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Mr Circuit Technology

Science/Electronics Experiment Kits and Labs


Exp. 10 - "HOW A TWO-TRANSISTOR OSCILLATOR WORKS"

LESSON PLAN

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- Page 13 - Price List for Parts Kits for your to order more. Send Purchase Order to Gary@MrCircuitTechnology.com or order online at www.MrCircuitTechnology.com

Experiment Parts Kit
#MC1-00-PK
Solderless Circuit Board
 Exciting, Educational and Fun




Experiment Parts only (packaged in a 3x5 inch resealable plastic bag.)
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Science/Electronics Kits and Labs

Science Experiment Kit
#MC1-10
"How a Two-Transistor Oscillator Works"
 Exciting, Educational and Fun

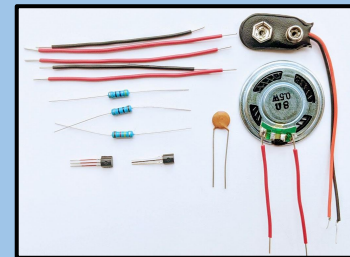
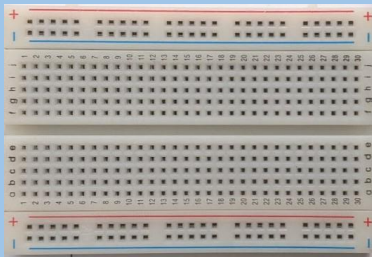


LEARN more today, EARN more tomorrow!
To get started, go to www.MrCircuitTech.com and click on Mr Circuit Labs 1 button and then, on the menu, click on Experiment 10 "How A Two-Transistor Oscillator Works" and then follow the instructions given by the online presentation. Enjoy this hands-on way to learn science and electronics!
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Science/Electronics Kits and Labs



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 #MC1-10-PK (that has the experiment parts) with a 9-Volt battery. Give these items to each student along with the 8 pages.

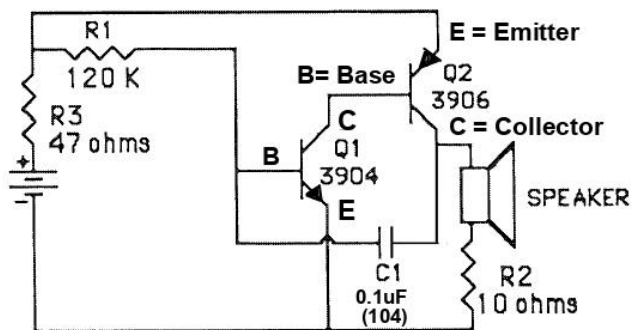
Step 3 - When your students have completed the experiment, collect all the Parts Kits and batteries for later use.

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

EXPLANATION OF EXPERIMENT part 1 of 2

*** You are going to build a two-transistor oscillator circuit to observe that an NPN and a PNP Transistor can cause a speaker to generate audio tones. Here is the SCHEMATIC DIAGRAM of the circuit you will build.

**RESISTORS IN THE CIRCUIT**

R1 - 120k Ohms (Brown, Red, Yellow, Gold)

R2 - 10 Ohms (Brown, Black, Black, Gold)

R3 - 47 Ohms (Yellow, Violet, Black, Gold)

In this experiment, you are going to use two bipolar transistors, an NPN and a PNP, to build this audio oscillator,

An audio oscillator is a device that generates a tone in the audio range, which, for the human ear, is approximately between 10 cycles per second (10 Hertz) and 16,000 cycles per second (16,000 Hertz).

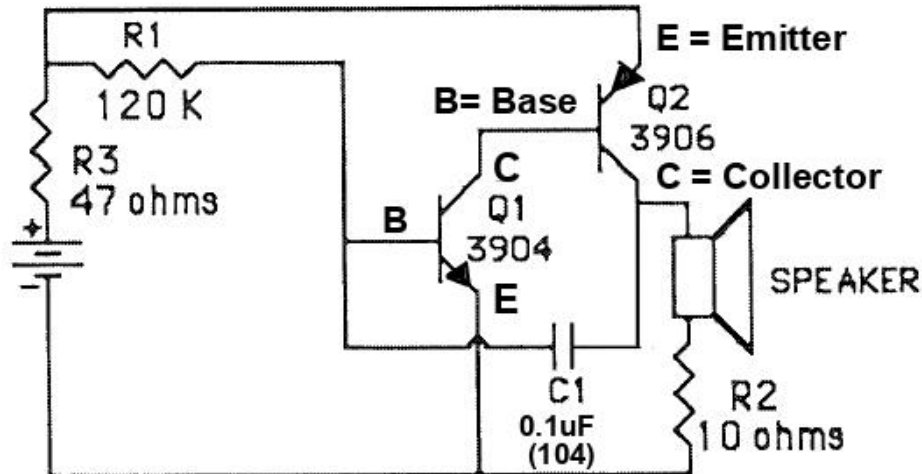
These two transistors will make the speaker oscillate so that your ear can hear the oscillations.

This two-transistor oscillator circuit has three resistors and a capacitor to control the frequency (tone) of the oscillations. The values that we are using, 120k ohms for R1, 10 Ohms for R2, and 47 Ohms for R3, and 0.1uF for the capacitor, will make the speaker oscillate at about 500 cycles per second (500 Hertz).

(Continue to Page 2)

EXPLANATION OF EXPERIMENT part 2 of 2

Let's talk about how the circuit works. Here is the schematic of the two-transistor oscillator that you will build.



When you connect the battery to the circuit, the electrons will begin to flow through the circuit from the negative terminal of the battery through resistor R2 and then through the coil of the speaker to charge the capacitor C1.

This current through the speaker coil will cause the speaker cone to move. At the same time, there is current flowing through transistor Q2 which will cause the capacitor to discharge.

Also, transistor Q1 will begin to conduct current which will discharge the capacitor. The charging and discharging of the capacitor will cause the current through the speaker to turn on and off.

(Continue to Page 3)

PURPOSE OF THIS EXPERIMENT

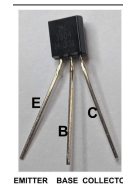
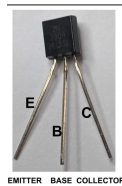
MC1-10-R-3

*** To observe that an NPN and a PNP Transistor can make an audio oscillator circuit.

PARTS NEEDED FOR EXPERIMENT

In this experiment, you will use

a BATTERY SNAP an NPN Transistor a PNP transistor



10 Ohm resistor

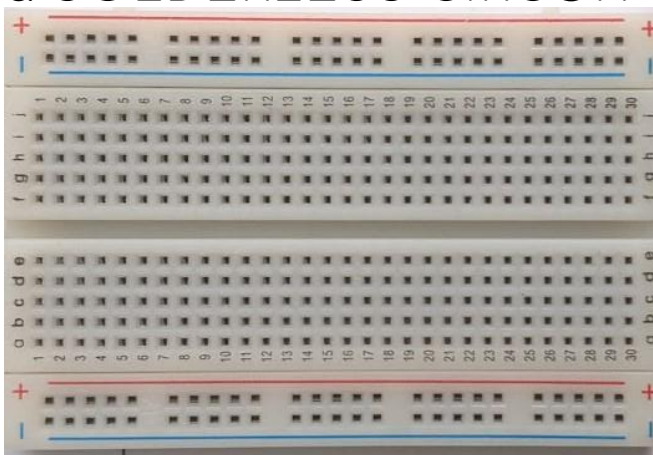


47 Ohm resistor

120k Ohm resistor



and a SOLDERLESS CIRCUIT BOARD and a 0.1uF disc.



You will also need a good 9 Volt battery

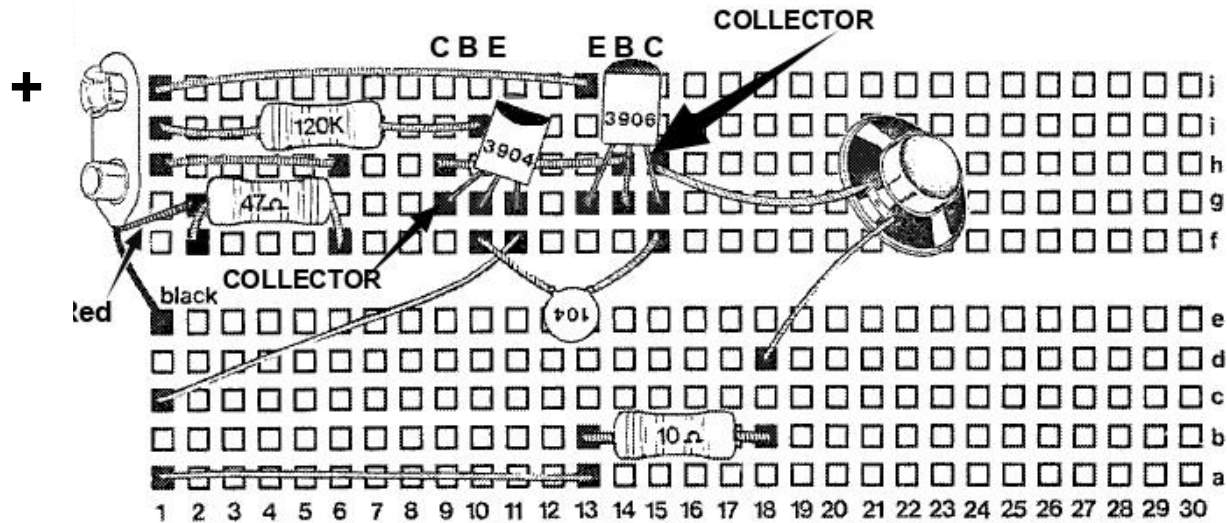
(Continue to Page 4)

DO THE EXPERIMENT (part 1 of 2)

MC1-10-R-4

Now you are going to build the circuit on a Solderless CB.

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



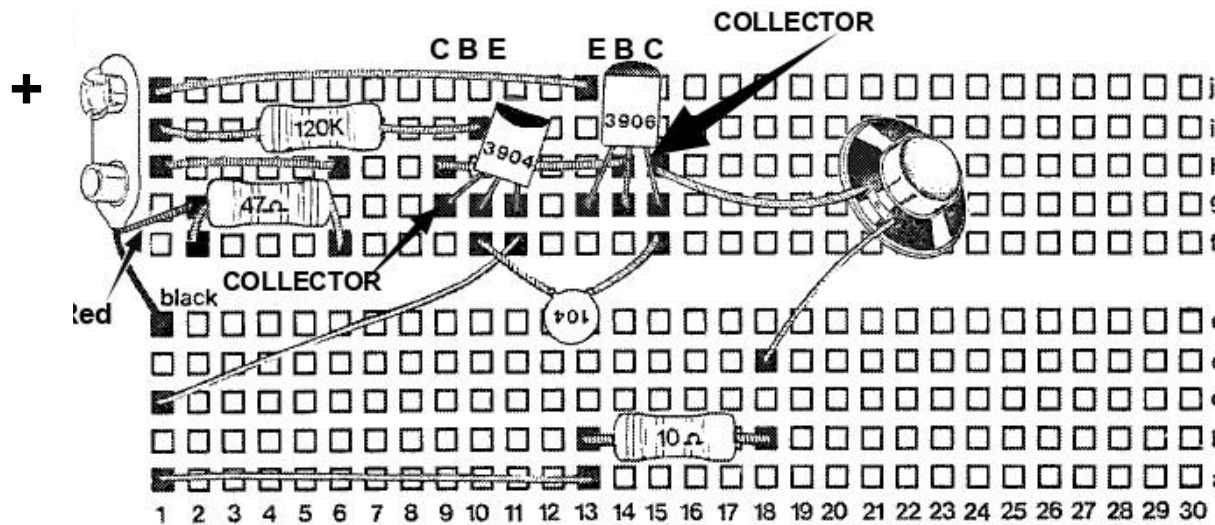
Step 2 - Install all the parts on the Solderless Circuit Board in this order. Check them off as you go.

- Install the 10 Ohm resistor (brown, black black, gold) in holes 13b to 18b
- Install the 47 Ohm resistor (yellow, violet, black, gold) in holes 2f and 6f
- Install the 120k Ohm resistor (brown, red, yellow, gold) in holes 1i to 10i
- Install the NPN Transistor - Collector in hole 9g, Base 10g, Emitter 11g
- Install the PNP Transistor - Emitter in hole 13g, Base 14g, Collector 15g
- Install the 0.1μF (104) disc Capacitor in holes 10f to 15f
- Install Jumper Wire #1 in holes 1a to 13a
- Install Jumper Wire #2 in holes 1c to 11f
- Install Jumper Wire #3 in holes 1h to 6h
- Install Jumper Wire #4 in holes 1j to 13j
- Install Jumper Wire #5 in holes 9h to 14h
- Install the Speaker in holes 15h and 18d
- Install the Battery Snap, Black lead in hole 1e and Red Lead in hole 2g

(Continue to Page 5)

DO THE EXPERIMENT (part 2 of 2)

MC1-10-R-5



Step 3 - "Connect the battery to the Battery Snap. You should hear a tone emitting from the speaker. (It is not real loud.)

If you do not hear a tone, check your wiring and the 9-volt battery.

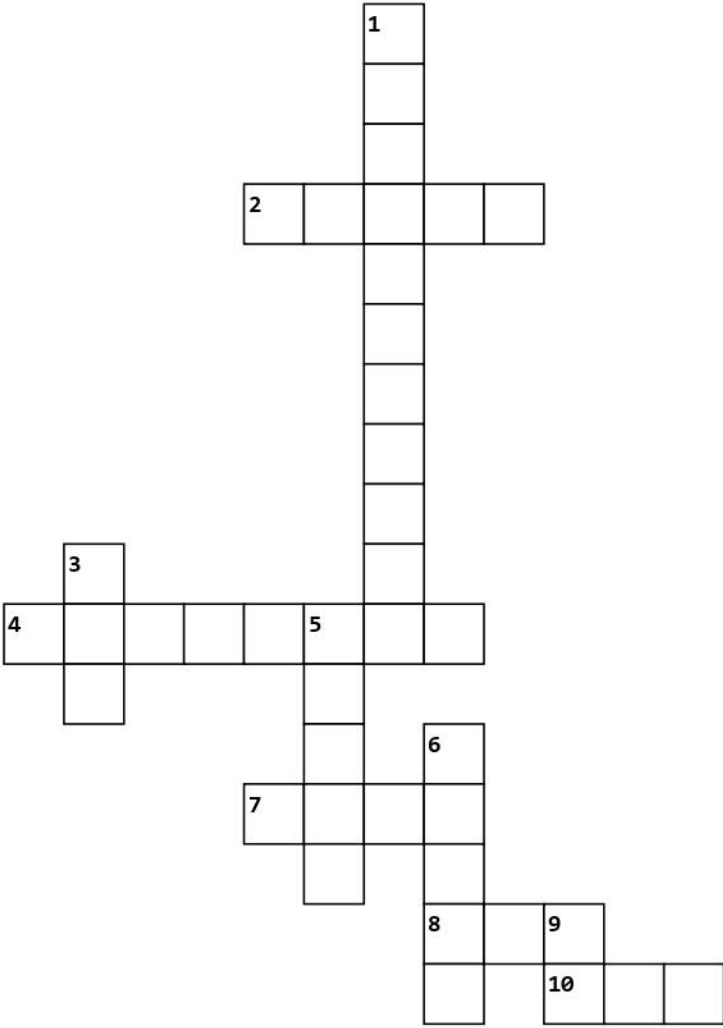
CONCLUSION

You should have observed in this simple experiment that an NPN and a PNP transistor can be used to make a Two-Transistor Audio Oscillator.

(End of Experiment 10)

CROSSWORD

Exp. 10 - "How a Two-Transistor Oscillator Works"



Across

- 2. How many resistors does this circuit use?
- 4. If you want to lower the tone frequency, you can _____ the value of R1 or C1.
- 7. The voltage needed to power this circuit is about ___ volts.
- 8. The human ear can hear from about _____ Hertz to about 16,000 Hertz.
- 10. How many capacitors does this circuit use?

Down

- 1. The value of the capacitor in this circuit is 0.1 _____.
- 3. This circuit uses an NPN and a _____ transistor.
- 5. This circuit emits an _____ tone.
- 6. This circuit produces a tone of about 500 _____?
- 9. Will the circuit work if you reverse the polarity of the battery leads?

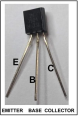
Exp. 10 - "How a Two-Transistor Oscillator Works"

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

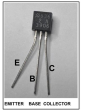
1. This two-transistor oscillator uses an NPN and a _____ transistor.
2. The _____ of the NPN transistor is connected to the BASE of the PNP transistor.
3. The EMITTER of the PNP transistor is connected to the BASE of the NPN through a capacitor.
4. If you reverse the polarity of the battery snap, the circuit will _____ work.
5. If you increase the value of capacitor C1, you will lower the _____ of the oscillator.
6. The tone, in this circuit, comes from the _____.
7. A frequency of 10 Hertz is the same as 10 _____ per second.
8. Both transistors used in the audio oscillator circuit are _____ transistors.
9. The resistors and capacitors make the transistors turn ON and _____.
10. Each of the transistors in this circuit has a EMITTER, BASE, and _____.



QUIZ for Exp 10 or STEM KIT #10 (Page 08) in the Mr Circuit Electronics Training Lab 1



This Quiz covers the training learned by completing



“How a Two-Transistor Oscillator Works” Experiment 10

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

A
B
C
D

#1 This two-transistor oscillator uses an NPN transistor and _____ .
A. an SCR
B. a PNP Transistor
C. a Diode
D. a Potentiometer

#6 In Exp. #10, how many transistors do we use to make an oscillator?
A. 5
B. 4
C. 3
D. 2

A
B
C
D

A
B
C
D

#2 In this two-transistor oscillator the Collector of transistor Q2 is connected to the Base of transistor Q1 through a _____ .
A. capacitor
B. resistor
C. wire
D. speaker

#7 The circuit in Exp. #10 generates a tone by turning the _____ on and off at an audio frequency.
A. capacitor
B. speaker
C. battery
D. capacitance

A
B
C
D

A
B
C
D

#3 In this two-transistor oscillator circuit, the Emitter of Q1 3904 is connected to the Base of transistor Q2 through a _____ ?
A. capacitor
B. resistor
C. wire
D. speaker

#8 Generally, an audio signal (one that can be heard by your ears) is in what frequency range?
A. 1 million to 10 million (cycles per second)Hz
B. 10 Hz to 16,000 Hz
C. 100 thousand Hz to 100 megahertz
D. zero to five Hz

A
B
C
D

A
B
C
D

#4 If we reverse the polarity of the battery snap on the circuit, what will happen?
A. The circuit will not work.
B. It will work just fine.
C. The transistors will burn out.
D. The speaker will self-destruct.

#9 In electronics, one Hz (Hertz) means one change per _____ or one cycle per _____ .
A. second, second
B. minute, minute
C. hour, hour
D. day, day

A
B
C
D

A
B
C
D

#5 What happens if we increase the value of resistor R1 in the circuit?
A. it will increase the frequency
B. it will make no change in frequency
C. it will cause the speaker to jam
D. it will lower the frequency

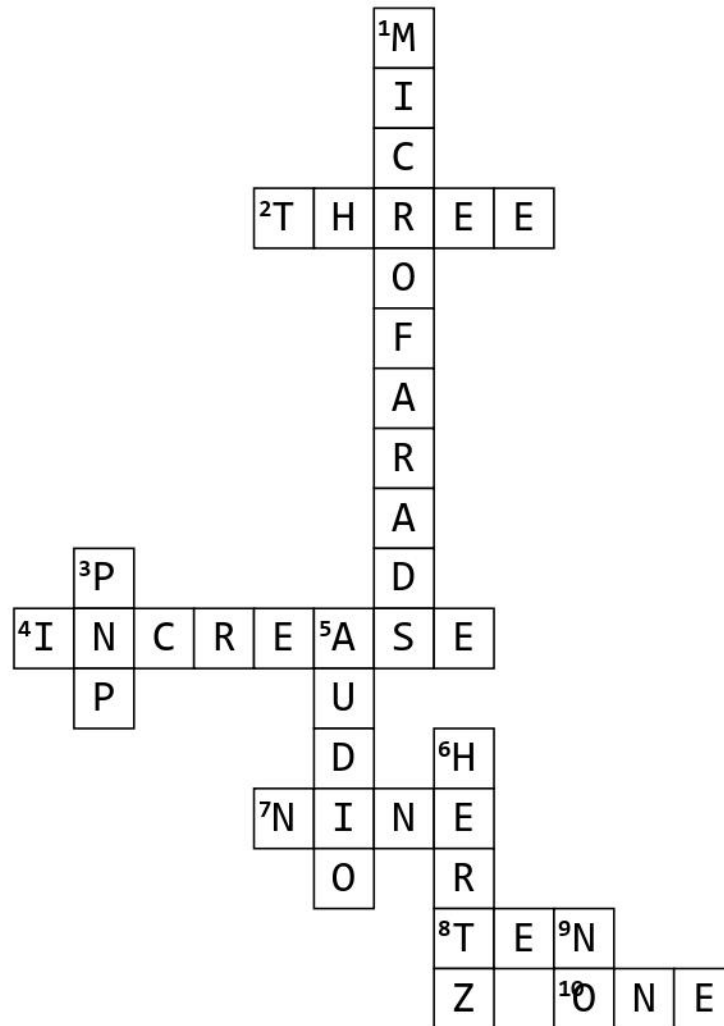
#10 What does the 10 Ohm resistor do in the circuit ?
A. increase the current through the speaker
B. vary the frequency of the oscillator
C. reduce current through the speaker
D. lower the frequency of the oscillator

A
B
C
D

Score	
-------	--

ANSWERS FOR CROSSWORD

Exp. 10 - "How a Two-Transistor Oscillator Works"



Across

- 2. How many resistors does this circuit use?
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- 10. How many capacitors does this circuit use?

Down

- 1. The value of the capacitor in this circuit is 0.1 _____.
- 3. This circuit uses an NPN and a _____ transistor.
- 5. This circuit emits an _____ tone.
- 6. This circuit produces a tone of about 500 _____?
- 9. Will the circuit work if you reverse the polarity of the battery leads?

ANSWERS FOR WORD SEARCH

Exp. 10 - "How a Two-Transistor Oscillator Works"

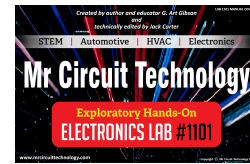
W	E	X	E	E	X	L	H	W	O	Q	G	T	N	T	N	E	T	Z	B
H	M	W	R	N	L	V	Q	B	J	G	J	S	S	D	W	U	I	F	J
N	I	B	R	S	K	V	Y	J	Q	B	F	P	R	J	E	Q	N	V	F
Z	T	I	R	L	Y	V	C	G	K	L	C	L	E	E	H	T	G	B	L
K	T	W	A	E	V	C	N	N	P	E	W	A	K	S	G	Q	G	W	S
X	E	K	L	C	V	J	E	P	M	E	S	V	A	J	X	T	B	G	S
W	R	G	O	V	C	Q	U	Q	R	R	G	E	Q	A	L	K	Y	V	
D	X	P	P	P	D	X	Q	W	L	O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

1. This two-transistor oscillator uses an NPN and a _____ transistor.
2. The _____ of the NPN transistor is connected to the BASE of the PNP transistor.
3. The EMITTER of the PNP transistor is connected to the BASE of the NPN through a capacitor.
4. If you reverse the polarity of the battery snap, the circuit will _____ work.
5. If you increase the value of capacitor C1, you will lower the _____ of the oscillator.
6. The tone, in this circuit, comes from the _____.
7. A frequency of 10 Hertz is the same as 10 _____ per second.
8. Both transistors used in the audio oscillator circuit are _____ transistors.
9. The resistors and capacitors make the transistors turn ON and _____.
10. Each of the transistors in this circuit has a EMITTER, BASE, and _____.

**QUICK-CHECK ANSWER KEY for Experiment 10 QUIZ
for Mr Circuit Electronics Training (“Two-Transistor Oscillator”)**

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.

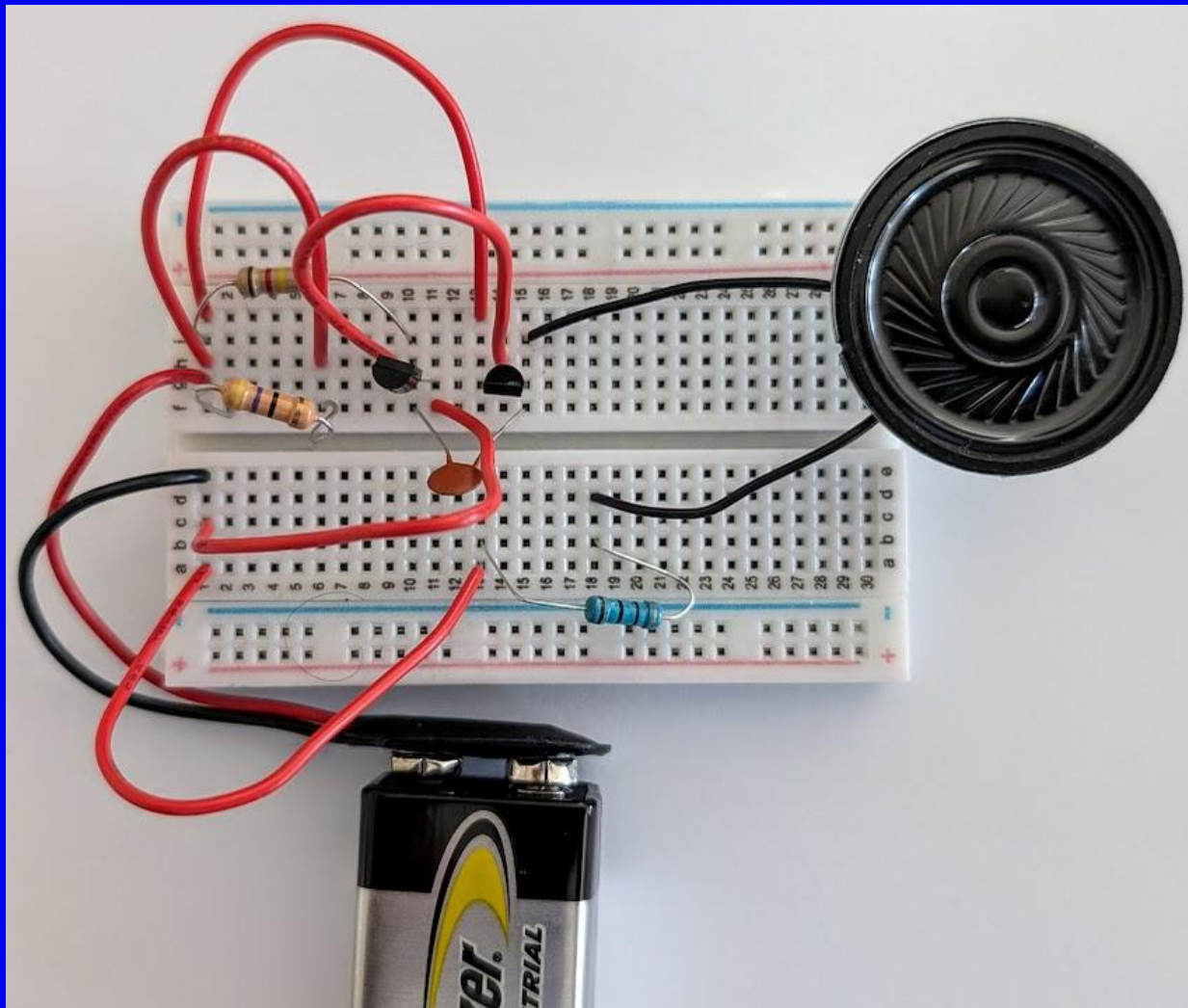
Count the right answers and record the score of right answers in your grade book.



A <input checked="" type="radio"/> B C D	#1 This two-transistor oscillator uses an NPN transistor and _____ . A. an SCR B. a PNP Transistor C. a Diode D. a Potentiometer	#6 In Exp. #10, how many transistors do we use to make an oscillator? A. 5 B. 4 C. 3 D. 2	A B C <input checked="" type="radio"/> D
A <input checked="" type="radio"/> B C D	#2 In this two-transistor oscillator the Collector of transistor Q2 is connected to the Base of transistor Q1 through a _____ . A. capacitor B. resistor C. wire D. speaker	#7 The circuit in Exp. #10 generates a tone by turning the _____ on and off at an audio frequency. A. capacitor B. speaker C. battery D. capacitance	A <input checked="" type="radio"/> B C D
A B <input checked="" type="radio"/> C D	#3 In this two-transistor oscillator circuit, the Emitter of Q1 3904 is connected to the Base of transistor Q2 through a _____ ? A. capacitor B. resistor C. wire D. speaker	#8 Generally, an audio signal (one that can be heard by your ears) is in what frequency range? A. 1 million to 10 million (cycles per second)Hz B. 10 Hz to 16,000 Hz C. 100 thousand Hz to 100 megahertz D. zero to five Hz	A <input checked="" type="radio"/> B C D
A <input checked="" type="radio"/> B C D	4 If we reverse the polarity of the battery snap on the circuit, what will happen? A. The circuit will not work. B. It will work just fine. C. The transistors will burn out. D. The speaker will self-destruct.	#9 In electronics, one Hz (Hertz) means one change per _____ or one cycle per _____ . A. second, second B. minute, minute C. hour, hour D. day, day	<input checked="" type="radio"/> A B C D
A B C <input checked="" type="radio"/> D	#5 What happens if we increase the value of resistor R1 in the circuit? A. it will increase the frequency B. it will make no change in frequency C. it will cause the speaker to jam D. it will lower the frequency	#10 What does the 10 Ohm resistor do in the circuit ? A. increase the current through the speaker B. vary the frequency of the oscillator C. reduce current through the speaker D. lower the frequency of the oscillator	A B <input checked="" type="radio"/> C D

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A TWO-TRANSISTOR OSCILLATOR

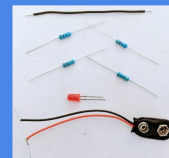


BASIC ELECTRONICS LAB 1

“HOW A TWO-TRANSISTOR OSCILLATOR WORKS”

(Poster MC1-10-P01)

(Page 12)



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PARTS KIT	Mr Circuit Series 1	Price
Number	SCIENCE / ELECTRONICS "PARTS KITS"	Each
MC1-00-PK	Solderless Circuit Board to build kits	\$3.95
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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