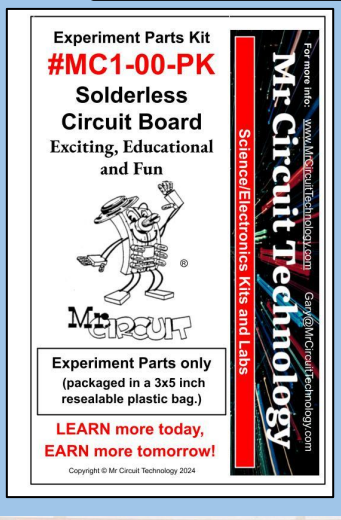
For more info: www.MrCircuitTechnology.com Gary@MrCircuitTechnology.com

Mr Circuit Technology

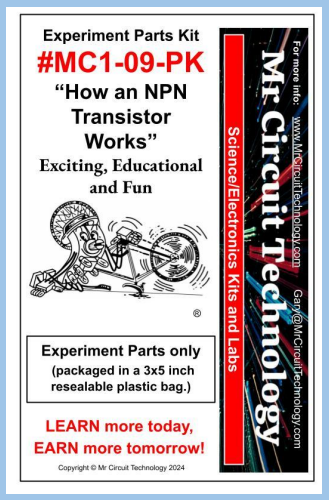
Science/Electronics Experiment Kits and Labs

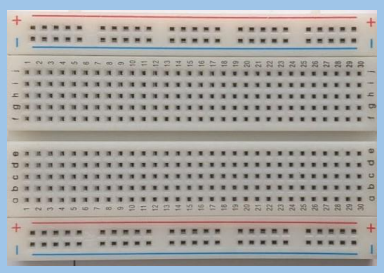
Exp. 9 - "HOW AN PNP TRANSISTOR WORKS"

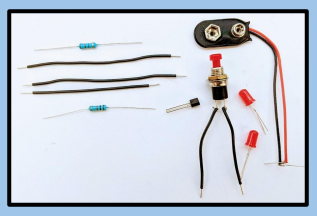


LESSON PLAN

Table of Contents







PREPARATION: You can put the Page 12 poster up on your classroom wall to announce the fact that you are going to do the Science-Electronics Experiment.

Step 1 - Make a copy of pages 1 through 8 for each student. The students can read and do these pages on their own or you can guide them.

Step 2 - Hand out Parts Kit #MC1-00-PK (that has the Solderless Circuit Board) and Parts Kit #MC1-09-PK (that has the experiment parts) with a 9-Volt battery. Give these items to each student along with the 8 pages.

Step 3 - When your students have completed the experiment, collect all the Parts Kits and batteries for later use.

Step 4 - Collect all the Written Quizzes for grading and use the Answer Key to grade them.

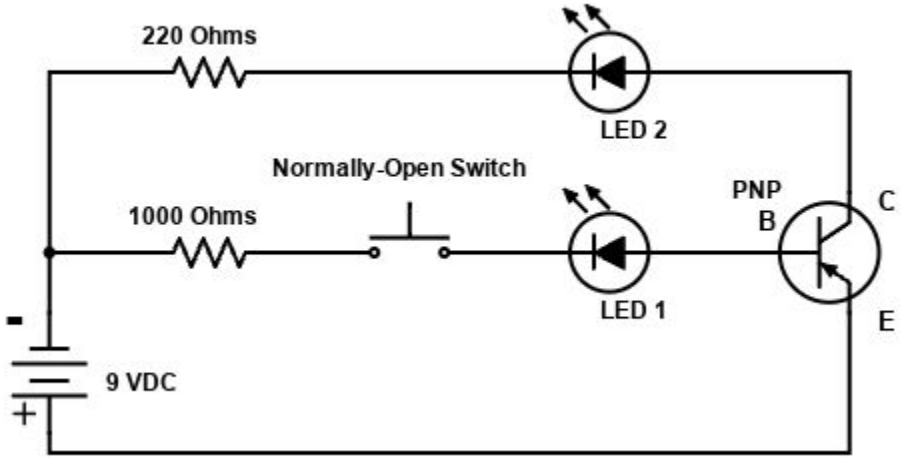
For Tech Support or any questions, you can email us or call 805-295-1642

How an PNP Transistor Works

EXPLANATION OF EXPERIMENT part 1 of 2

*** You are going to build a circuit to observe that a PNP Transistor can amplify current in a circuit.

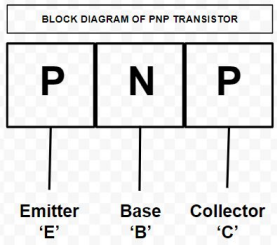
Here is the SCHEMATIC DIAGRAM of the circuit you will build.



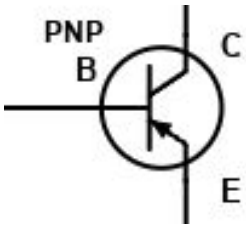
NOTE: E = Emitter pin B = Base pin C = Collector pin

Let's talk about an PNP transistor. A PNP transistor is made up of three sections. It has a 'N' section sandwiched between two 'P' sections. Thus it is called an NPN Transistor.

DRAWING



BLOCK DIAGRAM OF NPN TRANSISTOR



SCHEMATIC SYMBOL

It has 3 pins coming out of it. We call these pins the Emitter, the Base, and the Collector. The Emitter is connected to one of the 'P' sections, the Base is connected to the 'N' section, and the Collector is connected to the other 'P' section. The transistor is also referred to as a BIPOLAR TRANSISTOR.

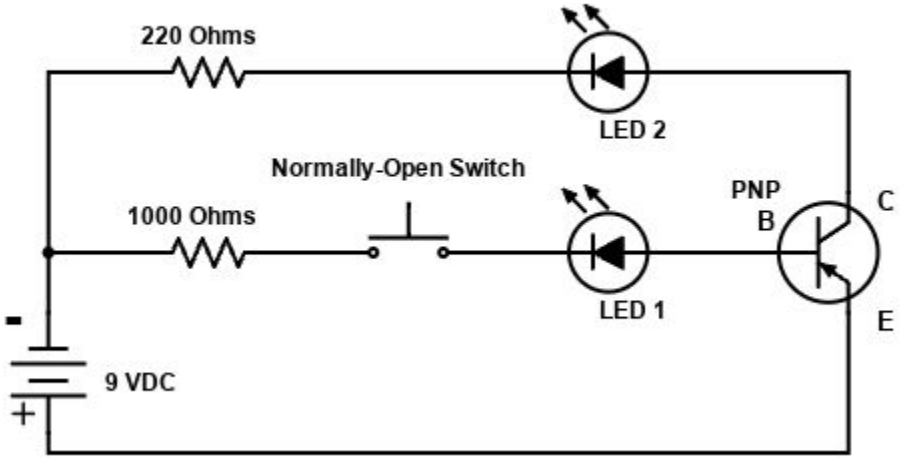
I always remember that the arrow on the schematic symbol always points towards the 'N' section, so this symbol is for the PNP transistor. Also, the arrow is always on the Emitter pin of the transistor. So, you can see the transistor has an 'E' for Emitter on the side with the arrow.

(Continue to Page 2)

How an PNP Transistor Works

EXPLANATION OF EXPERIMENT part 2 of 2

There are two electron current paths through an PNP transistor.



One path is from the Collector to the Base (we call this Base current) and the other path is from the Collector to the Emitter, (we call this Collector current).

The sum of these two currents, i.e. Base current and Collector current, is equal to the Emitter current.

The Base current is smaller than the Collector current. The relationship between these two currents is VERY IMPORTANT. The more current that flows in the Base current path, the more current that will flow in the Collector current path.

So, as we increase the Base current, the Collector current will increase This increase in Collector current in relationship to the Base current is referred to as AMPLIFICATION.

This circuit is designed so that a small Base current, which lights up LED 1, controls the larger Collector current, which lights up LED 2. You observe this because LED 2 is brighter than LED 1.

Thus you see that the PNP transistor can operate as a current amplifier. A small Base current causes a larger Collector current in the transistor.

(Continue to Page 3)

How an PNP Transistor Works

MC1-09-R-3

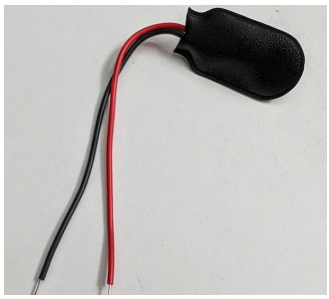
PURPOSE OF THIS EXPERIMENT

*** To observe that an PNP Transistor can amplify current in a circuit.

PARTS NEEDED FOR EXPERIMENT

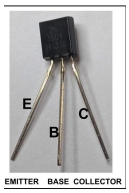
In this experiment, you will use

a BATTERY SNAP

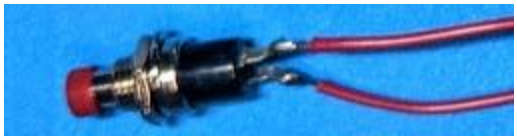


Two LEDs

an PNP Transistor



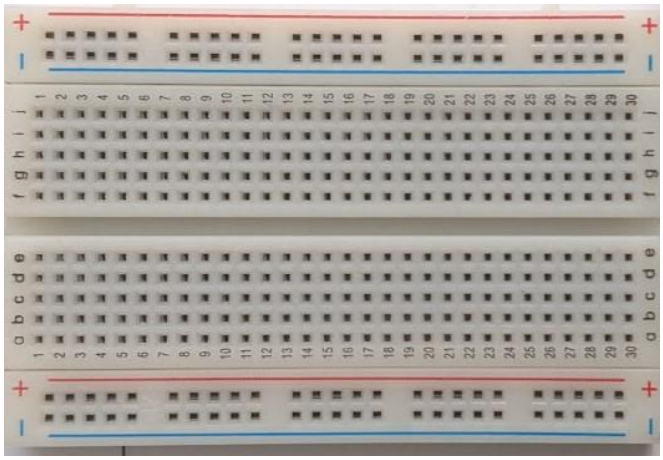
a switch



220 Ohm resistor

1000 Ohm resistor

and a SOLDERLESS CIRCUIT BOARD.



You will also need a good 9 Volt battery

(Continue to Page 4)

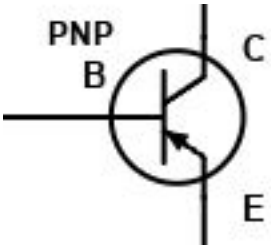
How an PNP Transistor Works

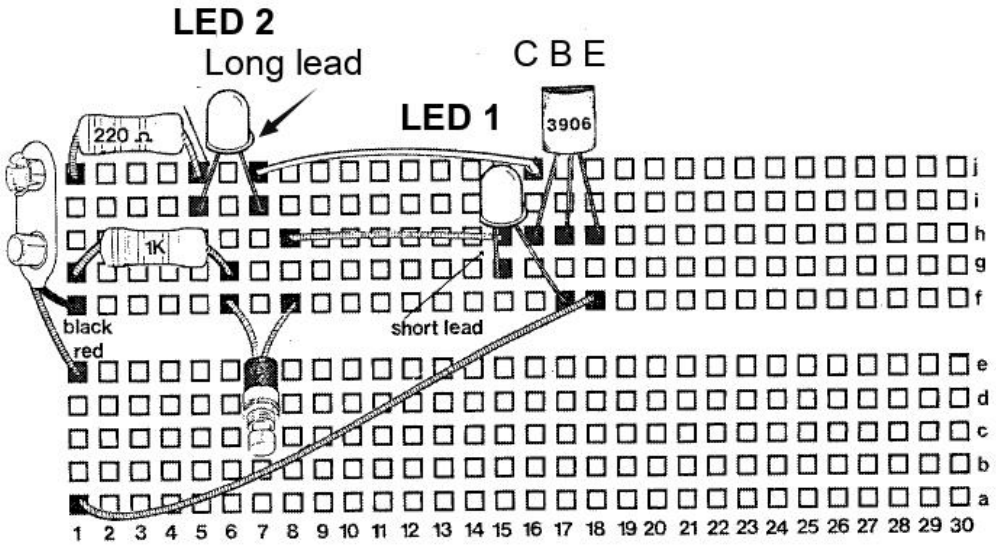
MC1-09-R-4

DO THE EXPERIMENT (part 1 of 2)

Now we are going to build the circuit.

Step 1 - Take out all the parts needed and a Solderless Circuit Board and 9-Volt battery.





Step 2 - Install all the parts on the Solderless Circuit Board in this order. Check them off as you go.

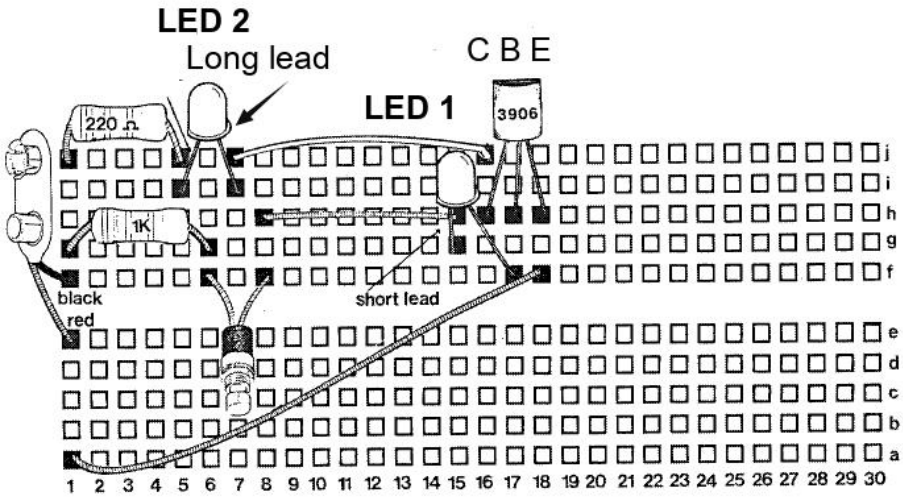
- ❑ Install an LED with the Short Lead in hole 15g and the Long Lead in hole 17f
- ❑ Install an LED with the Short Lead in hole 5i and the Long Lead in hole 7i
- ❑ Install the 220 Ohm resistor (red, red, brown, gold) in holes 1j to 5j
- ❑ Install the 1000 (1k) Ohm resistor (brown, black, red, gold) in holes 1g and 6g
- ❑ Install the NPN Transistor - Emitter in hole 18h, Base 17h, Collector 16h
- ❑ Install Jumper Wire #1 in holes 1a to 18f
- ❑ Install Jumper Wire #2 in holes 8h to 15h
- ❑ Install Jumper Wire #3 in holes 7j to 16j
- ❑ Install a Push Button Switch in holes 6f to 8f
- ❑ Install the Battery Snap, Black lead in hole 1f and Red Lead in hole 1e

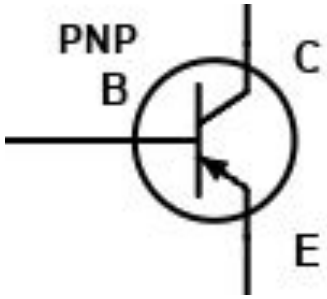
(Continue to Page 5)

How an PNP Transistor Works

MC1-09-R-5

DO THE EXPERIMENT (part 2 of 2)





Step 3 - "Connect the battery to the Battery Snap. <u>The LEDs should not light up until you press the pushbutton switch.</u>.

Step 4 - Now press the Pushbutton Switch Both LEDs should light up when the Pushbutton is pressed.

You should notice that one LED is a little brighter than the other. The reason is that the current flowing in the PNP Collector-Emitter circuit has more current flowing than the PNP Base-Emitter circuit. This is showing a small current controlling a larger current. This is called **Amplification.** You will learn more about this as you learn more about transistors.

CONCLUSION

You should have observed in this simple experiment that an PNP transistor can be used to Amplify current in a circuit.

Therefore, we can use a transistor to amplify the small current from a microphone so that we can hear the sound from a speaker.

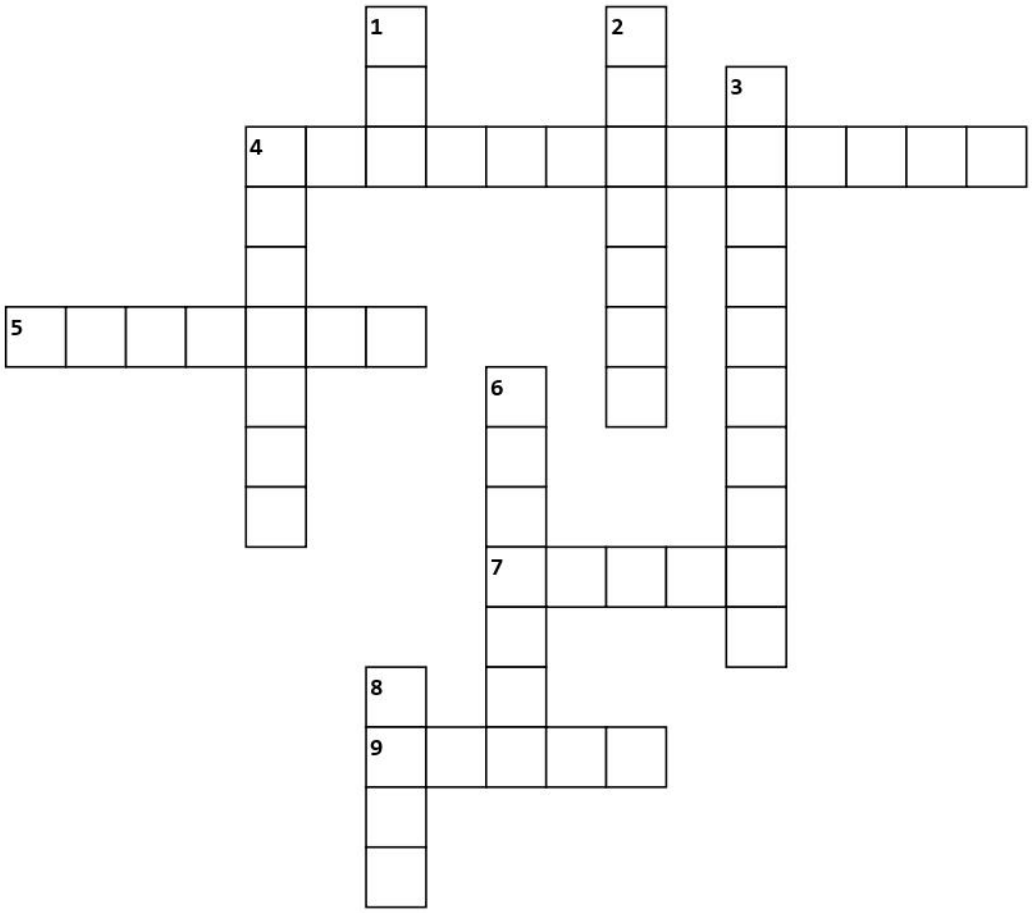
(End of Experiment 9)

Mr. CIRCUIT®

MC1-09-CW

CROSSWORD

Experiment 9 - “How a PNP Transistor Works”



Across

4. The process of having a small current controlling a larger current is called _____ .

5. The transistor we used in this experiment is referred to as a _____ transistor.

7. The transistor in this experiment has _____ sections.

9. The _____ on the schematic symbol for a PNP transistor points towards the 'P' side.

Down

1. The transistor in this experiment if referred to as an _____ transistor.

2. The three sections are called _____, BASE, and COLLECTOR.

3. The 'N' section is _____ between two 'P' sections.

4. In this experiment, you observed a PNP transistor can _____ current.

6. The largest current flow in the NPN transistor flows from the COLLECTOR to the _____ .

8. Which pin on the NPN transistor caries the smallest current?

Mr. CIRCUIT®

MC1-09-WS

WORD SEARCH

Experiment 9 - "How a PNP Transistor Works"

P P S H W B E G B E M I T T E R T Q J N
U G O G G K F D B V K U N N B N L L U M
I R I D Q W I N L I Q H V O P N S C J N
C C H C T G D B N L N B C I T C O G X E
C V U O C Z W H I J K Z R T C J J J Z Y
E C Q B H U U D L B H G T A L P L T F R
S W H R L Q N H A I Y M E C L Z V X D C
P D X N N P I A M P A K M I A V K N A D
D G G T B M C A P O A F I F A Q X I Z R
K N T R M Q M B L L N O T I V B A S N K
B E J N S R X I I A P U T L V K Z R V P
L E U I R T H V F R W O E P Q C C G S R
T R M X G P N P Y X A W R M J S I E J T
C H K R I K E E N I F M G A U Y J Q N J
W T K D S A N D W I C H E D G J W M M Y
V F G T T K K P K W T K W L A R R O W P
O K Q T X X N N I I Y M V I G T L N Z S
N Z S A V P S A L T N M Z P H X C W K M
E C Y E X L D F A X Y Z N R O I W T A L
L K D H S K X B U R L S D P Y B A S E O

1. The transistor in this experiment if referred to as an _____ transistor.

2. The transistor in this experiment has _____ sections.

3. The three sections are called _____, BASE, and COLLECTOR.

4. The 'N' section is _____ between two 'P' sections.

5. Which pin on the NPN transistor caries the smallest current?

6. The largest current flow in the NPN transistor flows from the COLLECTOR to the _____ .

7. The process of having a small current controlling a larger current is called _____ .

8. The _____ on the schematic symbol for a PNP transistor points towards the 'P' side.

9. In this experiment, you observed a PNP transistor can _____ current.

10. The transistor we used in this experiment is referred to as a _____ transistor.

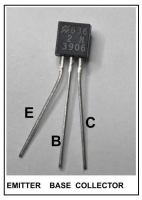
(Student Name) (Period/Student Number) (Date)

QUIZ for Exp 09 or STEM KIT #09
in the Mr Circuit Electronics Training Lab 1

(Page 8)

This Quiz covers the training learned by completing

"How an PNP Transistor Works" Experiment 9



Circle the letter for your answer to each question and then hand this quiz in to your teacher.

A B C D

#1 In this circuit, the Emitter of the PNP is connected to the _____ of the battery.
A. negative
B. positive
C. neutral
D. ground

A B C D

#2 In Exp. #9, we use LED brightnesses to compare the amount of _____ flowing.
A. current
B. voltage
C. resistance
D. air

A B C D

#3 In a PNP transistor circuit, which current is greater?
A. the Collector to Emitter current
B. the Base to Emitter current
C. the Emitter to Collector current
D. the Emitter to Base current

A B C D

#4 In a transistor circuit, when there is no base current, there is _____ .
A. no voltage
B. more collector current
C. no collector current
D. no anode voltage

A B C D

#5 In Exp. #9, the PNP transistor is working as _____.
A. an amplifier
B. a voltage regulator
C. a resistor
D. a variable capacitor

A B C D

#6 The PNP transistor we use in this experiment is referred to as a _____ transistor?
A. Bipolar
B. Dual
C. Double
D. Integrated

A B C D

#7 The schematic symbol of a PNP Transistor shows an arrow pointing to the _____ lead.
A. Cathode
B. Emitter
C. Base
D. Collector

A B C D

#8 A transistor controls a large amount of current with _____ .
A. a small amount of current
B. a large amount of current
C. a small amount of voltage
D. a huge amount of voltage

A B C D

#9 A PNP transistor has three pins: a Collector pin, a Base pin, and _____ pin.
A. an Anode
B. an Emitter
C. a Cathode
D. a Gate

A B C D

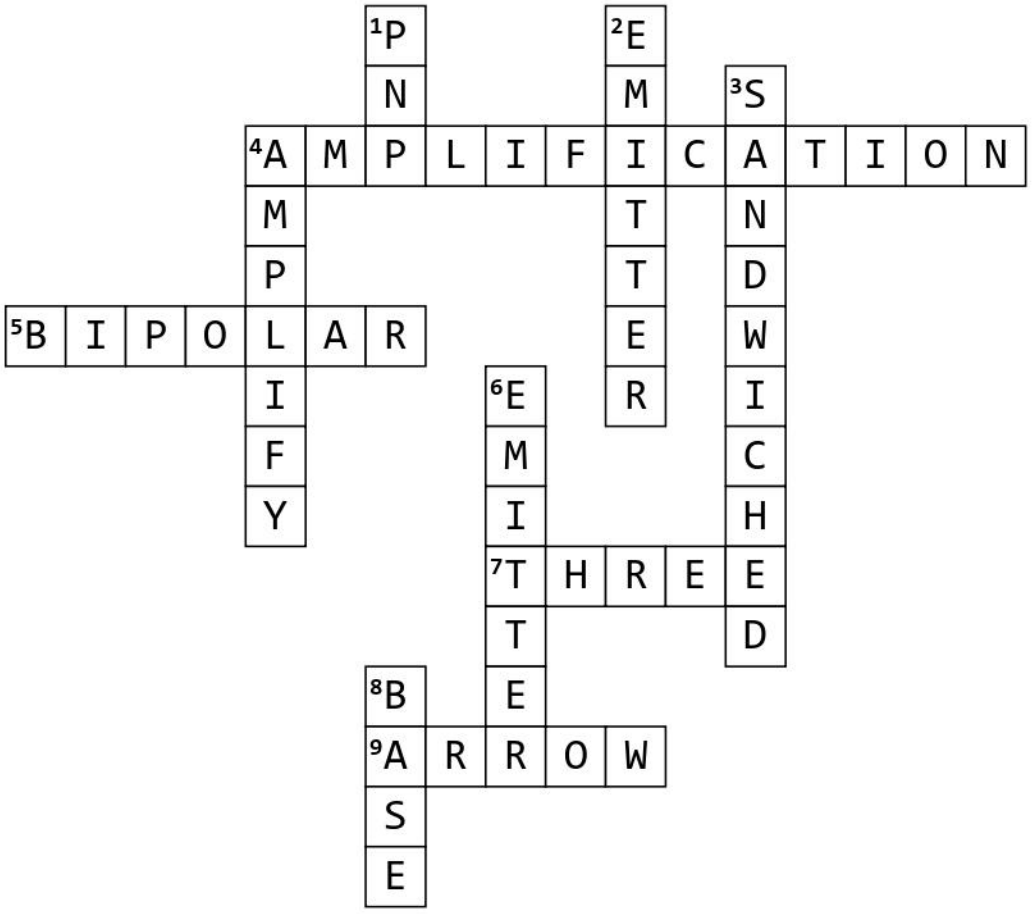
#10 In a PNP transistor, the direction of the electron flow is from _____ .
A. Base to Base
B. Emitter to Collector
C. Emitter to Base
D. Collector to Emitter

(Form SQ09)

Score

ANSWERS FOR CROSSWORD

Experiment 9 - "How a PNP Transistor Works"



Across

4. The process of having a small current controlling a larger current is called _____ .

5. The transistor we used in this experiment is referred to as a _____ transistor.

7. The transistor in this experiment has _____ sections.

9. The _____ on the schematic symbol for a PNP transistor points towards the 'P' side.

Down

1. The transistor in this experiment if referred to as an _____ transistor.

2. The three sections are called _____, BASE, and COLLECTOR.

3. The 'N' section is _____ between two 'P' sections.

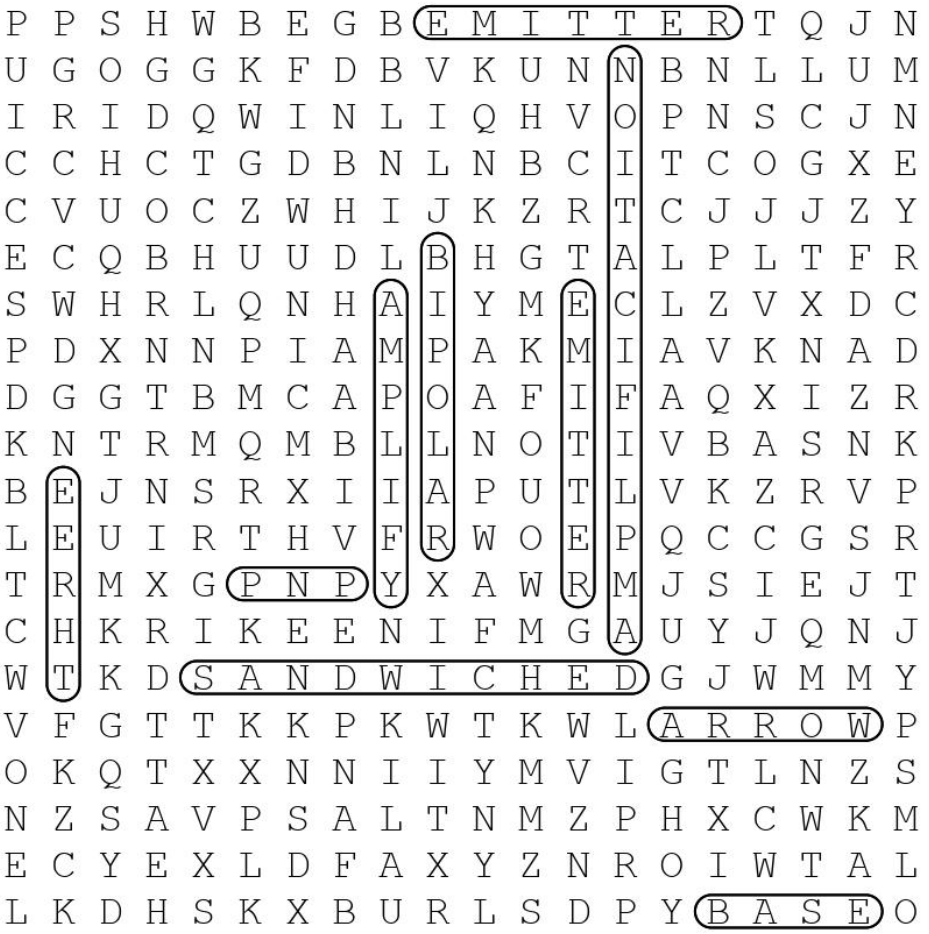
4. In this experiment, you observed a PNP transistor can _____ current.

6. The largest current flow in the NPN transistor flows from the COLLECTOR to the _____ .

8. Which pin on the NPN transistor caries the smallest current?

ANSWERS FOR WORD SEARCH

Experiment 9 - "How a PNP Transistor Works"



1. The transistor in this experiment if referred to as an _____ transistor.

2. The transistor in this experiment has _____ sections.

3. The three sections are called _____, BASE, and COLLECTOR.

4. The 'N' section is _____ between two 'P' sections.

5. Which pin on the NPN transistor caries the smallest current?

6. The largest current flow in the NPN transistor flows from the COLLECTOR to the _____ .

7. The process of having a small current controlling a larger current is called _____ .

8. The _____ on the schematic symbol for a PNP transistor points towards the 'P' side.

9. In this experiment, you observed a PNP transistor can _____ current.

10. The transistor we used in this experiment is referred to as a _____ transistor.

QUICK-CHECK ANSWER KEY for Experiment 09 QUIZ
for Mr Circuit Electronics Training ("PNP Transistor")

Place this sheet over top of the STUDENT QUIZ (offset a little to the left and then offset to the right) to compare the answers on this sheet to the answers that the student marked. Put an 'X' for each wrong answer.

Count the right answers and record the score of right answers in your grade book.

A
(B)
C
D

#1 In this circuit, the Emitter of the PNP is connected to the _____ of the battery.
A. negative
B. positive
C. neutral
D. ground

(A)
B
C
D

#6 The PNP transistor we use in this experiment is referred to as a _____ transistor?
A. Bipolar
B. Dual
C. Double
D. Integrated

(A)
B
C
D

#2 In Exp. #9, we use LED brightnesses to compare the amount of _____ flowing.
A. current
B. voltage
C. resistance
D. air

A
B
C
D

#7 The schematic symbol of a PNP Transistor shows an arrow pointing to the _____ lead.
A. Cathode
B. Emitter
C. Base
D. Collector

A
B
(C)
D

(A)
B
C
D

#3 In a PNP transistor circuit, which current is greater?
A. the Collector to Emitter current
B. the Base to Emitter current
C. the Emitter to Collector current
D. the Emitter to Base current

(A)
B
C
D

#8 A transistor controls a large amount of current with _____ .
A. a small amount of current
B. a large amount of current
C. a small amount of voltage
D. a huge amount of voltage

A
B
C
D

#4 In a transistor circuit, when there is no base current, there is _____ .
A. no voltage
B. more collector current
C. no collector current
D. no anode voltage

A
B
(C)
D

#9 A PNP transistor has three pins: a Collector pin, a Base pin, and _____ pin.
A. an Anode
B. an Emitter
C. a Cathode
D. a Gate

A
(B)
C
D

(A)
B
C
D

#5 In Exp. #9, the PNP transistor is working as _____.
A. an amplifier
B. a voltage regulator
C. a resistor
D. a variable capacitor

A
B
C
D

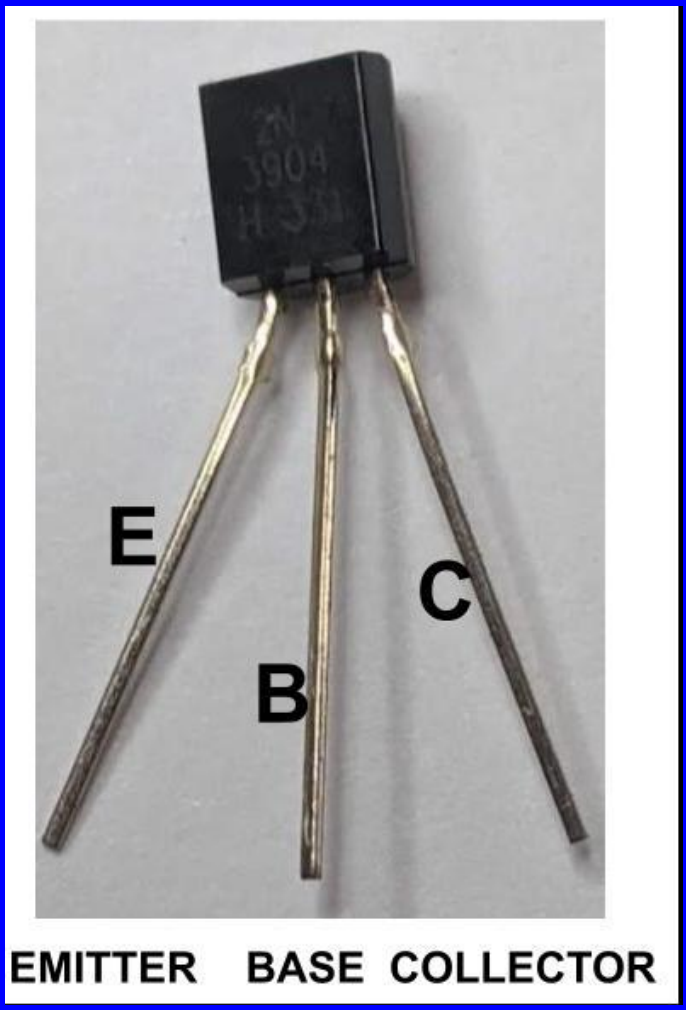
#10 In a PNP transistor, the direction of the electron flow is from _____ .
A. Base to Base
B. Emitter to Collector
C. Emitter to Base
D. Collector to Emitter

A
B
C
(D)

(Form SQAK09)

BUILD A BETTER FUTURE by UNDERSTANDING SCIENCE-ELECTRONICS

An PNP TRANSISTOR

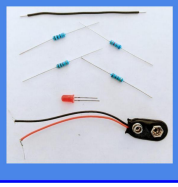


BASIC ELECTRONICS LAB 1

"HOW AN PNP TRANSISTOR WORKS"

(Poster MC1-09-P01)

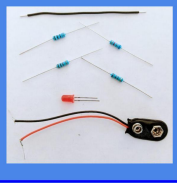
MC1-01
Electronic Parts



For more info: www.MrCircuitTechnology.com MrCircuit23@gmail.com

Mr Circuit Technology

MC1-01
Electronic Parts



PRICE LIST May 2024

PRICE LIST

PARTS KIT Number	Mr Circuit Series 1 SCIENCE / ELECTRONICS "PARTS KITS"	Price Each
MC1-00-PK	Solderless Circuit Board to build kits	$3.95
MC1-01-PK	Parts Kit for "How a Resistor Works	$1.95
MC1-02-PK	Parts Kit for "How a Potentiometer Works	$2.95
MC1-03-PK	Parts Kit for "How a Photocell Works	$1.95
MC1-04-PK	Parts Kit for "How a Capacitor Works	$2.95
MC1-05-PK	Parts Kit for "How a Speaker Works	$2.95
MC1-06-PK	Parts Kit for "How a Diode Works	$1.95
MC1-07-PK	Parts Kit for "How an SCR Works	$3.95
MC1-08-PK	Parts Kit for "How an NPN Transistor Works	$2.95
MC1-09-PK	Parts Kit for "How a PNP Transistor Works	$2.95
MC1-10-PK	Parts Kit for "How a Transistor Oscillator Works	$3.95
MC1-11-PK	Parts Kit for "How a 555 Timer IC Works	$2.95
MC1-12-PK	Parts Kit for "Burglar Alarm circuit	$3.95
MC1-13-PK	Parts Kit for "Solar-Activated Night Light circuit	$3.95
MC1-14-PK	Parts Kit for "DC to DC Power Supply circuit	$2.95
MC1-15-PK	Parts Kit for "Electronic Metronome circuit	$4.95
MC1-16-PK	Parts Kit for "Electronic Motorcycle circuit	$3.95
MC1-17-PK	Parts Kit for "Railroad Lights circuit	$2.95
MC1-18-PK	Parts Kit for "Variable Speed Lights circuit	$3.95
MC1-19-PK	Parts Kit for "Continuity Tester circuit	$4.95
MC1-20-PK	Parts Kit for "Audio Generator circuit	$5.95
MC1-21-PK	Parts Kit for "Electronic Police Siren circuit	$4.95
MC1-22-PK	Parts Kit for "Solar-Activated Wake-Up Alarm circuit	$3.95
MC1-23-PK	Parts Kit for "Variable Timer circuit	$3.95
MC1-24-PK	Parts Kit for "Moisture Detector circuit	$2.95
MC1-25-PK	Parts Kit for "Code Oscillator circuit	$4.95
MC1-26-PK	Parts Kit for "Audible Water Detector circuit	$4.95
MC1-27-PK	Parts Kit for "English Police Siren circuit	$4.95
MC1-28-PK	Parts Kit for "Electronic Canary circuit	$7.95
MC1-29-PK	Parts Kit for "fantasy Space Machine Gun circuit	$5.95
MC1-30-PK	Parts Kit for "Ultrasonic Pest Repeller circuit	$5.95
Set-MC1-PK	**Complete Set of All Series 1 Parts Kits (31 total)**	**$120.00**