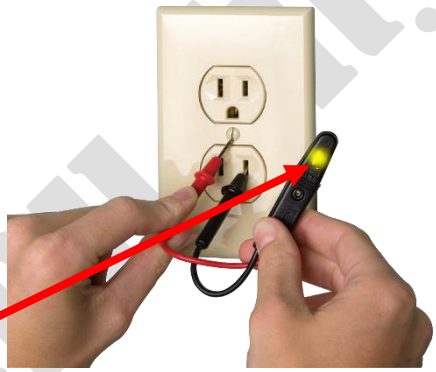
8.4 Check if all wires are properly hook and screwed to the GFCI terminals to avoid loose contacts.



8.5 Recheck your connection then carefully, fit the GFCI breaker into the panel.

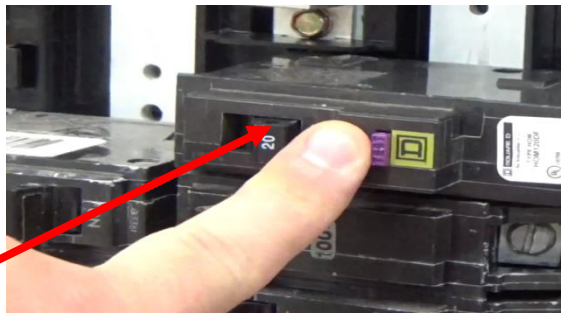


9. Insert the Test light again to one of the outlets coming from the GFCI breaker and turn the main and all other breakers ON including the GFCI breaker. This time the Test light indicator will be energized.



Light indicator energized

10. Go back to the panel and test the GFCI by pressing the TEST button. If the breaker pull-lever will move down and the light indicator's light simultaneously turned off, the GFCI functions properly and the installation is okay.



Lever down when TEST button is pressed

11. Finally, remove the signage that you labeled in step 2 and cover the panel board.

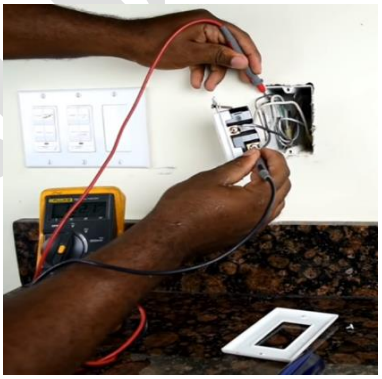
How to Replace or Install GFCI Receptacle Outlet?

1. Get ready by preparing all necessary tools, equipment, devices, and wear appropriate PPE.

2. Proceed to the panel board, look for the branch circuit in the **panel circuit directory** and turn OFF the breaker you will be working on. Put a sign "UNDER REPAIR" before going back to the location of the outlet to be replaced.

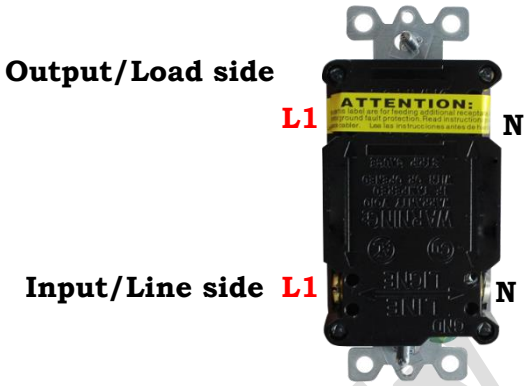
https://tinyurl.com/yd4p3gmd

3. Remove the cover and unscrew the outlet to be replaced and check again the presence of electricity in all conductors coming out from the box. If there are more than 3 wires, then they must be coming from the source and the other wires are the outputs feeding through other outlets in the circuit.

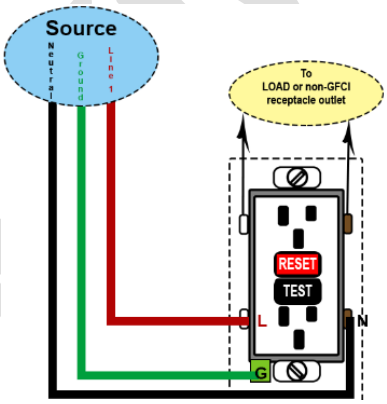


4. If there are more than 3 wires, identify which of them are outputs and which are inputs. Unscrew set of 2 wires that compose of 1 Neutral and 1 Hot from either of the side (input side or output side) of the device. Set aside the detach wires away from each other and from the other wires. Turn the breaker back ON and voltage check the detach wire. If there is no electricity between them then the wires are the Load side and aside from the ground, the two remaining wires are the input wires coming from the source. Put a tag to identify them easily. For easy identification, most terminals closest to the ground are the Line side (input)

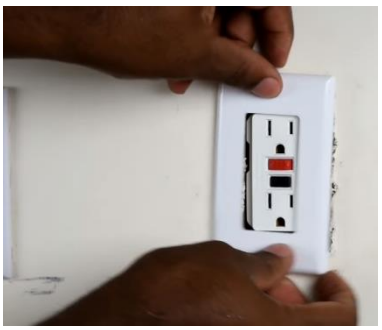
5. Prepare the new GFCI receptacle and identify the terminals. Often, output terminals are covered with a yellow sticker. DO NOT REMOVE THE STICKER to avoid confusions. Terminals are mostly color coded, gold are the Hot/Line 1 terminals, silver are the Neutral terminals, and the green screw is the ground.



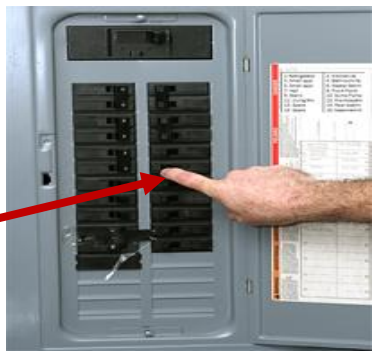
6. Connect the wires to the GFCI receptacle following the diagram.



7. Fit the receptacle to the box and cover with its plate.

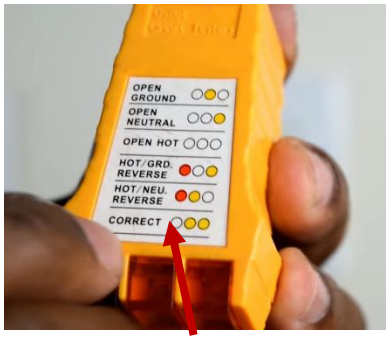


8. Go to the panel and turn the breaker back ON to energize the circuit then remove the signage that you put in step 2.



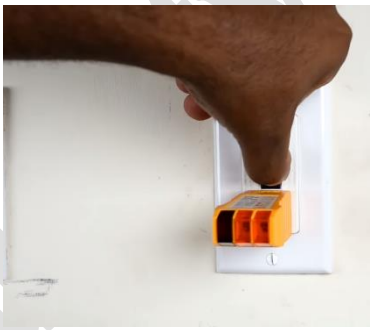
NOTE: Pictures from steps 3, 7, and 9 are screen shots taken from the YouTube video tutorial of **DIY Creators** entitled "How to Install or Replace a GFCI outlet" with a website address **https://tinyurl.com/y79dfsl3** while pictures from step 4 are taken from "How to Replace a GFCI Outlet" video tutorial of Craig Michaud-Electrical Instructor from YouTube address **https://tinyurl.com /ydxngszu.** You are encouraged to watch the videos for additional information.

9. Finally, do the test procedures below to verify the functionality of the installed GFCI outlet.



Correctly installed if two orange indicator-ON while dark indicator-OFF

Two orange indicators will light when RED button is pressed



Two orange indicators OFF when TEST button is pressed

What's More

Answer the following questions and write your answer in your notebook.

A. Enumeration

1. Enumerate the following:
   A. Basic tools and equipment used in replacing regular breakers with GFCI breakers.
   B. Appropriate PPE in installing or replacing ordinary outlets with GFCI outlets.
2. Give at least five important things that you must avoid when replacing ordinary breakers or outlets with GFCIs.
3. Give the 8 locations in a dwelling unit that the NEC/PEC required to have a GFCI installed.

B. True or False: Write TRUE if the statement is correct otherwise write FALSE.

1. Panels and breakers are all universally compatible.
2. Devices removed must be the same ratings with the devices installed.
3. Wearing of over-all clothing is an appropriate PPE in installing GFCI devices.
4. The conductors connected to the input terminals of the main breaker are always hot even if the breaker is in OFF position.
5. An electrician need not to check the functionality of the brand new GFCI devices since they passed through a quality check during manufacture.
6. It is not necessary to replace all regular breakers with GFCI.
7. The main breaker needs to be switched-on before testing the newly installed GFCI breaker.
8. There is no other way to test a GFCI outlet except using the GFCI tester.
9. Yellow sticker at the back of the GFCI receptacle indicates the Line side of the device.
10. It is okay to replace all outlets of the house to add more protection.

What I Have Learned

Let's evaluate what you have learned!

Questions 1-3 were answered for you. Provide your answer in question number 4 and write them in your notebook

1. How many regular outlets can be connected in one GFCI outlet?

Answer: When replacing a regular breaker with GFCI, the amperage and voltage rating must be the same. Therefore, the NEC/PEC provisions for Wire ampacity and size, Circuit breaker size, Conduit sizing, Circuit loading, and other guidelines still apply.

For a 20 Amp circuit, a maximum of 10 receptacles are allowed. Each receptacle is considered to assign a maximum draw of 1.5 amps to each receptacle.

2. How to find the first regular receptacle outlet in the circuit?

Answer: GFCI receptacle should be installed first of the line in a circuit. But how to locate the first outlet connected from the breaker? There is no better way than to disconnect all outlets from the circuit and voltage test the conductors in each box. But this method takes a lot of time so take a wise guess and choose the nearest possible outlet from the breaker. There is a greater probability that this outlet is the one you are looking for since most electricians consider the cost of installation. Taking the shortest way reduces the expenses for electrical materials.

3. Can I install a GFCI outlet under a GFCI breaker?

Answer: The function of all GFCI devices may be breaker or receptacles are the same. There is no need to install a GFCI outlet into a circuit protected by a GFCI breaker and vice versa. Doing so may affect the performance of each other. The GFCI breaker protects the whole circuit while the first GFCI outlet in the circuit protects all receptacles connected to it, may it be ordinary outlet or lightings.

4. When can we say that the GFCI device installed functions properly?
Answer:

_____
_____
_____
_____

What I Can Do

A. Roam around in your house take a picture of the following:

1. Picture any electrical devices that need to be repaired or replaced with a new one. Explain why the device needs to be replaced.
2. Locate and take a picture of all areas in your house that need GFCI installation. Support your answer.

B. Follow the steps and demonstrate and make a video of you doing the following:

1. Installing or replacing ordinary breaker with a new regular breaker or GFCI breaker.
2. Installing or replacing an ordinary outlet with a new regular outlet or GFCI outlet.

NOTE: No need to buy new devices for your video presentation. All you need to do is use the existing outlet or breaker in your house and assume that it is defective and needs to be replaced. Use the same device for installing. Remember to follow safety protocols in doing electrical jobs. Follow the steps carefully and DO NOT FORGET TO INFORM FIRST YOUR TRAINER and ALWAYS ASK YOUR PARENTS TO WATCH OVER YOU before you start this activity.

Rubric for Video Presentation				
	Excellent 10 points	**Good 8 points**	**Satisfactory 6 points**	**Needs Improvement 5 points**
Execution of Steps	The student clearly demonstrates the steps	The student demonstrates the steps	The student skip some of the steps	The student did not follow suggested steps

Safety	The presenter clearly demonstrates safety protocols	The presenter demonstrates safety protocols	The presenter demonstrates not so safe procedures	The presenter demonstrates no safety at all
Final Product	Devices installed functions well and looks professionally installed	Devices installed functions well but not so professionally installed	Devices installed functions well not so professionally installed	Devices installed did not function properly
5S	The student clearly applies 5S before, during, and after installation	The student applies 5S before, during, and after installation	The student not so clearly applies 5S before, during, and after installation	The student did not apply 5S at all before, during, and after installation

Assessment

Use a separate sheet in answering the test. Be sure to write the following:
Name: _____ Year & Section: _____
Module Title: _____ Quarter: _____ Module #: _____ Week #: _____

Directions: Read each statement carefully and write the letter and word/s of your answer on a separate sheet.

1. Written legibly and clearly and is located on the face or inside of the panel door in which the purpose is for circuit identification.
   A. Panel door B. Circuit breaker C. Circuit directory D. Circuit list
2. GFCI device that is used to control the entire house circuit.
   A. GFCI combo B. GFCI receptacle C. GFCI cord D. GFCI breaker
3. The white wire attached to the GFCI breaker is called _____.
   A. Neutral wire B. Hot wire C. Ground wire D. Line terminal
4. The GFCI breaker must carry the proper _____ rating of the circuit it will protect.
   A. Timer C. Weight
   B. Current & voltage D. Resistance & Wattage
5. NEC/PEC provisions of 20 Amps circuit is that it must take a maximum of _____ outlets.
   A. 5 B. 8 C. 10 D. 15
6. A personal protective equipment used to protect your eyes during regular electrical works.
   A. Hard hat B. Face mask C. Hand gloves D. Goggles
7. It is the board where the main circuit breaker is located.
   A. Main panel C. Sub-panel
   B. Main breaker D. Branch circuit breaker
8. The load terminal of the GFCI receptacle outlet is connected from/to _____.
   A. Circuit breaker C. Regular outlet

B. Another GFCI outlet D. Lightings

9. In GFCI receptacle devices, the most common color for the Neutral terminal is _____.
   A. Gold B. Black C. Green D. Silver
10. The following are indicators of a functional newly installed GFCI breaker, except _____.
   A. Breaker lever goes down from ON position when the TEST button is pressed.
   B. Power in the circuit cuts off when the TEST button is pressed.
   C. Breaker lever goes up from OFF position when TEST button is pressed.
   D. Light indicator of the Inserted test light in one of the downstream outlets of the circuit is energized.
11. A ground fault interrupter device with 2 input and output terminals with an additional built-in switch.
   A. GFCI combo switch C. GFCI receptacle outlet
   B. GFCI breaker D. GFCI cord
12. The white wire attached to the GFCI breaker is called _____.
   A. Line terminal B. Hot wire C. Ground wire D. Neutral wire

13. The purpose of replacing regular electrical devices with GFCI is to protect the person from _____.
   A. Short circuit B. Ground fault C. Open circuit D. Ground circuit
14. The green wire running through the house circuit should be connected/attached to a _____.
   A. House ceiling B. Ground rod C. Ground stone D. House ground
15. A measuring equipment used to measure volt, current, and resistance.
   A. Light indicator tester B. Tape rule C. Ruler D. Multitester

Answer Key

Answer key (What's More)

Enumeration

A. Longnose pliers, Side cutting pliers, lineman's pliers, wire stripper, VOM, Philip and flat screwdriver and GFCI tester

B. Hard hat, eye goggles, and rubberized hand gloves

There are many things to avoid during electrical works, to name a few;

Not wearing appropriate PPE

Using defective tools

Working in a wet area

Working in a hot circuit

etcetera

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