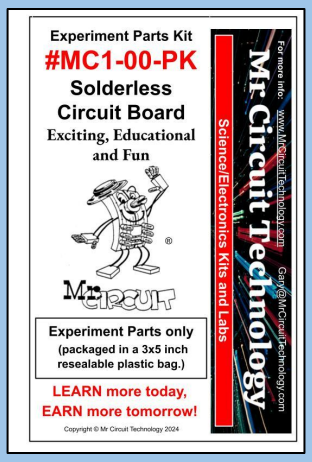
For more info: www.MrCircuitTechnology.com Gary@MrCircuitTechnology.com

Mr Circuit Technology

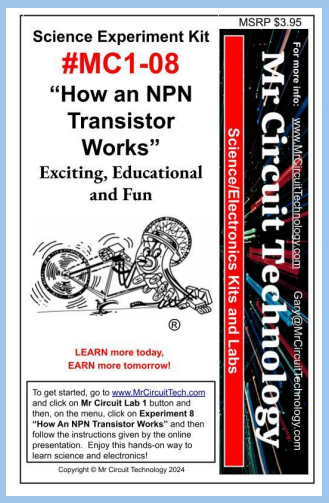
Science/Electronics Experiment Kits and Labs

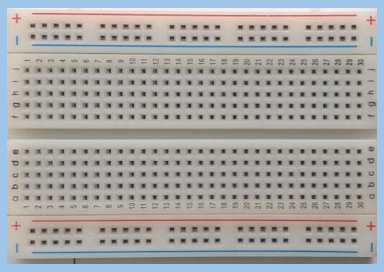
Exp. 8 - "HOW AN NPN TRANSISTOR WORKS"

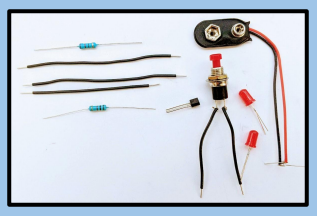


LESSON PLAN

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 #MC1-08-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.

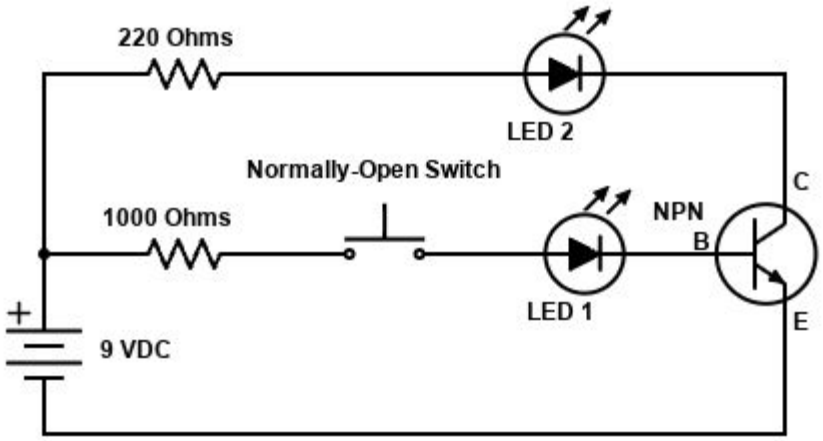
For Tech Support or any questions, you can email us or call 805-295-1642

How an NPN Transistor Works

EXPLANATION OF EXPERIMENT part 1 of 2

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

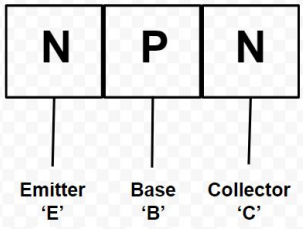
Here is the SCHEMATIC DIAGRAM of the circuit you will build.



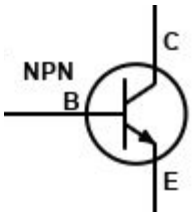
NOTE: E = Emitter pin B = Base pin C = Collector pin

Let's talk about an NPN transistor. An NPN transistor is made up of three sections. It has a 'P' section sandwiched between two 'N' 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 'N' sections, the Base is connected to the 'P' section, and the Collector is connected to the other 'N' section. The transistor is also referred to as a BIPOLAR TRANSISTOR.

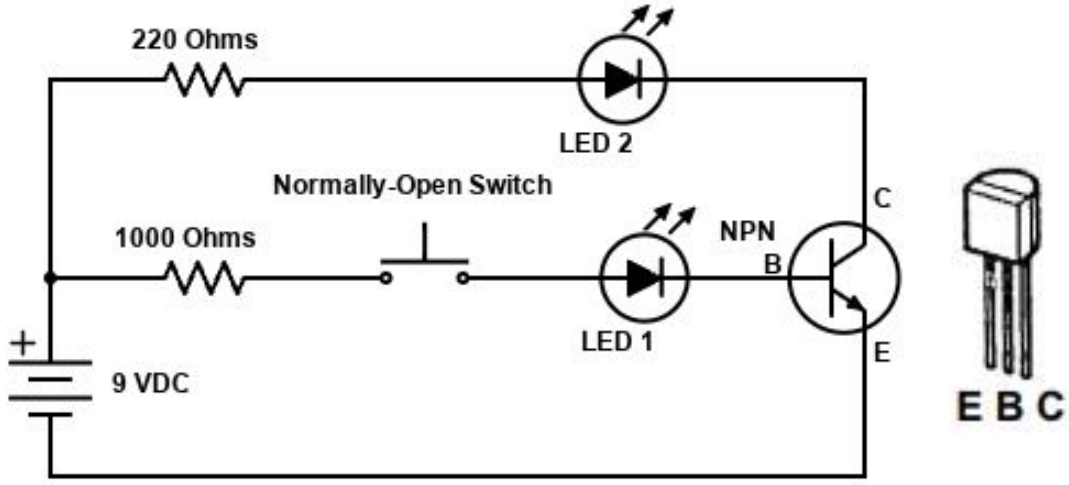
I always remember that the arrow on the schematic symbol always points towards the 'N' section, so this symbol is for the NPN transistor. Also, the arrow is always on the Emitter pin of the transistor. So, you can see the transistor has an 'E' for Emitter on the side with the arrow.

(Continue to Page 2)

How an NPN Transistor Works

EXPLANATION OF EXPERIMENT part 2 of 2

There are two electron current paths through an NPN transistor.



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

MC1-08-R-3

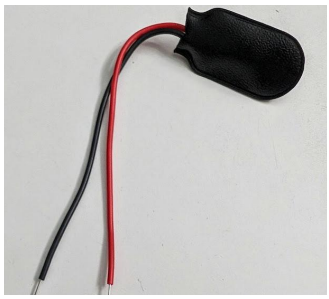
PURPOSE OF THIS EXPERIMENT

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

PARTS NEEDED FOR EXPERIMENT

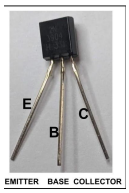
In this experiment, you will use

a BATTERY SNAP

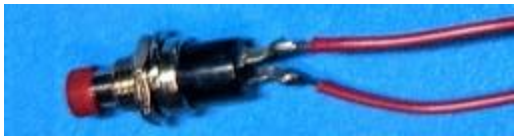


Two LEDs

an NPN Transistor



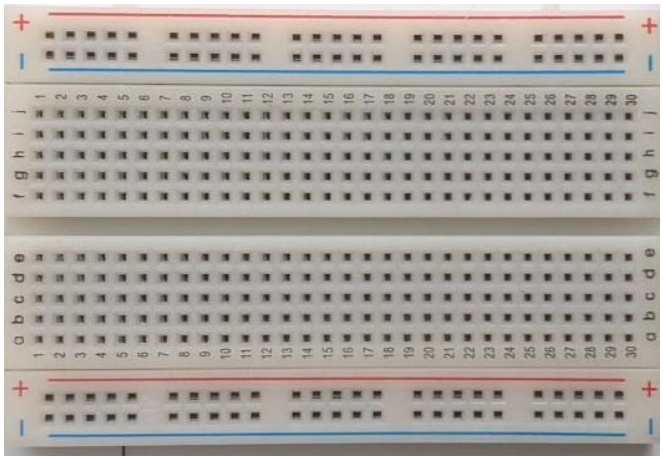
a switch



220 Ohm resistor

1000 Ohm resistor

and a SOLDERLESS CIRCUIT BOARD.



You will also need a good 9 Volt battery

(Continue to Page 4)

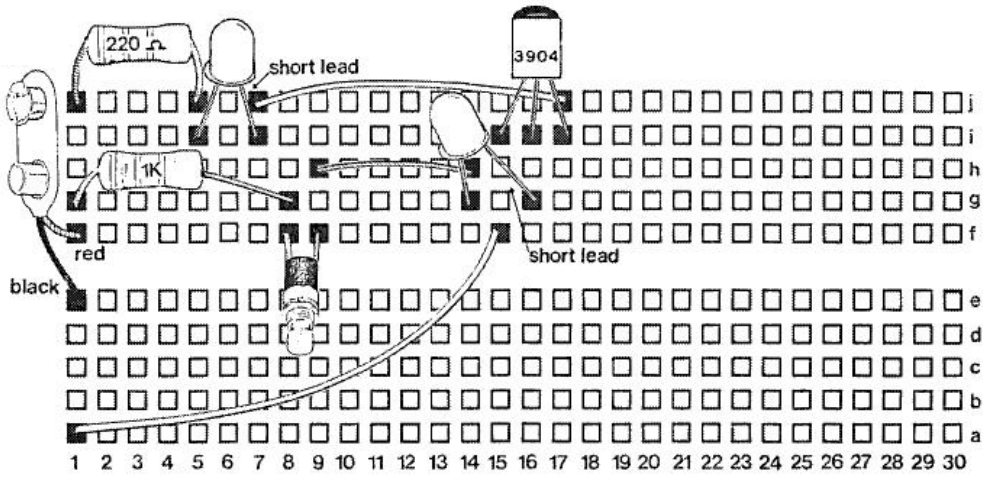
How an NPN Transistor Works

MC1-08-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.

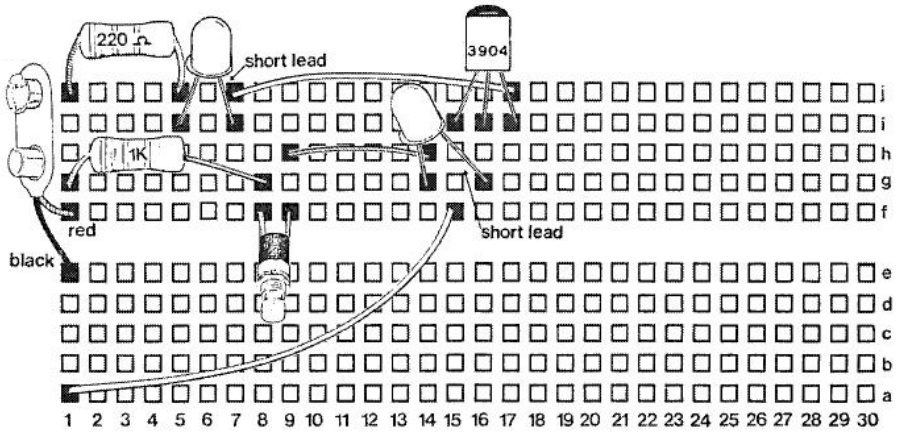
- ❑ Install an LED with the Short Lead in hole 16g and the Long Lead in hole 14g
- ❑ Install an LED with the Short Lead in hole 7i and the Long Lead in hole 5i
- ❑ Install the 220 Ohm resistor (red, red, brown, gold) in holes 1j to 5j
- ❑ Install the 1000 (1k) Ohm resistor (brown, black, red, gold) in holes 1g and 8g
- ❑ Install the NPN Transistor - Emitter in hole 15i, Base 16i, Collector 17i
- ❑ Install Jumper Wire #1 in holes 1a to 15f
- ❑ Install Jumper Wire #2 in holes 9h to 14h
- ❑ Install Jumper Wire #3 in holes 7j to 17j
- ❑ Install a Push Button Switch in holes 8f to 9f
- ❑ Install the Battery Snap, Black lead in hole 1e and Red Lead in hole 1f

(Continue to Page 5)

How an NPN Transistor Works

MC1-08-R-5

DO THE EXPERIMENT (part 2 of 2)



Step 2 - "Connect the battery to the Battery Snap. The LEDs should not light up.

Step 3 - 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 NPN Emitter-Collector circuit has more current flowing than the NPN Emitter-Base 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 NPN 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.

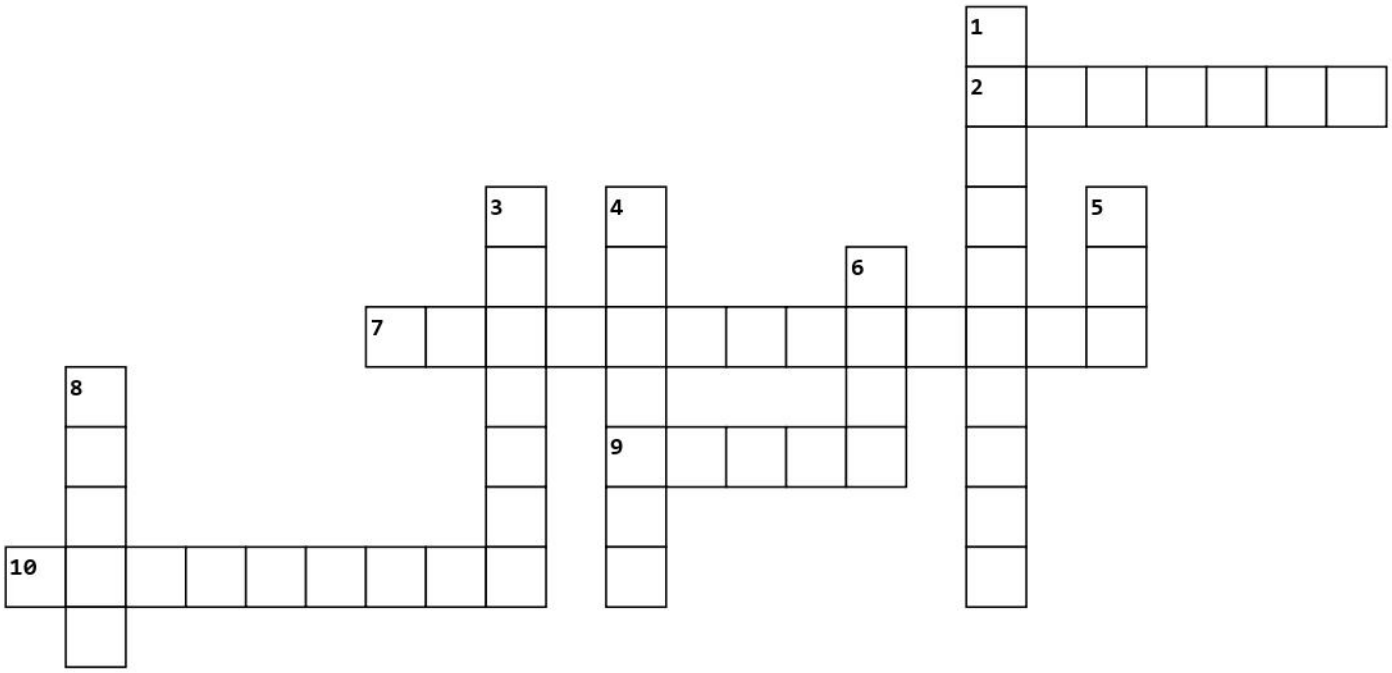
(End of Experiment 8)

Mr. CIRCUIT®

MC1-08-CW

CROSSWORD

Experiment 8 - "How an NPN Transistor Works"



Across

2. In this experiment, you observed an NPN transistor _____ current.

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

9. The transistor in this experiment has _____ sections.

10. The largest current flow in the NPN transistor flows from the EMITTER to the _____ .

Down

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

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

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

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

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

8. The _____ on the schematic symbol for an NPN transistor points towards the 'N' side.

Mr. CIRCUIT®

MC1-08-WS

WORD SEARCH

Experiment 8 - "How an NPN Transistor Works"

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

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

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

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

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

8. The _____ on the schematic symbol for an NPN transistor points towards the 'N' side.

9. In this experiment, you observed an NPN transistor _____ current.

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

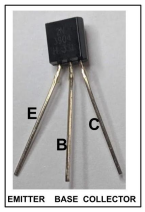
(Student Name) (Period/Student Number) (Date)

QUIZ for Exp 08 or STEM KIT #08 in the Mr Circuit Electronics Training Lab 1

(Page 8)

This Quiz covers the training learned by completing

"How an NPN Transistor Works" Experiment 8



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

A B C D

#1 The NPN 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 The schematic symbol of an NPN Transistor shows an arrow pointing to the _____ lead.

A. cathode
B. emitter
C. base
D. collector

A B C D

#3 The leads on an NPN transistor are called the Emitter, Base, and _____ .

A. Collector
B. Cathode
C. Anode
D. Gate

A B C D

#4 Most of the current traveling through an NPN transistor travels through the _____ circuit.

A. Emitter-Base
B. Emitter-Collector
C. Base-Base
D. Cathode-Anode

A B C D

#5 In an NPN transistor, the direction of the electron flow is from _____ .

A. Base to Emitter
B. Base to Base
C. Emitter to Emitter
D. Emitter to Collector

A B C D

#6 In this NPN transistor circuit, which LED should conduct the most electron current?

A. LED 1
B. LED 2
C. LED 3
D. LED 4

A B C D

#7 In this circuit, the Cathode of LED 2 is connected to the _____ of the NPN transistor.

A. Collector
B. Base
C. Emitter
D. Gate

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 An NPN transistor has three pins: a Collector, a Base, and _____ .

A. an Anode
B. an Emitter
C. a Cathode
D. a Gate

A B C D

#10 The process of having a small current controlling a large current is called _____ .

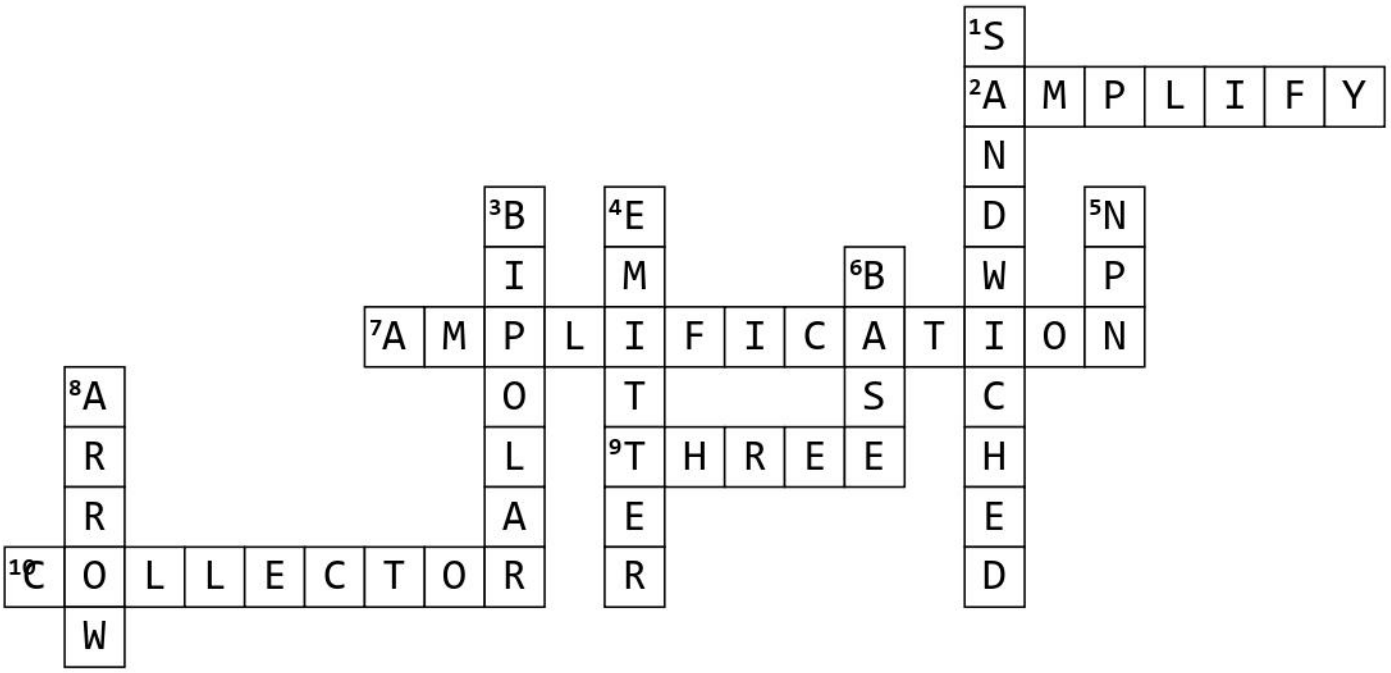
A. increase of the voltage
B. conservation of resources
C. reduction
D. amplification

(Form SQ08)

Score

ANSWERS FOR CROSSWORD

Experiment 8 - “How an NPN Transistor Works”



Across

2. In this experiment, you observed an NPN transistor _____ current.

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

9. The transistor in this experiment has _____ sections.

10. The largest current flow in the NPN transistor flows from the EMITTER to the _____ .

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

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

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

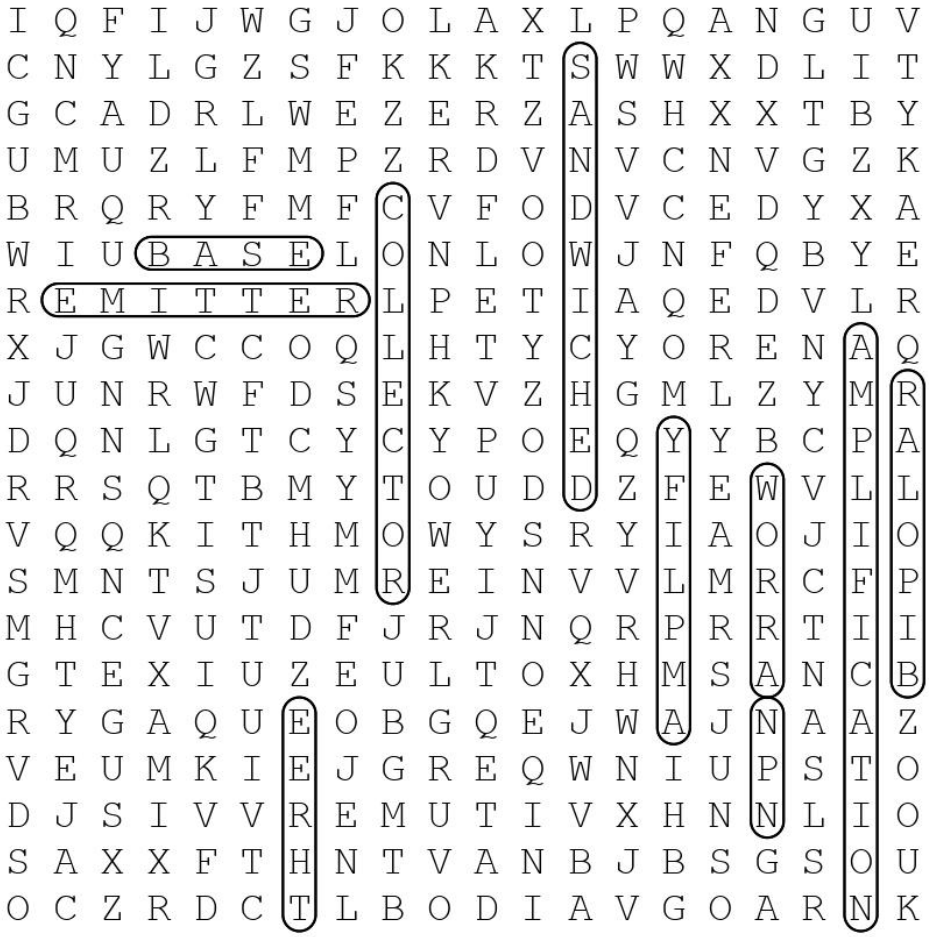
5. The transistor in this experiment if referred to as an _____ transistor.

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

8. The _____ on the schematic symbol for an NPN transistor points towards the 'N' side.

ANSWERS FOR WORD SEARCH

Experiment 8 - "How an NPN 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 'P' section is _____ between two 'N' sections.

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

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

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

8. The _____ on the schematic symbol for an NPN transistor points towards the 'N' side.

9. In this experiment, you observed an NPN transistor _____ current.

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

QUICK-CHECK ANSWER KEY for Experiment 08 QUIZ
for Mr Circuit Electronics Training ("NPN 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 The NPN 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 The schematic symbol of an NPN Transistor shows an arrow pointing to the _____ lead.

A. cathode
B. emitter
C. base
D. collector

A
B
C
D

#3 The leads on an NPN transistor are called the Emitter, Base, and _____ .

A. Collector
B. Cathode
C. Anode
D. Gate

A
B
C
D

#4 Most of the current traveling through an NPN transistor travels through the _____ circuit.

A. Emitter-Base
B. Emitter-Collector
C. Base-Base
D. Cathode-Anode

A
B
C
D

#5 In an NPN transistor, the direction of the electron flow is from _____ .

A. Base to Emitter
B. Base to Base
C. Emitter to Emitter
D. Emitter to Collector

A
B
C
D

#6 In this NPN transistor circuit, which LED should conduct the most electron current?

A. LED 1
B. LED 2
C. LED 3
D. LED 4

A
B
C
D

#7 In this circuit, the Cathode of LED 2 is connected to the _____ of the NPN transistor.

A. Collector
B. Base
C. Emitter
D. Gate

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 An NPN transistor has three pins: a Collector, a Base, and _____ .

A. an Anode
B. an Emitter
C. a Cathode
D. a Gate

A
B
C
D

#10 The process of having a small current controlling a large current is called _____ .

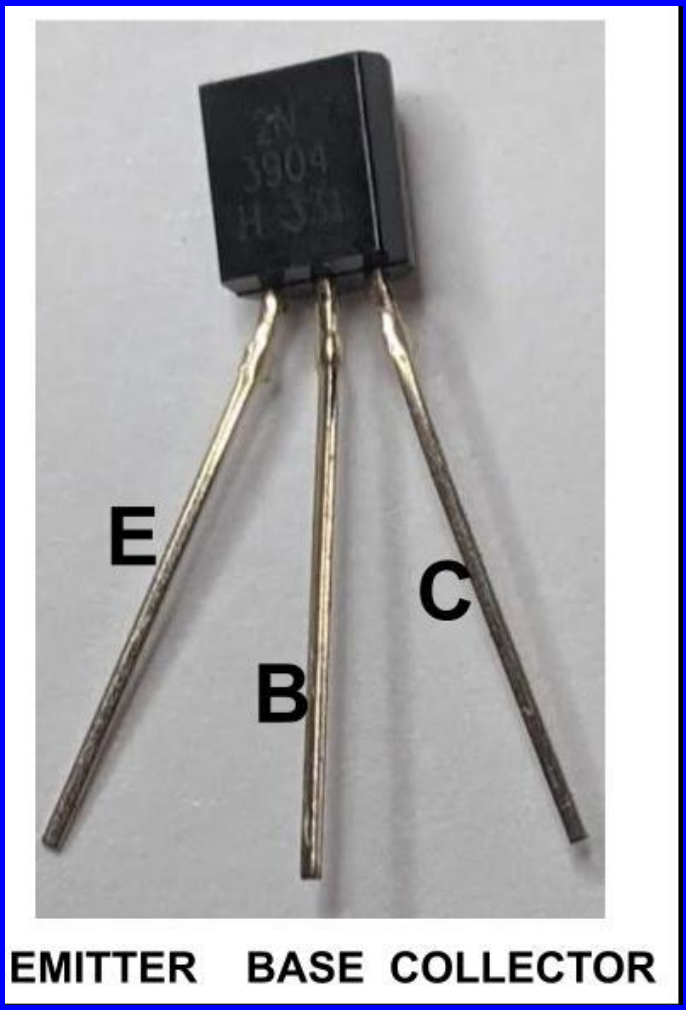
A. increase of the voltage
B. conservation of resources
C. reduction
D. amplification

A
B
C
D

(Form SQAK08)

BUILD A BETTER FUTURE by UNDERSTANDING SCIENCE-ELECTRONICS

AN NPN TRANSISTOR

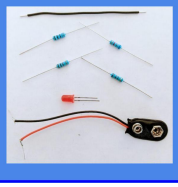


BASIC ELECTRONICS LAB 1

"HOW AN NPN TRANSISTOR WORKS"

(Poster MC1-08-P01)

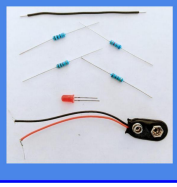
MC1-01
Electronic Parts



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**