10

TLE – Electrical Installation and Maintenance (EIM)

Quarter 1 – Module 2
Wiring Devices Used for Floor and Ground Fault Current Interrupter (GFCI)
(Week 2)

DepED
DEPARTMENT OF EDUCATION

What I Need to Know

This portion of the module contains information, facts, and details about Ground Fault Circuit Interrupter (GFCI). With thorough reading and examining the content, you will understand and learn what GFCI is all about, how it differs from other electrical devices, know, and examine its internal parts and functions, and study its significance in the electrical system. With complete knowledge of the basics, you will also inspect and manipulate whether the device is functional or not, and most importantly, use and operate it properly.

The lesson comprises the following:

- Development of GFCI devices in electrical system
- Uses and functions of GFCI
- Meaning of Ground Fault
- How GFCI works
- Different types of GFCI and their parts

After going through this module, you are expected to:

1. know and identify the different parts and types of GFCI,
2. differentiate GFCI from other electrical devices, and
3. inspect and check GFCI according to manufacturer' specification.

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 is also known as _____.
   A. Arc Fault Circuit Interrupter B. Residual Current Device
   C. Grid Fault Circuit Interrupter D. Ground Receptacle Current Interrupter
2. _____ happens whenever electricity outflows the limitations of the wiring in an appliance, light fixture, or power tool and takes a shortcut to the ground.
   A. Ground fault B. Short circuit C. Ground circuit D. Open circuit
3. _____ shuts off electric power when it detects that the current is flowing along the unintended path.
   A. Panel board B. Switch C. Outlet D. GFCI
4. Whenever the amount "returning" differs from the amount "going" by more than _____, the GFCI interrupts the current - preventing electrocution.
   A. 1mA + 4mA B. 2mA + 4mA C. 4mA + 1mA D. 5mA + 1mA
5. The best form that holds important information to use in testing and checking GFCI devices is the _____.

A. Warranty slip B. Product receipt
C. Manufacturer's manual D. Product feature

6. GFCIs should be tested regularly (_____) to guarantee they are in working condition.
   A. The least monthly B. Once every two months
   C. Twice every month D. Twice every two months
7. GFCI is a fast-acting circuit breaker designed to _____ in the event of a ground-fault within as little as 1/40 of a second. It works by comparing the amount of current going to and returning from equipment along the circuit conductors.
   A. Lessen current B. Lessen voltage
   C. Regulate electric power D. Shut-off electric current
8. _____ incorporates a GFCI device within one or more receptacle outlets.
   A. Switched type B. Receptacle type C. Breaker type D. Appliance type
9. Aside from the RESET button, GFCI has a _____ button which should be pushed to examine its functionality.
   A. Reset B. Switch C. Push D. Test
10. To test your GFCI receptacle, simply plug something in and press the button labeled 'test'. If what is plugged-in_____, your GFCI is working properly.
    A. Continues working B. Partially working
    C. Stops working D. Fully working

What's In

Why and How GFCI was Invented?

Charles Dalziel

(**https://tinyurl.com/y9txwwy**

Charles Dalziel (1904-1986), an American electrical engineering and computer sciences professor of UC Berkeley, conducted experiments on the physiological effects of electric shock on humans. He conducted a series of tests on animals and determined the minimum current required to produce ventricular fibrillation of the heart. His finding was that the heart of the tested animal was most vulnerable to electrical shocks.

Many American people alone died in ground faults and the result of his experiments led him to invent GFCI which can give more protection to humans than the present electrical safety devices in his time. This device offers more safety to users since it cuts off electrical supply immediately before a person gets electrocuted.

In the PGH-ATR Burn Center 2004 – 2012 data, there are 2596 Filipinos reported cases of burn in which 706 patients suffered from electrical injuries. Same reason as other countries, the Philippines updated its electrical code and requires GFCI in areas that need installation.

Before we will start with GFCI let us review first the different safety devices of electrical systems typically used in the Philippines.

Recall that there are many electrical devices that protect not just the electrical system but also the safety for humans. From the previous module, you were able to encounter some of these devices. Out of the many protective devices available in the market, below are typically used in the Philippines.

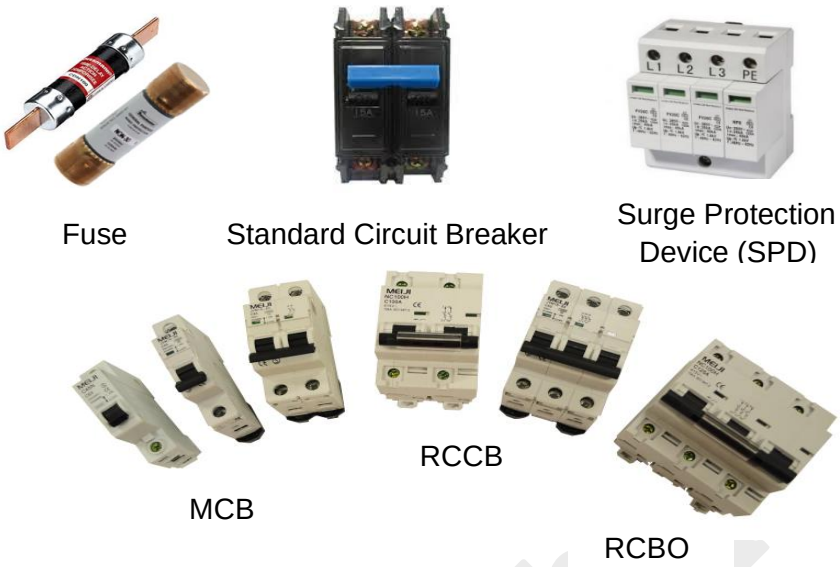


Figure 1.1: *Typically used electrical circuit protection in the Philippines*

Fuse - is an electrical safety device that can stop current from flowing if it becomes overloaded, or a device that is used to ignite an explosive device.

Circuit breaker - is a switching device that can be operated manually or automatically for controlling and protecting the electrical power system.

Surge Protection Device (SPD) - is the most frequently used and well-organized kind of over-voltage protective devices.

Miniature circuit breakers (MCB) – provide you with adequate overcurrent and short-circuit protection.

Residual-current circuit breakers (RCCB) – provide protection against residual current or earth fault currents.

Residual-current circuit breaker with overcurrent protection (RCBO) – is capable of acting as the only protective device in the circuit.

What's New

What is GFCI?

A **GFCI** or **Residual Current Device (RCD)** is a device that shuts off an electric power circuit when it detects that current is flowing along an unintended path, such as through water or a person. The GFCI is designed to protect people from severe or fatal electric shocks but because a GFCI detects ground faults, it can also prevent

some electrical fires and reduce the severity of other fires by interrupting the flow of electric current.

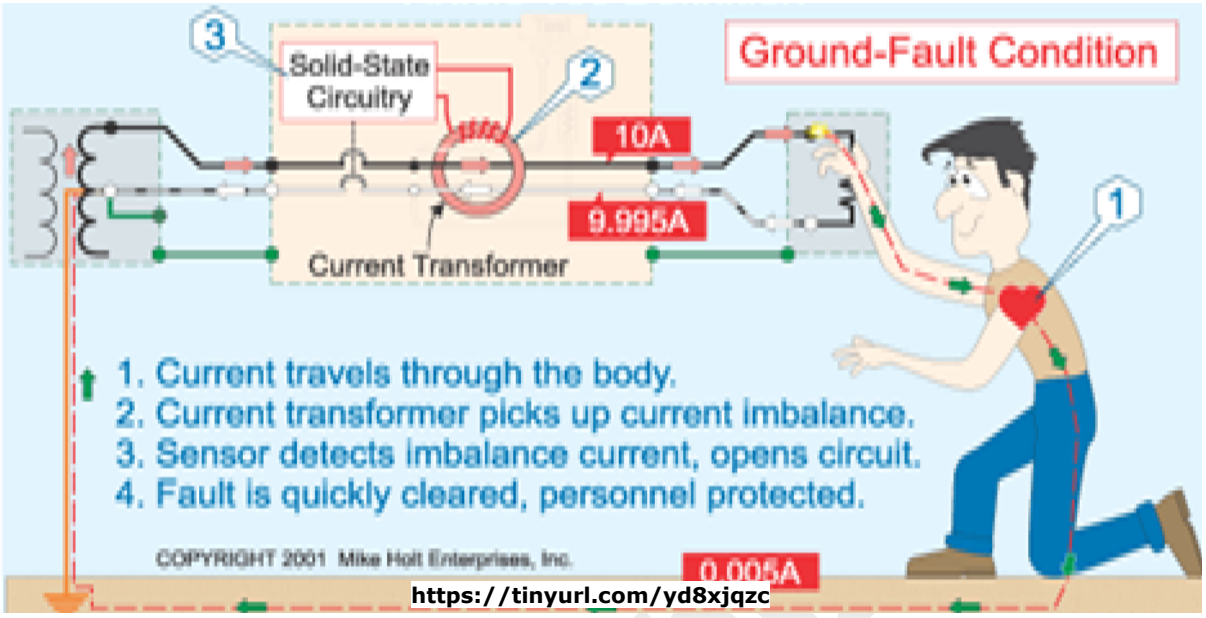


Figure 1.2: *GFCI shuts off an electric power when it detects that current is flowing along unintended path*

What is a Ground Fault?

A **ground fault** is an unintended contact between an energized conductor and **ground** or equipment frame. Ground faults most often occur when equipment is damaged or defective, such that live electrical parts are no longer adequately protected from accidental contact. If your body provides a path to the ground for this current, you could be burned, severely shocked or electrocuted.

Ground fault occurs each time electricity outflows the limitations of the wiring in an appliance, light fixture, or power tool and takes a shortcut to the ground. When that short cut is through a human body, the consequences can be fatal.

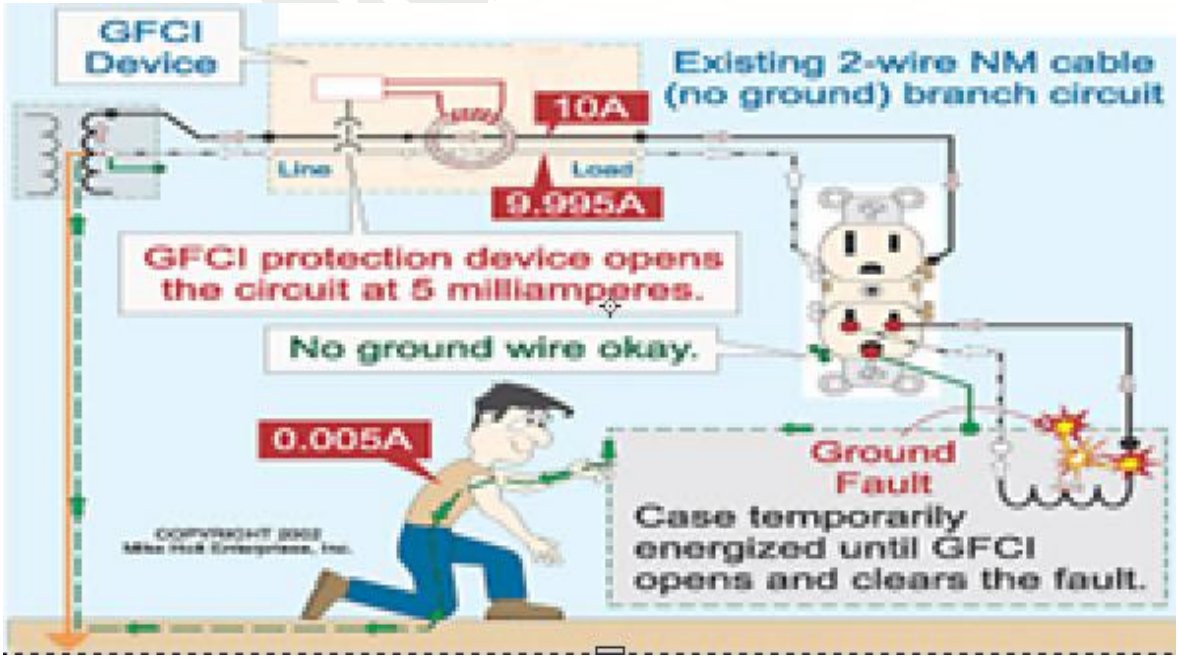
Figure 1.3: *Current flows to the body when grounded appliances touched by bare hand of a person*

https://tinyurl.com/yaua5h8g

Figure 1.4: *The body becomes part of an electrical path when ground fault energizes metallic objects*

How do GFCIs work?

The GFCI is a fast-acting circuit breaker that senses small imbalances in the circuit caused by current leakage to ground and, in a fraction of a second, shuts off the electricity. A GFCI continually monitors the amount of current returning from the device along the normal electrical path. Whenever the amount "returning" differs from the amount "going" by more than 5 mA + 1 mA, the GFCI interrupts the current - preventing electrocution. If there is any imbalance, it trips the circuit and it can react as quickly as one-thirtieth of a second.

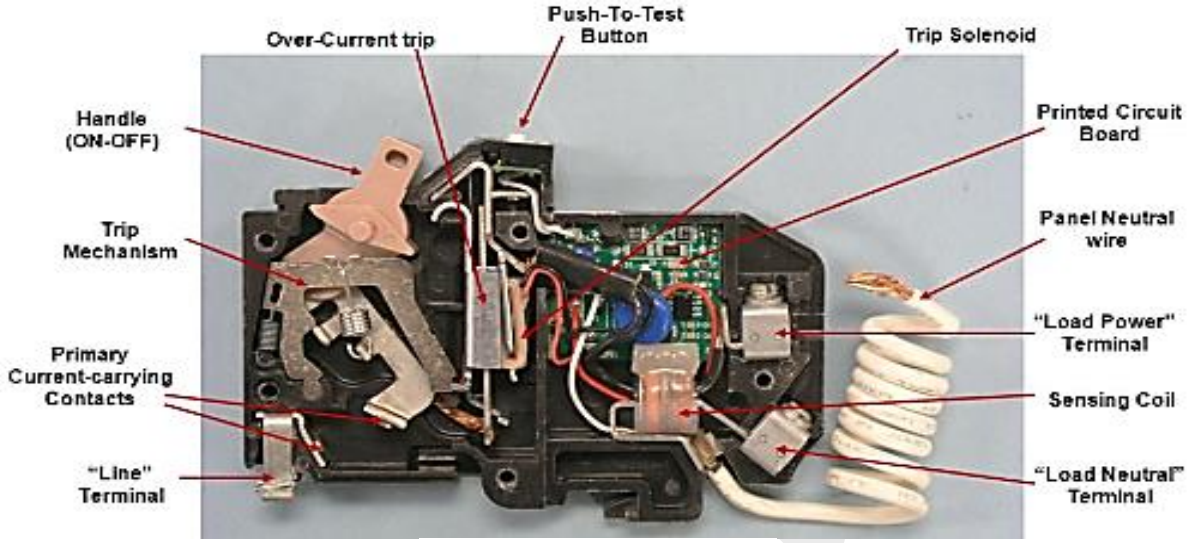


https://tinyurl.com/y76f3pkk

Figure 1.5: *GFCI prevents electrocution by interrupting current that exceeds 5 mA + 1 mA*

What is in the GFCI?

Like any other electrical circuit protection, GFCI has many functional parts inside its body. Inside the GFCI are Over-current trip, Push-to-Test button, Trip solenoid, PCB, Panel neutral wire, Load power and neutral terminal, Sensing coil, Line terminal, Primary contacts, Trip mechanism, and ON-OFF handle.



https://tinyurl.com/y8arl22q

Figure 1.6: *Cross-section of the GFCI (Circuit Breaker)*

Push-to-test button - pushing the TEST button should turn off the power to the circuit. For the receptacle-type GFCI, pushing the TEST button should cause the RESET button to pop up.

Trip solenoid/coil - it is the coil that moves the mechanism when energized after the sensing coil detects abnormality

PCB – a circuit board where electronically related parts of the GFCI are interconnected.

Panel neutral wire – its purpose is to serve as a path to return energy. It is connected to the neutral terminal of the panel.

Load power terminal – it is where the power line of the load is connected.

Sensing coil - a coil in the circuit that is used to detect ground fault.

Line terminal – it is where the line coming from the panel is connected

Primary-current-carrying contacts – also known as load contact, is actuated by the trip mechanism, this ON-OFF contact controls current coming from the panel going inside the device.

Trip mechanism - a pivoted metallic strip that moves the conductor connected to the load contact and the overcurrent trip device

ON-OFF handle – manually operated lever of the GFCI.
Over-current trip – trip device drive by the trip solenoid.

What is It

What are the types of GFCI?

For construction applications, there are several types of GFCIs available, with some variations:

Breaker Type – is inserted in the panel that protects the entire branch circuit.

(https://tinyurl.com/y8b89m7v)

Receptacle type – The receptacle type incorporates a GFCI device within one or more receptacle outlets. GFCI outlets do not require GFCI breakers, it is designed to immediately cut off power whenever there is a ground fault.

https://tinyurl.com/ybzwqkxl

Cord-Connected Type - The Cord-Connected Type of GFCI is an attachment plug incorporating the GFCI module. It protects the cord and any equipment attached to the cord.

https://tinyurl.com/ydf5zzcf

GFCI Adapter/Plug - Considered as one of the temporary GFCI's. Temporary GFCIs should be tested prior to every use. This device is used to upgrade older two-prong (non-grounded) outlets to three-prong (grounded) outlets without installing any new wire. This is safer than using the two-to-three prong adapter, as these adapters may not connect the appliance to ground at all

(https://tinyurl.com/y97tb3v6)
(https://tinyurl.com/y9byjcvd)

GFCI Switch Combo - This GFCI receptacle is used to directly control any electrical loads which needs ground fault protection

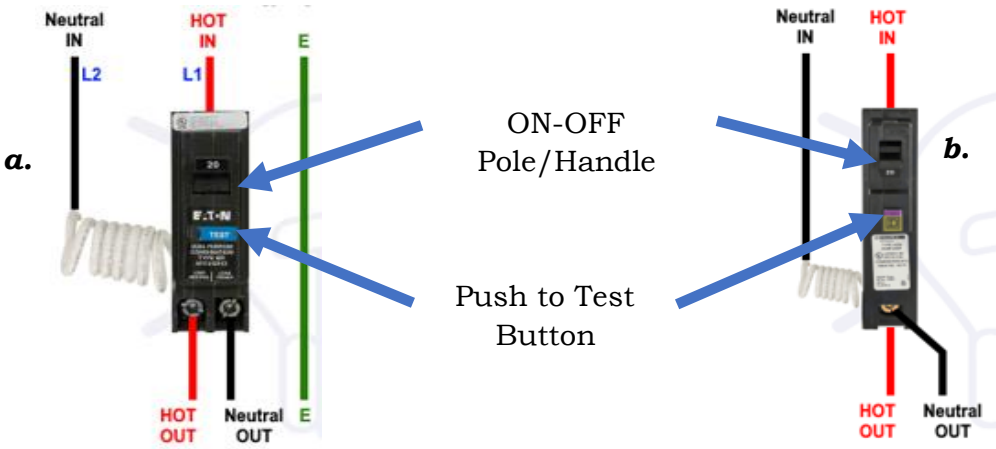
(https://tinyurl.com/ybympylf)
(https://tinyurl.com/y9t8cvng)

Portable Type - Portable type GFCIs are mostly waterproof and come in several styles, all designed for easy transport. Some are designed to plug into existing non-GFCI outlets or connect with a cord and plug arrangement.

(https://tinyurl.com/y8wynyq5)
(https://tinyurl.com/ydew28n4)

External Parts of GFCI

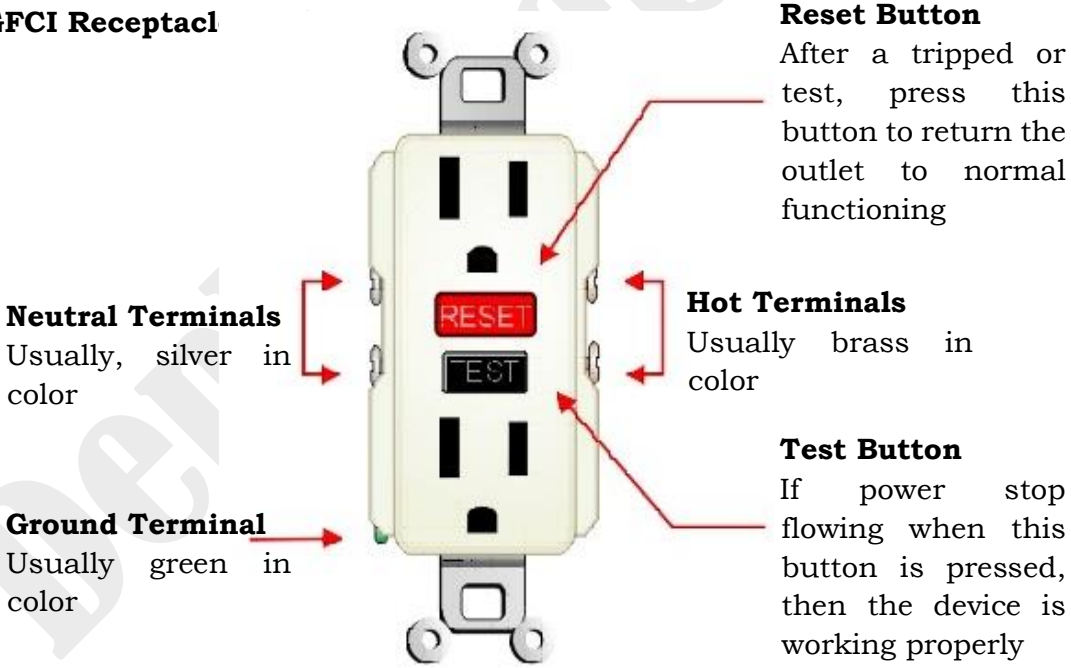
A. GFCI breaker



https://tinyurl.com/ydyoz3ar

Figure 1.7: *External parts of* ***a.*** *Double pole and* ***b.*** *Single pole GFCI (Circuit Breaker)*

B. GFCI Receptacl



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C. GFCI Combo Switch

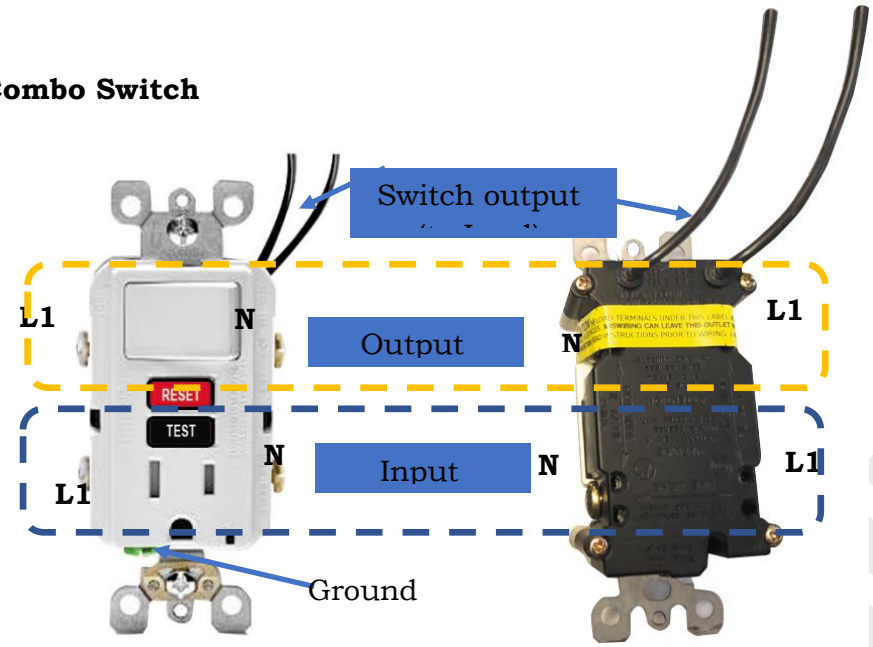

Figure 1.9: *External parts of the GFCI combo switch*

What I Have Learned

Now let's check what you have learned from this lesson. This is a self-check activity. Choose your answer from the box and write it on a separate sheet of paper.

1. It is an unintended contact between an energized conductor and ground or equipment frame and most often occur when equipment is damaged or defective, such that live electrical parts are no longer adequately protected from accidental contact.
2. GFCI is a device that quickly interrupts the current that exceeds _____ preventing the user from being electrocuted?
3. One of the types of GFCI that is inserted to the panel and protects the entire branch circuit?
4. Type of GFCI that is mostly waterproof.
5. White wire attached in the GFCI breaker is _____.

GFCI Breaker	**Ground Fault**	GFCI Receptacle
5 mA + 1 mA	Portable type GFCI	**Cord type GFCI**
Breaker type GFCI	Operational	**Neutral**
Monthly	Twice a month	Every two months

What's More

1. Explain the importance of installing GFCI devices.

_____

_____

2. How can GFCI protect a person from ground fault?

_____

_____

For additional and advanced information, watch videos on how to Test and Reset GFCI devices. You may click the link of the suggested videos below.

1. GFCI outlet: How it works and how to test

https://www.youtube.com /watch?v=Vkd43t2y2to

2. Replacing a faulty GFCI receptacle

https://www.youtube.com /watch?v=fkGWX6Ttyh8

3. Installing a GFCI breaker

https://www.youtube.com/ watch?v=nGO67WLQ1nE

4. How To Install a Ground Fault Circuit Breaker to Replace a GFCI Outlet or Receptacle

https://www.youtube.com/wa

5. Do-it-Yourself: GFCI receptacle installation

https://tinyurl.com/ycwz3u3u

What I Can Do

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

Directions: Look for available GFCI devices found in your house or go to any electrical stores or suppliers and ask different GFCIs available and do the following:

1. Take a picture of the GFCI breaker, GFCI receptacle, and GFCI cord.
2. Take a picture of an ordinary circuit breaker, regular convenience outlet, and regular cord/extension cord.
3. Print or draw the pictures you have taken then differentiate the GFCI from the ordinary devices by labeling the parts and terminals. Follow the format below.

GFCI Circuit Breaker	Ordinary Circuit Breaker
GFCI Receptacle Outlet	Ordinary Convenience Outlet
GFCI Cord	Ordinary Extension/Cord

Note: If the item is not available physically, search in the internet and print in color or draw them if you don't have a printer at home. You may submit your outputs online by sending the soft copy or picture of your printed outputs or submit them to your school via face-to-face on the date scheduled given by the school or by your adviser. More importantly, always be updated of the teacher's feedback of your outputs for improvement.

Rubric for Printed/Handwritten Drawings				
	Excellent 5	Good 4	Fair 3	Poor 2
Clarity of print/drawing	Print/drawing is very clear and colored	Print/drawing is clear and colored	Print/drawing is not clear but colored	Print/drawing is not clear and uncolored
Neatness of print/drawing	Print/drawing is very neat	Print/drawing is neat	Print/drawing is not neat	Print/drawing is not neat and messy
Timeliness	Outputs submitted before deadline	Outputs submitted on the deadline	Outputs submitted 1-2 days after the deadline	Outputs submitted 3 days and beyond after the deadline
Quality	Print/drawing shows the complete detailed parts of the devices	Print/drawing shows the parts of the devices	Print/drawing shows some parts of the devices	Print/drawing did not show the parts of the devices

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. GOOD LUCK!

A. Multiple choice

1. It happens whenever electricity outflows the limitations of the wiring in an appliance, light fixture, or power tool and takes a shortcut to the ground.
   a. Short circuit C. Ground circuit
   b. Ground fault D. Open circuit
2. It incorporates a GFCI device within one or more receptacle outlets.
   a. GFCI receptacle C. GFCI portable
   b. GFCI breaker D. GFCI cord
3. American electrical engineering and computer sciences professor who invented GFCI.
   a. Charles Darwin C. Charles Andrew
   b. Charles Montreal D. Charles Dalziel
4. It is a switching device that can be operated manually or automatically for controlling and protecting the electrical power system?
   a. Fuse C. Circuit breaker
   b. Surge Protection Device D. RCBO
5. The GFCI interrupts the flow of electrical energy in the circuit when the current is more than _____.
   a. 4mA + 1mA C. 6mA + 1mA
   b. 5mA + 1mA D. 7ma + 1mA

B. Identify and name the different devices below. Write the letter and word/s of your answer.

6.
A. GFCI circuit breaker
B. GFCI receptacle outlet
C. GFCI cord
D. GFCI combo switch

7.
A. GFCI circuit breaker
B. GFCI receptacle outlet
C. Convenience outlet
D. Combo switch

8.
A. 2-Pole circuit breaker
B. GFCI receptacle outlet
C. GFCI circuit breaker
D. Convenience outlet

9.
A. 2-Pole circuit breaker
B. 2-Pole receptacle outlet
C. GFCI circuit breaker
D. GFCI Receptacle outlet

10.
A. GFCI cord
B. GFCI receptacle outlet
C. GFCI circuit breaker
D. GFCI adapter

11.
A. GFCI cord
B. GFCI portable type
C. GFCI receptacle outlet
D. GFCI adapter

12.
A. GFCI breaker
B. GFCI receptacle outlet
C. GFCI combo switch
D. GFCI adapter

13.
A. GFCI cord
B. GFCI adapter
C. GFCI combo switch
D. GFCI circuit breaker

14.
A. GFCI breaker
B. GFCI male plug
C. GFCI combo switch
D. Single pole circuit breaker

15.
A. GFCI adapter
B. GFCI breaker
C. Surge protection device
D. Double pole circuit breaker

Answer Key

Answer Key (What I Have Learned)

1. GROUND FAULT 2. 5 mA + 1 mA 3. GFCI Breaker 4. GFCI cord
5.Neutral

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