SNAP CIRCUITS®

TEACHER GUIDE

FOR ELECTRONIC SNAP CIRCUITS®
MODEL SC-300R/500R/750R

Hands-on Program for Basic Electricity and Electronics

Prepared by the Educational Division of

ELENCO®
Learn by doing.

REV-D 753290

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INTRODUCTION & IMPORTANT INFORMATION

This educational version of the popular Snap Circuits® product is a tool for opening the exciting world of electronics. Following the Learn by Doing® concept, electronics will be easy for students to understand by using Snap Circuits® to build circuits as they learn about them. The Student Guide emphasizes the practical applications of electronics, without bogging down in mathematics. This course is as much about science as about electronics.

Why should students learn about electronics? Electronics plays an important and increasing role in their everyday lives, and so some basic knowledge of it is good for all of them. Learning about it teaches how to do scientific investigation, and the projects develop basic skills needed in today's world.

This product is intended for use at grades 4-12 in elementary, middle, and high schools. The only prerequisite is basic reading skills, however the material in the later chapters may not be suitable for or of interest to all students at the lower grade levels.

This course may be easily broken into several parts. Chapters 1-3 teach the basic electricity knowledge that everyone needs, this would be excellent for all students. Chapters 4-8 are an introduction to electronics covering topics like transistors, integrated circuits, and radio; this will stimulate a student's interest in this field.

If the students have model SC-100R then they have one project manual and the parts needed to build all the circuits referenced in the SC-100R Student Guide. If the students have model SC-300R then they have two project manuals and the parts needed to build all the circuits referenced in chapters 1-8 of the Student Guide. Purchase the UC-50 or UC-70 Upgrade Kit to do Parts II and III (see page 30).

If the students have model SC-500R, then they also have a third project manual and the parts needed to build all the circuits referenced in chapters 1-11 of the Student Guide. This expands the student's electronics knowledge with topics like meters, transformers, digital displays, and relays. Purchase the UC-80 Upgrade Kit to do Part III (see page 30).

If the students have model SC-750R, then they also have a fourth project manual, a CI-73 Computer Interface manual, and the parts needed to build all the circuits referenced in the Student Guide. This expands the student's knowledge with topics like electromagnetism and solar cells. If a personal computer is available, it can be used to show what electrical signals look like and learn about the tools used to study them.

Much of the text in all chapters is color-coded so that instructors can easily adapt the course based on the skills and interests of the students. Blue shading is the basic lesson and green shading is basic experiments. The orange-shaded boxes are more advanced material while the brown-shaded boxes are considered additional/background material, either can generally be omitted without a significant impact on the course. Chapter previews and summaries are gray-shaded, and yellow shading introduces new parts.

It is estimated that each chapter will take an average of four classroom sessions to complete, but this varies depending on the grade level of the students, the setup of the classroom/lab, how many students are working together, how much teacher instruction is involved, whether any reading is done outside of class, and the length of the sessions. Some chapters will take more or less time than others.

The table of contents in the Student Guide is the recommended curriculum to follow, it is reprinted in this book along with the main topics of each chapter and the circuit project #s associated with each section.

THE SNAP CIRCUITS® PROJECT MANUALS

The Snap Circuits® project manuals include lots of useful information in addition to the projects themselves, as listed below. The Student Guide provide an orderly lesson in electronics, slowly introducing new components and circuits of increasing complexity.

The project manuals summarize much of the lesson in the Student Guide while adding troubleshooting information. Model SC-100R contains one project manual, Model SC-300R contains two, Model SC-500R contains three, and Model SC-750R contains four.

First Project Manual contains:

1. Parts List (partial, continued in second manual)
2. **How To Use It** - brief description of how to make connections and understand the circuit drawings.
3. **About Your Snap Circuits® Parts** - brief description of what each component does (partial, continued in second manual).
4. **DO's and DON'Ts of Building Circuits** - brief but important guidelines for building circuits (additional guidelines are in second manual).
5. **Basic & Advanced Troubleshooting** - systematic testing procedure for identifying damaged parts (continued in second manual).
6. Project Listing
7. Projects 1-101

Other Project Manuals contain:

1. Parts List (partial, continued from first manual)
2. **How To Use It** - brief description of how to make connections and understand the circuit drawings.
3. **About Your Snap Circuits® Parts** - brief description of what each component does (partial, continued from first manual).
4. **DO's and DON'Ts of Building Circuits** - brief but important guidelines for building circuits.
5. **Basic & Advanced Troubleshooting** - systematic testing procedure for identifying damaged parts (continued from first manual).
6. Project Listing
7. Projects 102-305 (2nd manual), Projects 306-511 (3rd manual), or Projects 512-692 (4th manual)

INSTRUCTOR PREPARATION/ORGANIZATION

- Determine what the learning environment will be. Will the students be learning independently or in small groups? How much teacher instruction will there be for each section? Will the students be reading the lesson as homework and then have limited teacher instruction before performing the experiments? Decide when quizzes will be given and how they will be organized.
- Allocate time within the session as needed for:
    - Teacher instruction about the topics being covered during the session.
    - Getting the Snap Circuits® components into the workspace.
    - Teacher instruction about the specific projects to be performed during that session.
    - Building and testing the circuits.
    - Performing experiments (and teacher verification if desired).
    - Dismantling the circuits and returning Snap Circuits® components to storage area.
    - Reassembling the class for review.
- Make sure the students know their objectives for the day, how much time they will need for cleanup, and where the materials are being stored.
- Students must understand that there are usually many ways of making the same circuit, and that the instructor may not know all the answers. They are doing scientific investigation, and many circuit projects suggest variations to experiment with.
- Have students review the DO's and DON'Ts of Building Circuits on pages 4-5 of the project manuals at the beginning of each session (this is more comprehensive in the higher project manuals).

The following is the table of contents from the SC-100R Student Guide, with the main topics and circuit projects associated with each section highlighted. This will help you plan your lessons.

TABLE OF CONTENTS for SC-100R STUDENT GUIDE

Preface

Chapter 1: Basic Components & Circuits - *Introduces electricity with the components and circuit types listed here. By building circuits using Snap Circuits®, students begin to understand the electrical world.*

- 1-1 Electricity
- 1-2 Wires
- 1-3 Batteries
- 1-4 Switches
- 1-5 Lamps
- 1-6 Base Grid - *project 1 is discussed*
- 1-7 Series and Parallel circuits - *two mini-circuits are discussed*
- 1-8 Short Circuits
- 1-9 Solder
- 1-10 Schematics
- Summary & quiz

Chapter 2: Motors & Electricity - *Students learn how electricity and magnetism are used in motors and generators, about the electricity that runs their homes, and about lightning.*

- 2-1 Motors - *project 2 is discussed*
- 2-2 Motor circuits - *projects 5, 6, 80, 11, 12, 13 are discussed*
- 2-3 Fuses - *project 14 is discussed*
- 2-4 Your electric company - *projects 55 and 56 are discussed*
- 2-5 Static Electricity
- 2-6 Types of lamps
- 2-7 Types of switches
- 2-8 Electricians
- Summary & quiz

Chapter 3: Resistance - *Students learn how resistors are used to limit and control the flow of electricity. They also learn the basic rules for understanding circuits, and receive an introduction to digital electronics.*

- 3-1 Resistors
- 3-2 LEDs - *projects 7 and 8 are discussed*
- 3-3 The Photoresistor - *one mini-circuit is discussed*
- 3-4 Resistors in series and parallel - *three mini-circuits* are discussed
- 3-5 Resistance - *project 9 is discussed*
- 3-6 Resistance of water - *projects 98 and 99 are discussed*
- 3-7 Introduction to logic - *projects 47, 48, 49, 50 are discussed*
- 3-8 Digital electronics
- Summary & quiz

Chapter 4: Capacitors - *Students learn how electricity makes sound. They also learn about the integrated circuit modules included in Snap Circuits® and what is inside them. They have the opportunity to use ICs in many types of circuits.*

- 4-1 Electronic Sound - *three mini-circuits are discussed*
- 4-2 Whistle Chip - *one mini-circuit is discussed*
- 4-3 The ICs in Snap Circuits®
- 4-4 Description of all projects using ICs
  No projects are discussed in detail here but projects 38, 51, 58, 61, 81, and 83 are recommended.
- Summary & quiz

Summary of Components

Glossary

For Further Reading

The following is the table of contents from the SC-300R, SC-500R, & SC-750R Student Guide, with the main topics and circuit projects associated with each section highlighted. This will help you plan your lessons. If the students have Model SC-300R, then they have the parts needed to build all the circuits referenced in Part I. If they have Model SC-500R, then they have the parts needed to build all the circuits referenced in Parts I & II. If they have Model SC-750R, then they can build all circuits referenced.

TABLE OF CONTENTS for SC-300R, SC-500R, & SC-750R STUDENT GUIDE

Preface

PART I

Chapter 1: Basic Components & Circuits - *Introduces electricity with the components and circuit types listed here. By building circuits using Snap Circuits®, students begin to understand the electrical world.*

- 1-1 Electricity
- 1-2 Wires
- 1-3 Batteries
- 1-4 Switches
- 1-5 Lamps
- 1-6 Base Grid - *project 1 is discussed*
- 1-7 Series and Parallel circuits - *projects 152, 153 are discussed*
- 1-8 Short Circuits
- 1-9 Solder
- 1-10 Schematics
- Summary & quiz

Chapter 2: Motors & Electricity - *Students learn how electricity and magnetism are used in motors and generators, about the electricity that runs their homes, and about lightning.*

- 2-1 Motors - *project 2 is discussed*
- 2-2 Motor circuits - *projects 5, 6, 80, 262, 11, 12, 13 are discussed*
- 2-3 Fuses - *project 14 is discussed*
- 2-4 Your electric company
- 2-5 Static Electricity
- 2-6 Types of lamps
- 2-7 Types of switches
- 2-8 Electricians
- Summary & quiz

Chapter 3: Resistance - *Students learn how resistors are used to limit and control the flow of electricity. They also learn the basic rules for understanding circuits, and receive an introduction to digital electronics.*

- 3-1 Resistors
- 3-2 LEDs - *projects 7, 8, 102, 276 are discussed*
- 3-3 Resistors in series and parallel - *project 173 is discussed*
- 3-4 Resistance - *project 9 is discussed*
- 3-5 Adjustable resistor - *project 172 is discussed*
- 3-6 Photoresistor - *project 272 is discussed*
- 3-7 Resistance of water - *projects 166, 167 are discussed*
- 3-8 Introduction to logic - *projects 47, 48, 49, 50 are discussed*
- 3-9 Digital electronics
- Summary & quiz

Chapter 4: Capacitors - *Students learn about the different types of capacitors, how they store electric charge, and how they are used in circuits.*

4-1 Capacitors

4-2 Capacitor circuits - *projects 203, 235 are discussed*

4-3 Capacitors in series and parallel - *projects 165, 164, 296 are discussed*

Summary & quiz

Chapter 5: Transistors - *Students learn how transistors have changed their lives, how they work, and how they are used in many types of circuits.*

5-1 More about LEDs

5-2 Transistors

5-3 Transistor basics - *projects 215, 124, 125, 128, 129, 130, 131, 253 are discussed*

5-4 More transistor circuits - *projects 107, 261, 256, 252, 300, 302, 263, 225 are discussed*

5-5 Human resistor - *projects 246, 247 are discussed*

5-6 Motor as generator - *project 118 is discussed*

5-7 Microphone - *projects 273, 109 are discussed*

Summary & quiz

Chapter 6: Oscillators and Electronic Sound - *Students learn how electricity makes sound. They learn about oscillator circuits, and build some.*

6-1 Electronic sound

6-2 Oscillators - *projects 259, 236 are discussed*

6-3 Whistle chip - *project 199 is discussed*

6-4 Oscillator circuits - *projects 197, 198, 228, 185, 294 are discussed*

Summary & quiz

Chapter 7: Integrated circuits - *Students learn about the integrated circuit modules included in Snap Circuits® and what is inside them. They also have the opportunity to use them in many types of circuits.*

7-1 The ICs in Snap Circuits®

7-2 Description of all projects using ICs

No projects are discussed in detail here but projects 38, 51, 58, 61, 81, 83, 119, 158, 178, 202, 237, 238, 242, 245, 250, 255, 272, 297 are recommended.

Summary & quiz

Chapter 8: Electromagnetism and Radio - *Students learn how antennas are used to send radio signals through the air, how modulation is used to encode the information being sent, and about transformers. They build some radio circuits to demonstrate these concepts.*

8-1 AC - *projects 55, 56 are discussed*

8-2 Transformers

8-3 Inductance and antennas

8-4 Radio - *project 258 is discussed*

8-5 Radio circuits - *projects 242, 213 are discussed (and 198 in some manuals)*

Summary & quiz

Part II (Models SC-500R & SC-750R only)

Chapter 9: Meters, Transformers, & FM Radio - *Students learn how meters are used to measure current and voltage, about transformers and their magnetic properties, how transformers are used in oscillator circuits, about FM radio receivers, and learn how wires act as components at high frequencies.*

- 9-1 Meters
- 9-2 Meter Circuits - *projects 323-327, 506, and 508 are discussed*
- 9-3 More About Transformers - *projects 340, 358, and 359 are discussed*
- 9-4 Transformers in Oscillators - *project 477 and five new circuits are discussed*
- 9-5 More About FM Radio - *project 307 is discussed*
- 9-6 When Wires Are Not Wires
- Summary & quiz

Chapter 10: Diodes & Applications - *The chapter teaches about different types of diodes. Students are also introduced to electronic memory and recording circuits.*

- 10-1 More About Diodes - *projects 360, 487, and three new circuits are discussed*
- 10-2 Digital Displays - *projects 329, 330, 396, and 488 are discussed*
- 10-3 Recording IC - *projects 384 and 428 are discussed*
- Summary & quiz

Chapter 11: Electronic Switches - *Students learn about two types of electronic switches, relays and silicon controlled rectifiers. The course conludes with some basic principles for analyzing circuits.*

- 11-1 Relays - *projects 341-346, 353, 354, and 431 are discussed*
- 11-2 Silicon Controlled Rectifiers - *project 328 and two new circuits are discussed*
- 11-3 Voltage Dividers & Current Dividers
- Summary & quiz

Part III (Model SC-750R only)

Chapter 12: Electromagnetism - *Students learn about magnetic fields and how electricity can make a magnet. They build circuits to show how electricity can use magnetism to move things, and control magnetic fields in ways ordinary magnets can't. They also learn more about motors and capacitors.*

- 12-1 Magnetism
- 12-2 An Electronic Magnet
- 12-3 Magnetic Fields - *projects 660-665 and a mini-circuit are discussed*
- 12-4 Electromagnet Oscillators - *projects 666, 669, 674, and 683 are discussed*
- 12-5 The Anti-Capacitor - *projects 531, 535, and 658 are discussed*
- 12-6 More About Motors - *projects 536 and 617 are discussed*
- Summary & quiz

Chapter 13: Sun Power - *Students learn about solar energy, the benefits of it to our society, and how solar cells work. Circuits demonstrate the applications for solar electricity and the limitations of it.*

- 13-1 Born in the Space Program
- 13-2 How Your Solar Cell Works - *projects 549 and 555 are discussed*
- 13-3 More Solar Circuits - *projects 548, 550, and 559-561 are discussed*
- 13-4 Our Solar Future
- Summary & quiz

Chapter 14: More Circuits & New Ways to Look at Them - *This chapter shows many of the diverse ways electricity is used, while reviewing what the students have learned. It also gives an introduction to the Snap Circuits® computer interface, which shows what electrical signals look like by simulating an oscilloscope and spectrum analyzer. Students see the benefits and limitations of using a computer to store measurements.*

14-1 Vibration Switch - *projects 684, 689, and 692 are discussed*

14-2 Other Applications - *many circuits are summarized, and projects 542-547 are recommended*

14-3 The Snap Circuits® Computer Interface - *one new circuit is discussed*

Summary & quiz

Summary of Components

Glossary

QUESTIONS FOR QUIZZES

Chapter 1

1.1 Which of the following statements is false?

A. Electricity is closely related to magnetism.

B. Electricity is an attraction and repulsion between small particles in a material.

C. Electricity is stronger than gravity because its effects are never balanced out.

D. Electricity can be created by pressure, chemistry, light, friction, and magnetism.

1.2 Which of these products is electrical but not electronic?

A. Something using transistors and capacitors.

B. Drill

C. Computer

D. Radio

1.3 Which of the following statements is false?

A. Wire length and size never matter.

B. Wires are made of metals like copper.

C. Wires offer low resistance to the flow of electricity.

D. Most wires have a colored coating for protection and identification.

1.4 An electrical ground is . . .

A. the bottom point on which circuits are constructed.

B. the 0V or "–" side of a battery or other voltage source, sometimes connected to lightning rods.

C. a board used as a frame for building circuits.

D. All of the above.

1.5 Advantages of printed circuit boards include . . .

A. metal strips are "printed" on the surface to make interconnections.

B. they are a stable platform for mounting components.

C. they allow circuits to be made smaller and less expensive.

D. All of the above.

1.6 Which of the following would all be connected in series?

A. A lamp and a switch on the wall controlling it.

B. Two lamps in a room controlled by the same switch.

C. Two lamps in different rooms of a house.

D. The air conditioner and microwave oven in your home.

1.7 Which of the following would all be connected in parallel?

A. A lamp and a switch on the wall controlling it.

B. The streetlamps in your neighborhood.

C. A string of inexpensive Christmas lights that all go out if one bulb is loose.

D. None of the above.

1.8 It is better to connect lamps in a parallel circuit configuration when . . .

A. the power source can supply enough current but not enough voltage to light them all.

B. if one bulb burns out, you want the others to still light.

C. you are also adding switches to control each lamp separately.

D. All of the above.

1.9 A short circuit is . . .

A. a special condition that improves circuit performance in most cases.

B. an accidental no-resistance path between different parts of a circuit.

C. the shortest wiring path between two points in a circuit.

D. All of the above.

1.10 Solder is . . .

A. glue that holds components in place, it resists the flow of electricity.

B. always applied by hand.

C. a metal that is melted to make solid electrical connections.

D. a special metal made of copper and other alloys that melts at a low temperature.

1.11 Draw the schematic for a circuit using a battery set and slide switch to control three 2.5V lamps, if one of the bulbs burns out the others must still work.

1.12 Draw the schematic for a circuit using two sets of batteries to power two 6V lamps, each lamp must have a separate slide switch controlling it.

1.13 Draw the schematic for a circuit using a battery set and three slide switches to control a 2.5V lamp, the lamp should be on if any switch is on.

1.14 Draw the schematic for a circuit using a battery set and three slide switches to control a 2.5V lamp, the lamp should be off if any switch is off.

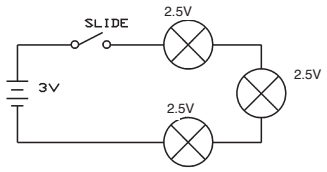
1.15 Which of these circuits has the three lamps connected in parallel?

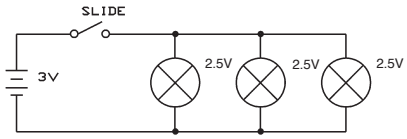
A. Top only

B. Bottom only

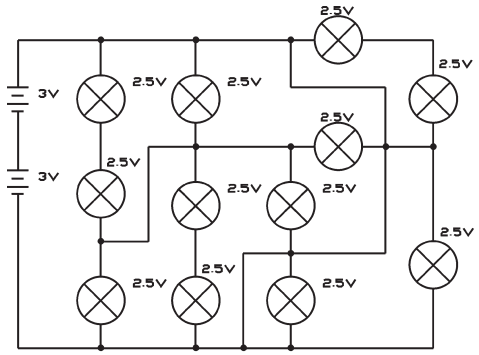
C. Both

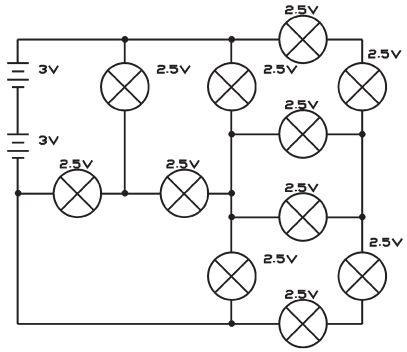
D. Neither





1.16 Which of these circuits is a short circuit?

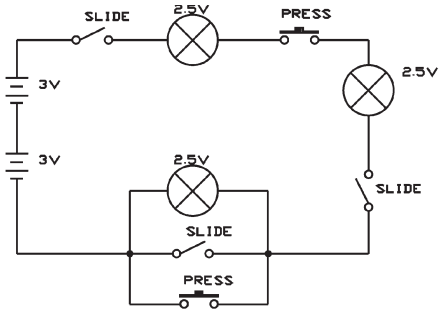


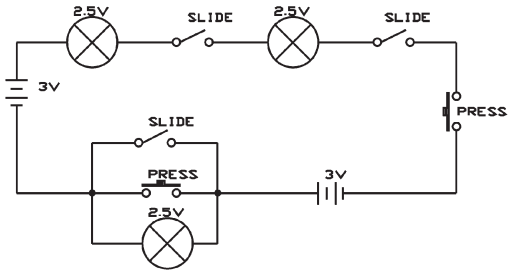


A. Top only C. Both

B. Bottom only D. Neither

1.17 Will these circuits work the same?





A. Yes

B. No

C. Depends on which switches are closed.

D. Impossible to tell from these schematics.

1.18 The two basic ways of arranging parts in a circuit are in series and in parallel, all large circuits are made up of combinations of these.

TRUE or FALSE?

1.19 At its most basic level, electricity is an attraction and repulsion between sub-atomic particles within a material.

TRUE or FALSE?

1.20 Voltage is a measure of how fast electricity is flowing in a wire.

TRUE or FALSE?

Chapter 2

2.1 What is the most important benefit of electricity?

A. Energy can be easily transported.

B. Radio communication.

C. Television.

D. The Internet.

2.2 How does a generator work?

A. An electric current in a coil of wire creates a current in another coil through magnetism.

B. The magnetic field from an electric current in a coil of wire spins a magnet.

C. Pressurized water or steam spins a magnet, creating an electric current in a coil of wire around it.

D. Electricity creates mechanical motion.

2.3 A circuit uses batteries to run a motor with fan. How could you reduce the speed of the motor?

A. Using more batteries to increase the voltage.

B. Place a lamp in series with the motor to reduce the voltage to it.

C. Remove the fan from the motor.

D. None of the above.

2.4 A circuit uses batteries to run a motor with fan. How could you reverse the direction of airflow?

A. Place a lamp in parallel with the motor.

B. Place a switch in series with the motor.

C. Reverse the batteries.

D. None of the above.

2.5 Which product would probably NOT have a fuse?

A. Hand-held radio or CD player.

B. Electric saw.

C. Tabletop stereo/radio/CD player.

D. Microwave oven.

2.6 What is the voltage at the electrical outlets in your home?

A. 5V

B. 12V

C. 60V

D. 120V

2.7 When clothes cling together due to static electricity, they are . . .

A. storing a large electrical charge at a low voltage.

B. storing a small electrical charge at a high voltage.

C. storing a large electrical charge at a high voltage.

D. storing a small electrical charge at a low voltage.

2.8 Why do incandescent light bulbs have a glass bulb?

A. To prevent the filament from reacting with oxygen and burning up.

B. To protect people if the filament explodes.

C. To protect the copper in the filament.

D. The glass looks nicer.

2.9 Which of the following would NOT cause a blackout?

A. A problem in the electrical distribution network cuts off electricity to part of a city.

B. All the lights in a city are turned off at night to confuse attacking bombers during a war.

C. The power company reduces the voltage it supplies when unable to supply enough current.

D. A storm damages the electrical distribution network in a city.

2.10 Why do local governments have building codes regulating the electrical wiring of buildings?

A. To make money for the government through building permit fees.

B. To ensure the building will be safe after many years and different owners.

C. To ensure local electricians will always have jobs.

D. To meet standards imposed by the local power companies supplying the electricity.

Chapter 3

3.1 Which statement applies to LEDs?

A. They can be used with very high currents.

B. They have a turn-on threshold of about 5V that must be exceeded before current can flow.

C. They block the flow of electricity in one direction.

D. They appear brightest when viewed from the side.

3.2 Placing resistors in _____ increases the total resistance while placing them in _____ decreases total resistance.

A. parallel; series

B. series; ohm

C. watt; kirchhoff

D. series; parallel

3.3 Which of these is Ohm's Law?

A. Current equals Power divided by Resistance.

B. Current equals Voltage divided by Resistance.

C. Voltage equals Current divided by Resistance.

D. All current flowing into a point must flow out of it.

3.4 Kirchhoff's Laws are . . .

A. a basic set of rules for analyzing circuits.

B. variations of Ohm's Law.

C. a method of calculating the total resistance of resistors in series and in parallel.

D. a method of marking resistors with colored bands for easy identification.

3.5 Electrical power is . . .

A. calculated by multiplying the voltage and current together.

B. a measure of how much energy is moving through a wire.

C. expressed in Watts.

D. All of the above.

3.6 Which of these statements about resistors is wrong?

A. Resistors get warm because they convert electrical energy into heat.

B. They are made from materials like tin and lead.

C. Resistance is friction between an electric current and the material it is moving through.

D. Resistors control and limit the flow of electricity.

3.7 Copper is a good _____ while paper is a good _____.

A. resistor; conductor

B. insulator; conductor

C. conductor; insulator

D. semiconductor; insulator

3.8 Nearly all electricity eventually becomes . . .

A. heat.

B. information.

C. garbage.

D. chemical energy.

3.9 Which has the least resistance?

A. Air.

B. Distilled water.

C. Salt water.

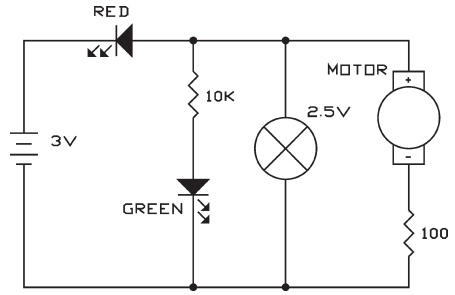
D. Drinking water.

3.10 Draw the schematic for a circuit using a battery set, an LED, and two 1KΩ resistors. The total resistance in the circuit must be less than 1KΩ, and the LED must light.

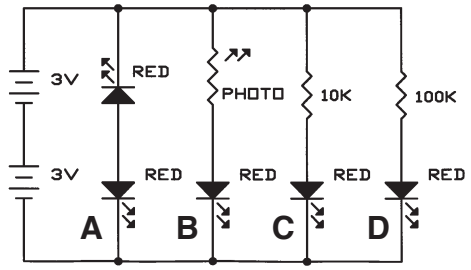
3.11 Draw the schematic for a circuit using a battery set, an LED, and three 1KΩ resistors. The total resistance in the circuit must be greater than 2KΩ, and the LED must light.

3.12 Draw the schematic for a circuit using a battery set, an LED, a slide switch, a 100Ω resistor, and a 1KΩ resistor. The LED must always light and must never have less than 100Ω in series with it. The slide switch should used to adjust the LED brightness, brighter if the switch is on.

3.13 What will this circuit do?

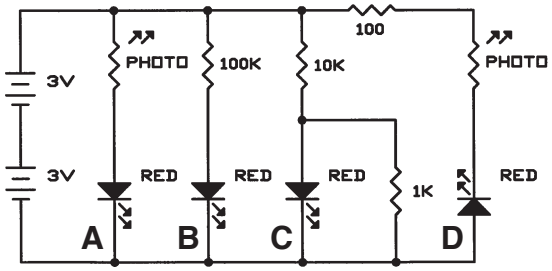


A. Light the LED.
B. Light the lamp.
C. Spin the motor.
D. Nothing.



3.14 Which LED will be brightest in a dark room?

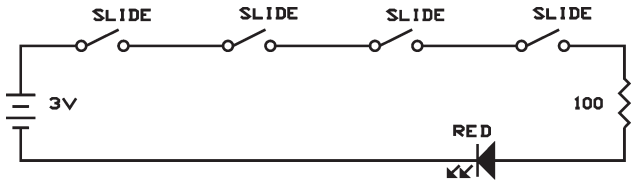
A. LED A
B. LED B
C. LED C
D. LED D



3.15 In a bright room which LED will be brightest?

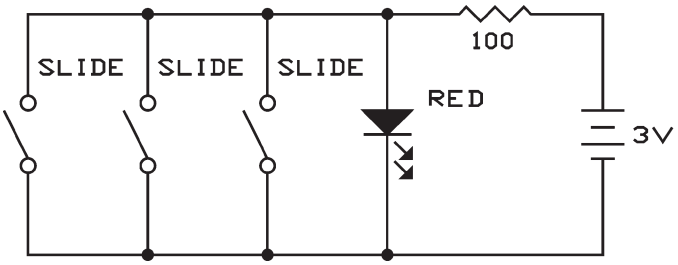
A. LED A
B. LED B
C. LED C
D. LED D

3.16 What type of logic circuit is this?



A. OR
B. AND
C. NAND
D. NOR

3.17 What type of logic circuit is this?



A. OR
B. AND
C. NAND
D. NOR

3.18 Digital electronics . . .

A. uses computers to process electronic information.
B. uses a series of numbers to represent an electronic signal.
C. always gives better performance at lower cost.
D. always has a display with at least one digit.

3.19 The accuracy of a digital representation of a signal depends on . . .

A. the speed of the microprocessor in the computer.
B. the voltages used in the measurement.
C. how accurately and how often the original signal was measured.
D. the complexity of the circuit.

3.20 Which of these is the name of a circuit that is a basic building block in computers, made up of transistors?

A. NEVER
B. ALWAYS
C. SOMETIMES
D. AND

Chapter 4 (SC-100R ONLY)

4.1 How does a speaker create sound waves?

A. A changing signal through a coil makes a magnet vibrate, creating variations in air pressure.

B. A changing signal through a coil creates variations in air pressure.

C. An unchanging signal through a coil makes a magnet vibrate, creating variations in air pressure.

D. A resistor is changed in value, creating sound waves.

4.2 Which has the lowest frequency?

A. Raindrops during a thunderstorm.

B. Planes taking off at a busy airport.

C. Christmas.

D. The seconds hand passing 12 on a clock.

4.3 The range of frequencies that can be heard by the human ear are called the _____ range.

A. radio

B. audio

C. microwave

D. sub-sonic

4.4 Which of these are advantages of integrated circuits?

A. Cost

B. Size

C. Reliability

D. All of the above.

4.5 Sound waves are variations in electric current created by mechanical vibrations.

TRUE or FALSE?

4.6 If you are increasing the pitch of a sound, then you must be decreasing its frequency.

TRUE or FALSE?

4.7 Frequency is measured in Hertz.

TRUE or FALSE?

4.8 The average American home has fewer than five integrated circuits used throughout all the electronic products in it.

TRUE or FALSE?

4.9 The integrated circuits in some modern computers have more than a million transistors in them.

TRUE or FALSE?

4.10 Integrated circuit manufacturing is so specialized that particles of dust can ruin parts.

TRUE or FALSE?

Chapter 4 (SC-300R, SC-500R, SC-750R ONLY)

4.1 Capacitors . . .

A. store electric charge.

B. can isolate parts of a circuit while letting signals move between them.

C. have metal plates separated by dielectric materials.

D. All of the above.

4.2 Capacitance is a measure of a capacitor's . . .

A. capacity for storing electric charge.

B. ability to withstand electrical pressure.

C. electromagnetic induction.

D. quantity of metal-dielectric layers.

4.3 Why are batteries better at storing electricity than capacitors?

A. Batteries store magnetic energy while capacitors store electrical energy.

B. Batteries store chemical energy while capacitors store electrical energy.

C. Batteries are always larger.

D. Higher quality materials are used in batteries, and batteries cost more.

4.4 How do capacitors combine when placed in series or in parallel?

A. When capacitors are in series, total capacitance decreases.

B. When capacitors are in parallel, total capacitance increases.

C. Opposite to how resistors combine.

D. All of the above.

4.5 What determines how long it takes to charge or discharge a capacitor?

A. The resistance and capacitance in the charge/discharge paths.

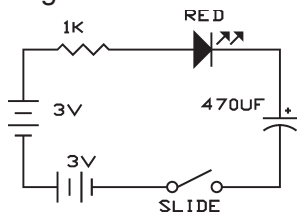
B. The voltage that is charging the capacitor.

C. The capacitance in the charge/discharge paths.

D. The resistance in the charge/discharge paths.

4.6 Draw the schematic for a circuit to charge up a 100μF capacitor to 3V, using as few parts as possible.

4.7 How could you change this circuit so the LED stays on longer after the switch is turned on?



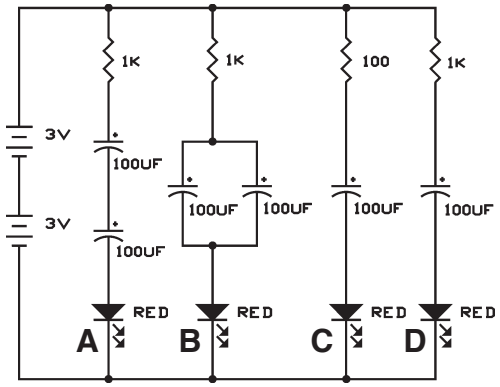
A. Place a second capacitor in series with the first.

B. Place a second capacitor in parallel with the first.

C. Decrease the resistor value.

D. Decrease the capacitor value.

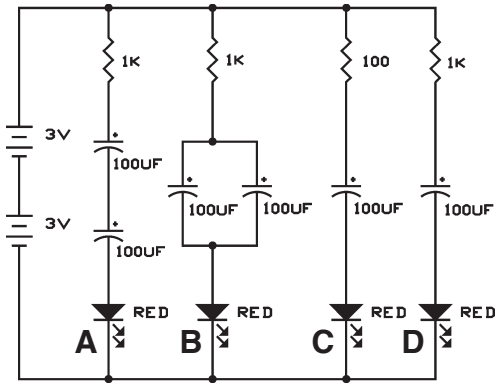
4.8 When the circuit is turned on, which LED will be brightest in the first moment?



A. LED A C. LED C

B. LED B D. LED D

4.9 In the circuit for problem 4.8, which LED will stay lit the longest?



A. LED A C. LED C

B. LED B D. LED D

4.10 Capacitance is measured in _____.

A. Farads C. Henrys

B. Ohms D. Watts

Chapter 5

5.1 What is the key advantage of semiconductors?

A. Their resistance can be decreased depending on their operating conditions.
B. They can be miniaturized.
C. They are made from inexpensive materials.
D. They are used in computers.

5.2 How do transistors work?

A. They are like one-way low-current resistors.
B. They are resistance amplifiers.
C. They are voltage amplifiers.
D. They use a small current to control a larger current.

5.3 What happens when the turn-on voltage level is exceeded on a semiconductor?

A. The resistance becomes very low in all directions.
B. The resistance becomes very low in one direction.
C. The voltage increases across it.
D. The semiconductor is damaged.

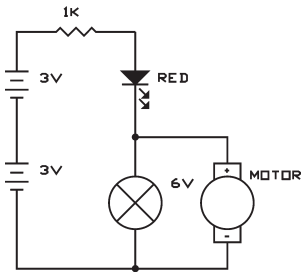
5.4 In an NPN transistor a small _____ current controls a larger _____ current.

A. Collector-emitter; base-emitter.
B. Emitter-base; emitter collector.
C. Base-emitter; collector-emitter.
D. Base-collector; base-emitter.

5.5 The microphone acts like a _____ that changes when exposed to sound waves.

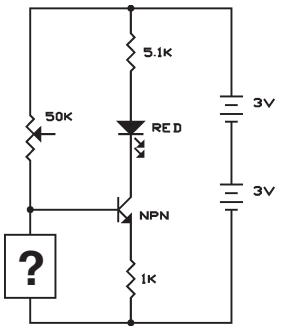
A. Capacitor
B. Transistor
C. Speaker
D. Resistor

5.6 What will this circuit do?



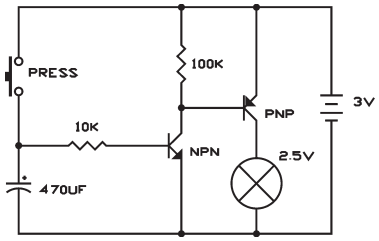
A. Light the LED and spin the motor.
B. Light the LED only.
C. Light the LED and lamp.
D. Light the lamp and spin the motor.

5.7 Which component can be placed in the ? box so the LED is bright?



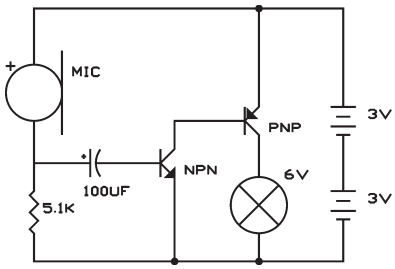
A. 0.02μF capacitor.
B. Jumper wire.
C. 100Ω resistor.
D. 1KΩ resistor.

5.8 What does the 470μF capacitor do in this circuit?



A. It has no effect.
B. It makes the lamp brighter.
C. It turns on the lamp as soon as the switch is pressed.
D. It keeps the lamp on for a few seconds after the press switch is released.

5.9 What effect would blowing on the microphone have on this circuit?



A. Turn off the lamp for a few seconds.
B. Increase the brightness of the lamp.
C. Turn on the lamp for a few seconds.
D. Reduce the brightness of the lamp.

5.10 What was the transistor originally developed to replace?

A. Diode
B. Vacuum Tube
C. Collector
D. Silicon

Chapter 6

6.1 How does a speaker create sound waves?

A. A changing signal through a coil makes a magnet vibrate, creating variations in air pressure.

B. A changing signal through a coil creates variations in air pressure.

C. An unchanging signal through a coil makes a magnet vibrate, creating variations in air pressure.

D. A resistor is changed in value, creating sound waves.

6.2 Which has the lowest frequency?

A. Raindrops during a thunderstorm.

B. Planes taking off at a busy airport.

C. Christmas.

D. The seconds hand passing 12 on a clock.

6.3 The range of frequencies that can be heard by the human ear are called the _____ range.

A. radio

B. audio

C. microwave

D. sub-sonic

6.4 Feedback is . . .

A. the rate at which something repeats.

B. using the output of one system to control the input of another.

C. something you always want to avoid.

D. using part of the output from a system to control the input.

6.5 The whistle chip acts like a . . .

A. resistor.

B. transistor.

C. capacitor.

D. microphone.

6.6 Capacitors . . .

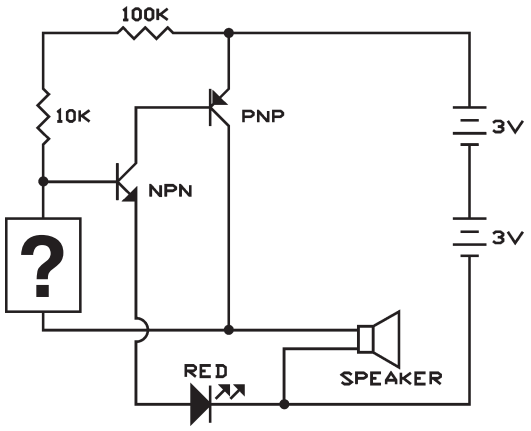
A. have lower resistance at lower frequencies and higher resistance at higher frequencies.

B. have lower resistance at higher frequencies and higher resistance at lower frequencies.

C. have high resistance at all frequencies.

D. should not be used in filtering circuits because of their ability to store electric charge.

6.7 Which component should be placed in the ? box to make this circuit into an oscillator?



A. 0.1μF capacitor

B. 6V lamp

C. 1KΩ resistor

D. LED

6.8 Sound waves are variations in electric current created by mechanical vibrations.

TRUE or FALSE?

6.9 If you are increasing the pitch of a sound, then you must be decreasing its frequency.

TRUE or FALSE?

6.10 Frequency is measured in Hertz.

TRUE or FALSE?

Chapter 7

7.1 The following parts can be built into an integrated circuit except . . .

A. resistors

B. LEDs

C. transistors

D. capacitors

7.2 Which of these are advantages of integrated circuits?

A. Cost

B. Size

C. Reliability

D. All of the above.

7.3 The average American home has fewer than ten integrated circuits used throughout all the electronic products in it.

TRUE or FALSE?

7.4 The integrated circuits in some modern computers have more than a million transistors in them.

TRUE or FALSE?

7.5 Integrated circuit manufacturing is so specialized that particles of dust can ruin parts.

TRUE or FALSE?

Chapter 8

8.1 The electricity at the electrical outlets in your home . . .

A. is 60V.

B. is alternating current.

C. has a frequency of 120Hz.

D. is direct current.

8.2 Why do electric companies use high voltages when transporting electricity over long distances?

A. Higher voltages and lower currents reduce power loss in the wires.

B. The equipment on the receiving end needs a high voltage.

C. Low voltage circuits cannot transport energy over long distances.

D. High voltages are safer than low voltages.

8.3 The following are advantages of transformers except . . .

A. they can isolate circuits, since the connection is magnetic and not electrical.

B. they can change the voltage in a circuit without wasting power.

C. they are equally useful in both AC and DC circuits.

D. they allow one circuit to create a current in another using magnetic fields.

8.4 How can you increase the inductance of a coil?

A. Place an iron bar inside the coil.

B. Use less loops of wire in the coil.

C. Place a plastic bar inside the coil.

D. Use thicker wire in the coil.

8.5 Inductors are made to . . .

A. block high frequency signals.

B. store electrical energy as magnetic energy.

C. pass low frequency signals.

D. all of the above.

8.6 Frequency modulation . . .

A. is less protected from interference than AM.

B. uses one signal to change the frequency of another.

C. uses 7kHz channel bands.

D. was the first system for radio broadcasts to be widely used.

8.7 The electricity supplied by a battery is an example of AC power.

TRUE or FALSE?

8.8 AM radio circuits are more complex than FM radio circuits.

TRUE or FALSE?

8.9 The inductance of a coil is measured in Henrys.

TRUE or FALSE?

8.10 The Federal Trade Commission (FTC) regulates use of the radio frequency spectrum in the United States.

TRUE or FALSE?

PART II QUIZ QUESTIONS

Chapter 9

9.1 By itself the meter can only measure voltages up to 0.3V; how can higher voltages be measured?

A. By connecting a low value resistor in parallel with the meter.

B. By connecting a high value resistor in series with the meter.

C. By connecting a capacitor in series with the meter.

D. Higher voltages can never be measured with this meter.

9.2 If one side of a transformer has more current and less voltage than the other side, then that side must have . . .

A. less loops of wire.

B. more loops of wire.

C. less resistance.

D. much more power.

9.3 If one coil has more loops of wire than a similar coil with less loops of wire, then the first coil will have . . .

A. less inductance than the second coil.

B. more inductance than the second coil.

C. the same inductance as the second coil.

D. no inductance.

9.4 Which of the following properties is most important in a coil of wire when there is a steady and unchanging DC voltage applied to it?

A. The capacitance of the coil.

B. The magnetic properties of the coil.

C. The resistance of the wire in the coil.

D. All of the above are of equal importance.

9.5 Transformers work with . . .

A. AC (changing) signals only.

B. DC (unchanging) signals only.

C. both AC and DC signals.

D. neither AC nor DC signals.

9.6 Which is an advantage of using a transformer in an oscillator circuit that uses a speaker?

A. It makes the sound louder without drawing as much power form the batteries.

B. It isolates the speaker from the rest of the circuit.

C. It provides less voltage but more current to the speaker.

D. All of the above.

9.7 Why is the spacing between components more important at FM radio frequencies than at audio or AM radio frequencies?

A. The magnetic effects between components increase as their spacing increases.

B. Longer wires have more resistance.

C. At high frequencies long wires have enough inductance to change the performance of a circuit.

D. All of the above.

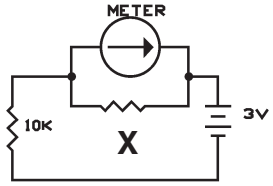
9.8 Which value for resistor X will give the highest reading on the meter?

A. 100Ω.

B. 1kΩ.

C. 5.1kΩ.

D. 100kΩ.



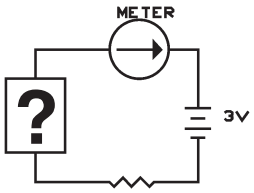
9.9 Which component should be placed in the ? box to measure the highest current on the meter?

A. 0.02μF capacitor.

B. 10kΩ resistor.

C. 2.5V lamp.

D. Red LED.



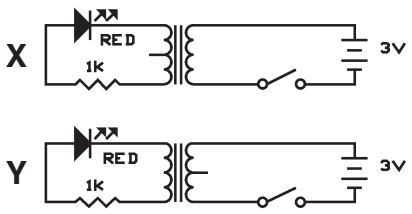
9.10 Which circuit(s) will flash the LED?

A. Circuit X only.

B. Circuit Y only.

C. Both circuits.

D. Neither circuit.



Chapter 10

10.1 What is the turn-on voltage level for a standard silicon diode?

A. 0.7V.

B. 1.5V.

C. 3.0V.

D. Any voltage turns it on.

10.2 Which statement best describes a rectifier circuit?

A. It converts a DC voltage into an AC voltage.

B. It converts a fast-changing voltage into a slow-changing voltage.

C. It can be made with a diode and a resistor.

D. They are often used in AM radio transmitters.

10.3 Electronic products use mostly _____ to filter out unwanted AC ripples in their DC voltages.

A. switches

B. motors

C. resistors

D. capacitors

10.4 The LEDs in the 7-segment LED display . . .

A. operate just like normal single LEDs, but have their + sides connected together.

B. have a much higher turn-on voltage level of at least 3V.

C. are different from normal LEDs because they don't have any turn-on voltage level.

D. cannot all be on at the same time.

10.5 Electronic memories that lose their information when the power is turned off are usually made with vast arrays of . . .

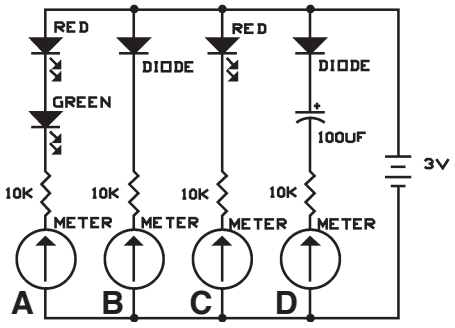
A. resistors.

B. transistors.

C. CDs.

D. diodes.

10.6 Which meter will indicate the highest current?



A. Meter A.

B. Meter B.

C. Meter C.

D. Meter D.

10.7 Most standard diodes are made from Gallium Arsenide.

TRUE or FALSE?

10.8 Diodes are often used in rectifier circuits to convert DC voltages into AC voltages.

TRUE or FALSE?

10.9 LEDs are special diodes with a higher turn-on voltage level and which emit light as the current increases.

TRUE or FALSE?

10.10 Electronic recording circuits are too expensive to be used in toys.

TRUE or FALSE?

Chapter 11

11.1 What does a relay do?

A. It uses magnetism to open or close a mechanical switch.

B. It amplifies a small current into a large one.

C. It changes the ratio of current to voltage in a circuit.

D. All of the above.

11.2 Which of these are advantages of relays?

A. They allow a low-voltage circuit to control a high-voltage circuit.

B. The controlling signal and the signal being controlled do not affect each other.

C. They allow a low-voltage circuit to control a high-current circuit.

D. All of the above.

11.3 An SCR is like a controlled diode except _____.

A. it allows current to flow in both directions.

B. it has a much higher turn-on voltage level.

C. it needs a voltage at its gate to turn on and then stays on until the voltage at its anode drops below a threshold.

D. All of the above.

11.4 The voltage is the same across all the resistances in _____ circuits.

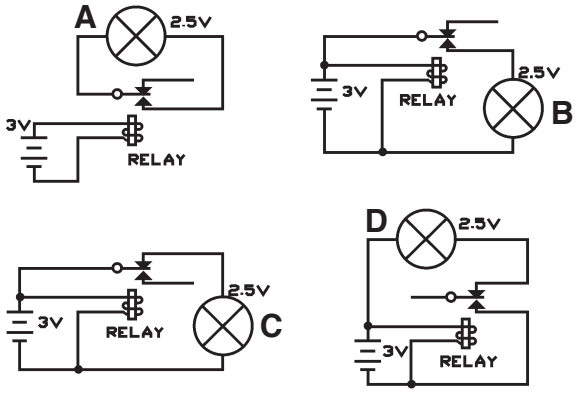
A. parallel.

B. series.

C. both series and parallel.

D. neither series nor parallel.

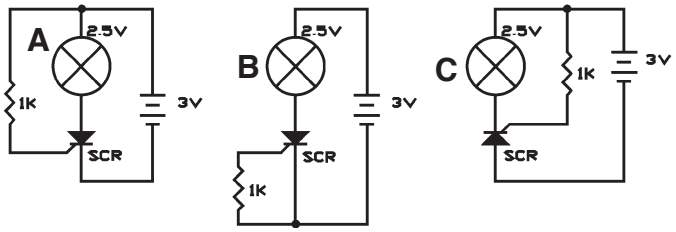
11.5 Which lamp will be on?



A. Lamp A. C. Lamp C

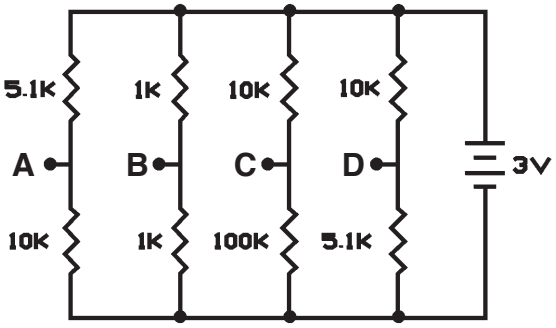
B. Lamp B. D. Lamp D

11.6 Which lamp will be on?



A. Lamp A. C. Lamp C.

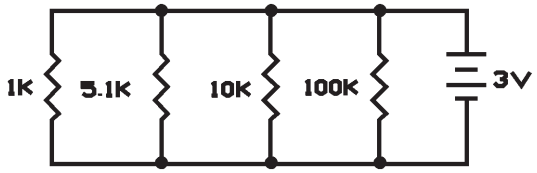
B. Lamp B. D. None of the lamps.



11.7 Which point will have the highest voltage?

A. Point A. C. Point C.

B. Point B. D. Point D.



11.8 Which resistor will have the highest current through it?

A. 1kΩ. C. 10kΩ.

B. 5.1kΩ. D. 100kΩ.

11.9 Which of these products usually operate with 120V?

A. Home appliances. C. Flashlights.

B. Flash cameras. D. Spacecraft.

11.10 SCRs are often made from . . .

A. copper. C. silicon.

B. wood. D. carbon.

PART III QUIZ QUESTIONS

Chapter 12

12.1 How many poles does a magnet have?

A. One

B. Two

C. Three

D. Four

12.2 Why does a compass needle always point north?

A. It is attracted by the earth's magnetic field.

B. It always points toward Santa's workshop.

C. There is an enormous pile of iron sitting at the North Pole.

D. It is attracted to all the ice there.

12.3 Which is the best material for a magnet?

A. Copper

B. Rubber

C. Solder

D. Iron

12.4 Placing an iron core inside a coil of wire _____ the magnetic effects of a current flowing through the wire.

A. Decreases

B. Increases

C. Does not change

D. Eliminates

12.5 What happens to the energy stored in an electromagnet's magnetic field when the current is turned off?

A. It disappears instantly.

B. It is transformed into dust particles.

C. It is released back into the circuit.

D. It is converted to light.

12.6 Which would make the best electronic magnet?

A. Capacitor

B. Coil of wire

C. Resistor

D. Diode

12.7 If you want to be able to turn a magnetic field on and off, you should use an electronic magnet instead of an ordinary magnet.

TRUE OR FALSE?

12.8 Placing two coils in series in a circuit decreases the total inductance.

TRUE OR FALSE?

12.9 An electronic magnet stores energy in an electrical field.

TRUE OR FALSE?

12.10 A coil of wire has the same effect on a circuit at all frequencies.

TRUE OR FALSE?

Chapter 13

13.1 What are solar cells made from?

A. Silicon

B. Carbon

C. Iron

D. Plastic

13.2 How do you increase the voltage from a solar cell?

A. Place several cells in parallel.

B. Place several cells in series.

C. You always have enough voltage from a solar cell.

D. Reduce the amount of light shining on it.

13.3 Which of these light sources will produce the most electricity from a solar cell?

A. Dim sunlight, like on a cloudy day

B. An incandescent light bulb

C. A fluorescent light bulb

D. Bright sunlight

13.4 Approximately how much of the energy in sunlight can solar cells convert into electricity?

A. Less than 1%

B. 15%

C. 50%

D. 95%

13.5 How do you increase the current from a solar cell?

A. Place several cells in parallel.

B. Place several cells in series.

C. You always have enough current from a solar cell.

D. Reduce the amount of light shining on it.

13.6 What happens when a solar cell cannot supply enough current to a circuit?

A. The voltage from the solar cell drops.

B. The voltage from the solar cell increases.

C. The solar cell gets hot.

D. The silicon crystals in it break down and the cell is permanently damaged.

13.7 What were solar cells first developed for?

A. As an alternative fuel for cars

B. Undersea exploration

C. The space program

D. Remote desert areas

13.8 Which of these is NOT an advantage of solar cells?

A. Solar cells are quiet.

B. Solar cells won't wear out because they have no moving parts.

C. Solar cells are inexpensive.

D. Solar energy is pollution-free.

13.9 Why are solar cells often used with re-chargeable batteries?

A. The sun isn't always shining when you need electricity.

B. The batteries can store up electricity from the solar cells and then supply high currents during peak electricity use.

C. The batteries reduce the pollution from the solar cells.

D. Both A and B

13.10 Why are solar cells more efficient in space?

A. It is warmer in space.

B. The sun's brightness is reduced as it passes through the earth's atmosphere.

C. There isn't as much electromagnetic interference in space.

D. None of the above.

Chapter 14

14.1 Which of these would be a good application for a vibration switch?

A. As an on/off switch for an air conditioner.

B. As an on/off switch for a computer.

C. To have a toy play a tune when you pick it up.

D. As an on/off switch for a VCR or DVD player.

14.2 If the 10KΩ resistor, motor with fan, 2.5V lamp, and 0.1μF capacitor are all in parallel and connected to a battery, which will have the highest current through it?

A. 10KΩ resistor

B. Motor with fan

C. 2.5V lamp

D. 0.1μF capacitor

14.3 Oscilloscopes and spectrum analyzers _____.

A. can be found in most homes.

B. are never used by electronics engineers.

C. are used to make performance measurements on electronic signals.

D. are not very expensive.

14.4 Why do projects PC1-PC73 all connect Winscope to the circuit output?

A. This allows you to compare what you see in the signal to what you hear or see from the circuit.

B. It is the only place in the circuit that you can connect to.

C. The signal would be too high in frequency to view anywhere else in the circuit.

D. It doesn't matter because the signal looks the same everywhere in the circuit.

14.5 The horizontal scale in oscilloscope mode represents . . .

A. Frequency

B. Time

C. Distance

D. Voltage

14.6 The vertical scale in spectrum analyzer mode represents . . .

A. Frequency

B. Time

C. Distance

D. Voltage

14.7 When a computer measures an electrical signal, the accuracy of the data depends on the resolution of the measurement and how often it takes a measurement.

TRUE OR FALSE?

14.8 Frequency is a measure of how often something occurs.

TRUE OR FALSE?

14.9 A tone sound from an inexpensive toy has all its energy concentrated in a single frequency.

TRUE OR FALSE?

14.10 When a current flows through a resistor, electrical energy is converted to heat.

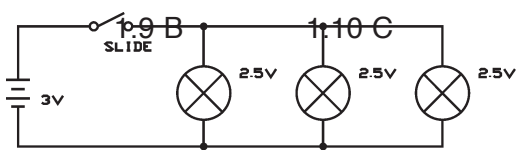
TRUE OR FALSE?

ANSWERS TO QUIZ QUESTIONS

Chapter 1

1.1 C 1.2 B 1.3 A 1.4 B

1.5 D 1.6 A 1.7 B
1.8 D 1.9 B 1.10 C
1.11



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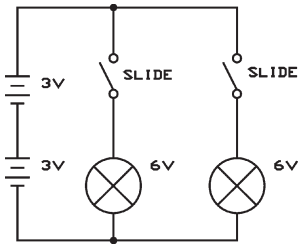

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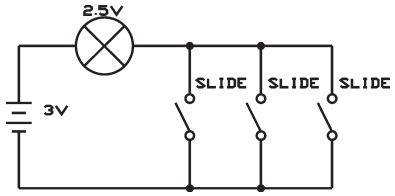

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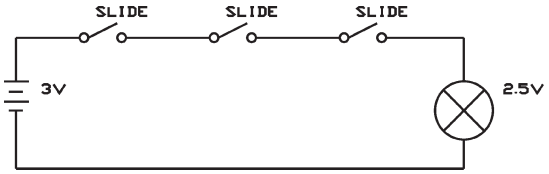


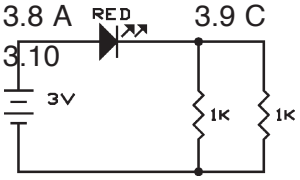
1.15 B 1.16 A 1.17 A
1.18 True 1.19 True 1.20 False

Chapter 2

2.1 A 2.2 C 2.3 B 2.4 C
2.5 A 2.6 D 2.7 B
2.8 A 2.9 C 2.10 B

Chapter 3

3.1 C 3.2 D 3.3 B 3.4 A
3.5 D 3.6 B 3.7 C
3.8 A 3.9 C
3.10



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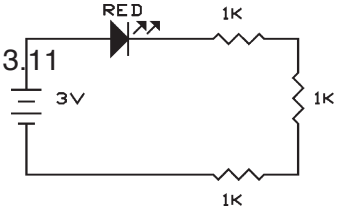
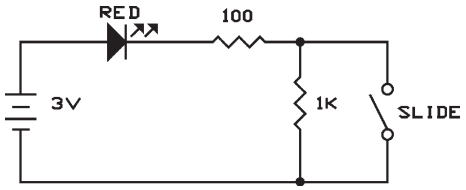


3.12



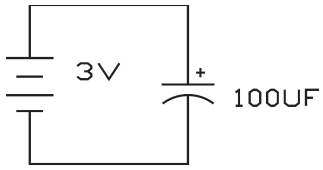
3.13 D 3.14 C 3.15 A 3.16 B
3.17 D 3.18 B 3.19 C 3.20 D

Chapter 4 (SC-100R only)

4.1 A 4.2 C 4.3 B 4.4 D
4.5 False 4.6 False 4.7 True
4.8 False 4.9 True 4.10 True

Chapter 4 (SC-300R, SC-500R, SC-750R only)

4.1 D 4.2 A 4.3 B 4.4 D
4.5 A
4.6



4.7 B 4.8 C 4.9 B 4.10 A

Chapter 5

5.1 A 5.2 D 5.3 B 5.4 C
5.5 D 5.6 B 5.7 A
5.8 D 5.9 C 5.10 B

Chapter 6

6.1 A 6.2 C 6.3 B 6.4 D
6.5 C 6.6 B 6.7 A
6.8 False 6.9 False 6.10 True

Chapter 7

7.1 B 7.2 D 7.3 False
7.4 True 7.5 True

Chapter 8

8.1 B 8.2 A 8.3 C 8.4 A
8.5 D 8.6 B 8.7 False
8.8 False 8.9 True 8.10 False

PART II QUIZ ANSWERS

Chapter 9

9.1 B	9.2 A	9.3 B	9.4 C
9.5 A	9.6 D	9.7 C	9.8 D
9.9 C	9.10 A		

Chapter 10

10.1 A	10.2 B	10.3 D	10.4 A
10.5 B	10.6 B	10.7 False	
10.8 False	10.9 True	10.10 False	

Chapter 11

11.1 A	11.2 D	11.3 C	11.4 A
11.5 B	11.6 A	11.7 C	11.8 A
11.9 A	11.10 C		

PART III QUIZ ANSWERS

Chapter 12

12.1 B	12.2 A	12.3 D	12.4 B
12.5 C	12.6 B	12.7 True	
12.8 False	12.9 False	12.10 False	

Chapter 13

13.1 A	13.2 B	13.3 D	13.4 B
13.5 A	13.6 A	13.7 C	13.8 C
13.9 D	13.10 B		

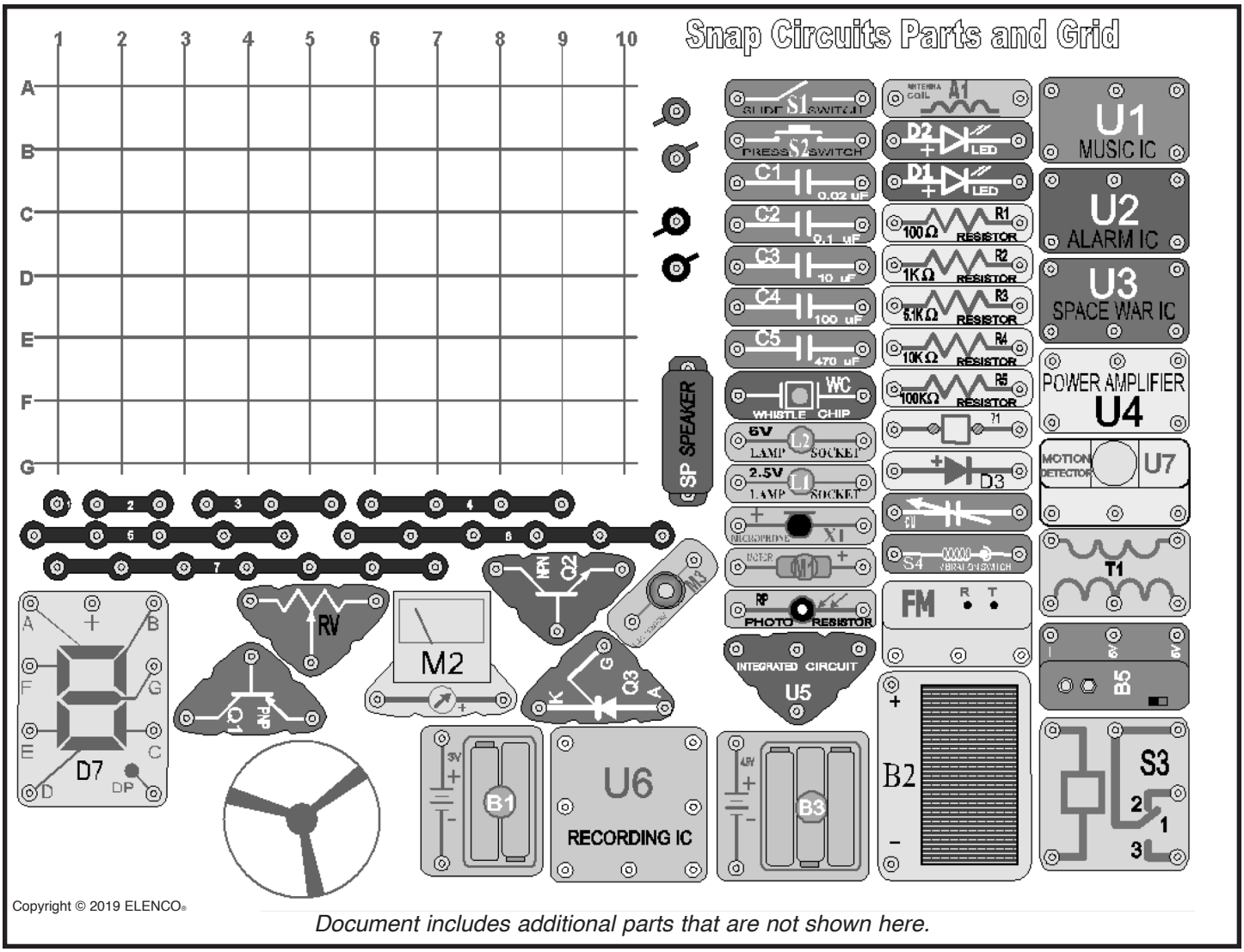
Chapter 14

14.1 C	14.2 B	14.3 C	14.4 A
14.5 B	14.6 D	14.7 True	
14.8 True	14.9 False	14.10 True	

NOTES

CREATING YOUR OWN SNAP CIRCUITS® DRAWINGS

ELENCO® provides the circuit designer show below so that Snap Circuits® users can make their own circuit drawings. This is a Microsoft® Word document that can be downloaded from www.elenco.com/snap-circuits-designer or through the www.elenco.com website. It includes the instructions shown below. Contact Elenco® if you have any questions about it.



Document includes additional parts that are not shown here.

INSTRUCTIONS FOR MAKING YOUR OWN CIRCUIT DRAWINGS (BASED ON MICROSOFT® WORD 2000)

ELENCO® provides the part symbols above so that our customers can make their own custom circuit drawings. Use the drawing features available in Microsoft® Word 2000. If the drawing toolbar is not visible select <View> - <Toolbar> - <Drawing>. If you have any questions about how to use Word, click on <Help> with left mouse button or press <Alt> + <H>. You may not have all the parts shown above. Contact ELENCO® to purchase upgrade sets or individual parts.

1. While holding down the control key <Ctrl>, click and drag any part to the grid to make a copy of that part on the grid. You may drag any number of parts to the grid as long as you hold down the control key and they will be duplicated on the grid. The original part should still be on the page in its original position if needed again.
2. To rotate a part, select the part then click on <Draw> in the drawing menu. Move to <Rotate or Flip> and then click on <Rotate Left> or <Rotate Right>.
3. To move parts from bottom to top click on the part you want to move with the left mouse button, and then click on <Draw>. Next go to <Order> and select <Bring to Front>.
4. To print your drawing, use <Select Objects> to select all the parts on the grid, including the grid. After all parts have been selected you can press <Ctrl> + <C> keys to place them on the clipboard. Then open a new drawing and paste your clipboard in this new drawing with <Ctrl> + <V>. Print this document and save it as your drawing.
5. When closing the original drawing do not save changes and the master will remain ready for next drawing.

Snap Circuits® Replacement Parts & Upgrade Kit Order Form (Page 1)

Qty.	Part #	Description	Price	Total
	3308M2	PICAXE® 08M2 IC	$11.95	$__.__
	440409	Wall Transformer for AC Adapter	$14.95	$__.__
	533004	Replacement Fuse for 6SCF1	$0.95	$__.__
	590002	"AA" Alkaline Battery	$1.00	$__.__
	6CAPS1	Stonewashed Black Cap	$12.95	$__.__
	6SC01	Single Snap Conductor	$0.30	$__.__
	6SC02	Conductor with 2-snaps	$0.60	$__.__
	6SC03	Conductor with 3-snaps	$0.80	$__.__
	6SC04	Conductor with 4-snaps	$1.00	$__.__
	6SC05	Conductor with 5-snaps	$1.20	$__.__
	6SC06	Conductor with 6-snaps	$1.40	$__.__
	6SC07	Conductor with 7-snaps	$1.60	$__.__
	6SC3DSNAP	3D Snap	$2.95	$__.__
	6SCA1	Antenna Coil	$2.95	$__.__
	6SCAF	Air Fountain	$14.95	$__.__
	6SCAFB	Ball for Air Fountain	$0.50	$__.__
	6SCAFS	Spout for Air Fountain	$0.50	$__.__
	6SCB1	Battery Holder (2-AA)	$2.75	$__.__
	6SCB2	Solar Cell 4.5V	$24.95	$__.__
	6SCB3	Battery Holder 4.5V (3-AA)	$3.75	$__.__
	6SCB3B	Battery Holder SCB-20	$4.95	$__.__
	6SCB4	Battery Rechargeable 3.6V	$12.95	$__.__
	6SCB6	Snap Module for AC Adapter	$14.95	$__.__
	6SCB7	Solar Cell 7V	$16.95	$__.__
	6SCB9	9V Battery Holder & Switch	$6.95	$__.__
	6SCBAND1	Rubber band	$0.25	$__.__
	6SCBAR1	"+" Shaped Bar	$0.95	$__.__
	6SCBE	Battery Eliminator for FM2	$2.95	$__.__
	6SCBG	Base Grid (11" x 7.7")	$4.95	$__.__
	6SCBGM	Mini Base Grid (7.7" x 5.5")	$3.50	$__.__
	6SCBGM2	Base Grid Mini 2-Sided	$11.95	$__.__
	6SCBGSUP	Base grid support	$0.95	$__.__
	6SCBGMF	(Discontinued)		
	6SCC1	0.02μF Capacitor	$1.35	$__.__
	6SCC2	0.1μF Capacitor	$1.35	$__.__
	6SCC3	10μF Capacitor	$1.35	$__.__
	6SCC4	100μF Capacitor	$1.35	$__.__
	6SCC4N	100μF Capacitor NP	$1.95	$__.__
	6SCC5	470μF Capacitor	$1.75	$__.__

Qty.	Part #	Description	Price	Total
	6SCC7	1μF Capacitor	$1.95	$__.__
	6SCC8	4700μF Capacitor	$6.95	$__.__
	6SCCARD1	Illusion Cards	$1.95	$__.__
	6SCCOM	Compass	$1.50	$__.__
	6SCCRAWBA	Crawler Body	$9.95	$__.__
	6SCCRAWP	Crawler Parts	$9.95	$__.__
	6SCCV	Variable Capacitor	$4.25	$__.__
	6SCD1	Red LED	$1.50	$__.__
	6SCD2	Green LED	$1.50	$__.__
	6SCD3	Diode 1N4001	$1.50	$__.__
	6SCD4	White LED	$4.95	$__.__
	6SCD5	Yellow LED	$4.95	$__.__
	6SCD6	White LED	$5.95	$__.__
	6SCD7	7-Segment LED Display	$5.95	$__.__
	6SCD8	Color LED	$5.95	$__.__
	6SCD9	Blue LED	$4.95	$__.__
	6SCD10	Red/Yellow bicolor LED	$4.95	$__.__
	6SCD11	Blink Red LED	$4.95	$__.__
	6SCD12	Color2 LED	$5.95	$__.__
	6SCDISC	Foam Disc	$0.25	$__.__
	6SCDM	Disco Motor	$19.95	$__.__
	6SCDMCH	Disco Cover, Hexagon	$1.95	$__.__
	6SCDMCT	Disco Cover, Triangle	$1.95	$__.__
	6SCDMSB	Disco Cover Support Bar	$0.50	$__.__
	6SCEC	Copper Electrode	$0.60	$__.__
	6SCECS	Copper Electrode with Snap	$1.10	$__.__
	6SCEGG	Egg LED Attachment	$1.95	$__.__
	6SCEZ	Zinc Electrode	$0.60	$__.__
	6SCEZS	Zinc Electrode with Snap	$1.10	$__.__
	6SCF1	0.5A Fuse	$4.95	$__.__
	6SCFC	Fiber Optic Cable	$4.95	$__.__
	6SCFCHB	Fiber Optic Cable Holder, Black	$0.95	$__.__
	6SCFCHC	Fiber Optic Cable Holder, Clear	$0.95	$__.__
	6SCFILM	Prismatic Film	$0.95	$__.__
	6SCFM	FM Module	$8.95	$__.__
	6SCFM2	FM Radio	$9.95	$__.__
	6SCFM2B	Earphone for 6SCFM2	$3.95	$__.__
	6SCFMB	Mounting Base (for Fiber Optic Tree)	$1.95	$__.__
	6SCFRGB	Red/Green/Blue Filters Set	$1.95	$__.__

Qty.	Part #	Description	Price	Total
	6SCFT	Fiber Optic Tree	$6.95	$__.__
	6SCFT2	Fiber Optic Festive Tree	$9.95	$__.__
	6SCG3DC	3D color glasses	$2.50	$__.__
	6SCGEAR1	1.0" Gear	$0.95	$__.__
	6SCGEAR2	1.75" Gear	$1.25	$__.__
	6SCGEAR3	2.55" Gear	$1.65	$__.__
	6SCGEAR4	3.3" Gear	$1.95	$__.__
	6SCGEAR5	Small Gear 22T, for M9	$2.25	$__.__
	6SCGEAR6	Large Gear 30T, for M9	$2.25	$__.__
	6SCGM	Geared Motor	$14.95	$__.__
	6SCHC	Hand Crank	$12.95	$__.__
	6SCIF	Package of Iron Filings	$2.95	$__.__
	6SCJ1	Jumper Wire 18" (Black)	$0.85	$__.__
	6SCJ2	Jumper Wire 18" (Red)	$0.85	$__.__
	6SCJ3A	Jumper Wire 8" (Orange)	$0.85	$__.__
	6SCJ3B	Jumper Wire 8" (Yellow)	$0.85	$__.__
	6SCJ3C	Jumper Wire 8" (Green)	$0.85	$__.__
	6SCJ3D	Jumper Wire 8" (Purple)	$0.85	$__.__
	6SCJ3E	Jumper Wire 8" (Gray)	$0.85	$__.__
	6SCJ3F	Jumper Wire 8" (White)	$0.85	$__.__
	6SCJ4	Jumper Wire 4" (Blue)	$0.85	$__.__
	6SCJ5RED	Red snap-to-pin wire	$1.95	$__.__
	6SCJA	Audio Jack	$4.95	$__.__
	6SCJWBJBLK	Snap to Banana Plug, black	$2.50	$__.__
	6SCJWBJRED	Snap to Banana Plug, red	$2.50	$__.__
	6SCL1	2.5V Lamp (built-in bulb)	$1.75	$__.__
	6SCL1B	2.5V / 3.2V Bulb	$0.50	$__.__
	6SCL2	6V Lamp (built-in bulb)	$1.75	$__.__
	6SCL2B	6V / 6.2V Bulb	$0.50	$__.__
	6SCL4	4.5V Lamp (built-in bulb)	$1.75	$__.__
	6SCL4B	4.5V Bulb	$0.50	$__.__
	6SCLH	Liquid Holder Green	$7.95	$__.__
	6SCLLENS	Lined lens LED attachment	$0.95	$__.__
	6SCLS	Unmarked Lamp Socket	$1.50	$__.__
	6SCM1	Motor	$4.25	$__.__
	6SCM1DH	Disc Holder	$2.95	$__.__
	6SCM1DS	Set of Disc Cutouts (6 pcs./set)	$1.95	$__.__
	6SCM1F	Fan	$0.50	$__.__
	6SCM1FG	Glow Fan Blade	$1.95	$__.__

Prices subject to change without notice.

Snap Circuits® Replacement Parts & Upgrade Kit Order Form (Page 2)

Qty.	Part #	Description	Price	Total
	6SCM1T	Spare Motor Top	$0.25	$__.__
	6SCM2	Analog Meter	$5.95	$__.__
	6SCM3	Electromagnet	$9.95	$__.__
	6SCM3B	Iron Core Rod, 36mm	$0.75	$__.__
	6SCM3C	Iron Core Rod, 46mm	$0.95	$__.__
	6SCM4	Motor Low Speed	$7.95	$__.__
	6SCM4B	Fan Green	$0.75	$__.__
	6SCM4C	Water Wheel	$0.75	$__.__
	6SCM5	5V-1mA-1A Meter	$7.95	$__.__
	6SCM6	5V-0.5mA-50mA Meter	$7.95	$__.__
	6SCM7	Light Motor	$14.95	$__.__
	6SCM8	Programmable Fan	$16.95	$__.__
	6SCM9	Orange Motor	$9.95	$__.__
	6SCM9B	Gear Insert, for M9	$0.50	$__.__
	6SCMAG	Permanent Magnet	$1.25	$__.__
	6SCMBASE	Mirror mounting base	$0.50	$__.__
	6SCMBASE2	Illusion Card Holder	$0.95	$__.__
	6SCMCAR	Mini Car	$9.95	$__.__
	6SCMGRB	Merry-go-round base	$2.95	$__.__
	6SCMGRD	Disc Cutouts (4pcs. / set)	$1.95	$__.__
	6SCMGRF	Cardboard Figures (9pcs. / set)	$2.95	$__.__
	6SCMIRBAL	Mirror Ball	$4.95	$__.__
	6SCMIRROR	Mirror	$0.95	$__.__
	6SCMSPRG	Springs for mirror mounting base	$0.50	$__.__
	6SCNS	Nut Snap	$0.50	$__.__
	6SCPLANE	Airplane Parts	$9.95	$__.__
	6SCPROJ	Projector LED attachment	$3.95	$__.__
	6SCPSB	Pivot Stand Base	$3.95	$__.__
	6SCPSP	Pivot Post	$0.50	$__.__
	6SCPST	Pivot Top	$0.50	$__.__
	6SCPULL1	0.9" Pulley	$0.95	$__.__
	6SCPULL2	1.3" Pulley	$1.25	$__.__
	6SCPULL3	2.1" Pulley	$1.65	$__.__
	6SCPY1 or 6SC?1	Two-spring Socket ?1	$2.95	$__.__
	6SCPYQ or 6SC?Q	Three-spring Socket ?Q	$4.95	$__.__
	6SCPYU8 or 6SC?U8	Eight-pin IC Socket ?U8	$6.95	$__.__
	6SCQ1	PNP Transistor	$2.50	$__.__
	6SCQ2	NPN Transistor	$2.50	$__.__

Qty.	Part #	Description	Price	Total
	6SCQ3	SCR	$2.50	$__.__
	6SCQ4	Phototransistor	$4.95	$__.__
	6SCR1	100Ω Resistor	$1.25	$__.__
	6SCR2	1kΩ Resistor	$1.25	$__.__
	6SCR3	5.1kΩ Resistor	$1.25	$__.__
	6SCR4	10kΩ Resistor	$1.25	$__.__
	6SCR5	100kΩ Resistor	$1.25	$__.__
	6SCRB	Rover Body	$29.95	$__.__
	6SCRP	Photosensitive Resistor	$2.25	$__.__
	6SCRUBRG	Rubber ring, 0.375" dia.	$0.25	$__.__
	6SCRV	Adjustable Resistor 50kΩ	$3.25	$__.__
	6SCRV2	Adjustable Resistor 10kΩ	$3.95	$__.__
	6SCRV3	Adjustable Resistor 500kΩ	$3.95	$__.__
	6SCRX1	R/C Receiver	$16.95	$__.__
	6SCRX2	Deluxe R/C Receiver	$19.95	$__.__
	6SCS1	Slide Switch	$1.35	$__.__
	6SCS2	Press Switch	$1.35	$__.__
	6SCS3	Relay	$9.95	$__.__
	6SCS4	Vibration Switch	$2.95	$__.__
	6SCS5	SPDT Switch	$2.50	$__.__
	6SCS6	Switcher S6	$5.95	$__.__
	6SCS7	Tilt switch	$3.95	$__.__
	6SCS8	Selector	$4.95	$__.__
	6SCS9	Reed Switch	$2.95	$__.__
	6SCSCREW1	Screw PAW 2.6mm x 6mm	$0.25	$__.__
	6SCSCREW2	Screw PA 2.3mm x 8mm	$0.25	$__.__
	6SCSCREW3	Screw PM 3x8 mm	$0.25	$__.__
	6SCSEDCB	Sound Energy Demo Base	$2.95	$__.__
	6SCSEDCF	Sound Energy Demo Sheet	$0.50	$__.__
	6SCSEDCT	Sound Energy Demo Tube	$1.95	$__.__
	6SCSP	Speaker 8Ω	$3.95	$__.__
	6SCSP2	Speaker 32Ω	$4.95	$__.__
	6SCSTAB	Stabilizer	$0.75	$__.__
	6SCT1	Transformer	$3.50	$__.__
	6SCT2	Clock	$7.95	$__.__
	6SCTOWER	Tower LED Attachment	$1.95	$__.__
	6SCTX1	Remote Control Unit	$17.95	$__.__
	6SCTX1A	R/C Antenna	$0.60	$__.__

Qty.	Part #	Description	Price	Total
	6SCU1	Music IC	$4.95	$__.__
	6SCU2	Alarm IC	$4.95	$__.__
	6SCU3	Space War IC	$4.95	$__.__
	6SCU4	Power Amplifier IC	$4.95	$__.__
	6SCU5	High Frequency IC	$2.95	$__.__
	6SCU6	Recording IC	$11.95	$__.__
	6SCU7	Motion Detector IC (for SCP-03)	$15.95	$__.__
	6SCU8	Motor Control IC	$19.95	$__.__
	6SCU9	Sound & Recording IC	$24.95	$__.__
	6SCU15	CMOS Inverter Gate 4069	$9.95	$__.__
	6SCU16	CMOS AND Gate 4081	$9.95	$__.__
	6SCU17	CMOS OR Gate 4071	$9.95	$__.__
	6SCU18	CMOS NAND Gate 4011	$9.95	$__.__
	6SCU19	CMOS NOR Gate 4001	$9.95	$__.__
	6SCU20	CMOS XOR Gate 4070	$9.95	$__.__
	6SCU21	U21 PICAXE® Micro IC in socket	$18.95	$__.__
	6SCU21S	U21 8-pin Socket w/ Micro Marking	$7.95	$__.__
	6SCU22	Color Organ	$19.95	$__.__
	6SCU23	Strobe IC	$9.95	$__.__
	6SCU24	Infrared Receiver	$9.95	$__.__
	6SCU26	Keyboard	$29.95	$__.__
	6SCU27	Voice Changer	$19.95	$__.__
	6SCU28	Echo IC	$24.95	$__.__
	6SCU29	LED Display & Microcontroller	$29.95	$__.__
	6SCU30	Light Tunnel	$24.95	$__.__
	6SCU31	Snapino module	$39.95	$__.__
	6SCU32	Melody IC	$7.95	$__.__
	6SCV1	Vertical snap wire 90°	$2.50	$__.__
	6SCV2	Vertical Snap Wire 45°	$3.50	$__.__
	6SCW1	Horn	$3.50	$__.__
	6SCWC	Whistle Chip	$1.75	$__.__
	6SCWIRE1	Coil for BYO electromagnet	$3.95	$__.__
	6SCX1	Microphone	$2.95	$__.__
	623047	Case for SCM-400	$19.95	$__.__
	626100	Stand	$1.25	$__.__
	662510	Rubber Grommet .125"ID-0.3"OD	$0.25	$__.__
	753077	Arcade SCA-200 Manual	$9.95	$__.__
	753097	Beginner SCB-20 Manual	$7.95	$__.__

Snap Circuits® Replacement Parts & Upgrade Kit Order Form (Page 3)

Upgrade Kits Available

Get the additional parts and manuals to take your Snap Circuits® set to the next level!

UC-30 Upgrade Kit

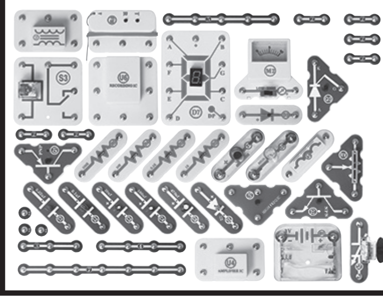
Converts SC-100 Snap Circuits® Jr. into SC-300 Snap Circuits®

includes 29 new parts (AM radio components, transistors, ICs, capacitors, resistors, & more) and 200 projects!

$34.95

UC-40 Upgrade Kit

Converts SC-100 Snap Circuits® Jr. into SC-500 Snap Circuits® Pro



includes 41 new parts, AM/FM radio, recorder, meter & more, and 400 projects!

$69.95

Qty.	Part #	Description	Price	Total
	9UC90	Upgrade Kit SCROV-10 to SCROV-50	$45.95	$___.__
	9UC100	Upgrade Kit SC-300 to SCM-400	$45.95	$___.__
	9UCDL	Disc Launcher Upgrade Kit	$29.95	$___.__
	MWK01P5	Thin Metal Bar	$0.25	$___.__
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		Subtotal		$___.__
		IL sales tax add 9.0%		$___.__
		Shipping charges		$___.__
		Total		$___.__

Shipping & Handling Charges:

Order Size	USA	Can.
0-$25	$6	$10
$25-$75	$9	$15
over $75	$12	$20

Qty.	Part #	Description	Price	Total
	753098	Projects 102-305 Manual	$9.95	$___.__
	753102	Projects 1-101 Manual	$9.95	$___.__
	753104	Projects 306-511 Manual	$9.95	$___.__
	753106	Snapino manual	$7.95	$___.__
	753120	SOUND Manual	$9.95	$___.__
	753131	R/C Snap Rover® Manual	$9.95	$___.__
	753134	Motion SCM-165 Manual	$9.95	$___.__
	753135	SC-3DMEG manual	$9.95	$___.__
	753136	SC-STEM1 manual	$9.95	$___.__
	753154	XP™ Manual	$14.95	$___.__
	753285	LIGHT Manual	$9.95	$___.__
	753286	Select SC-130 Manual	$9.95	$___.__
	753292	Projects 512-692 Manual	$9.95	$___.__
	753293	Projects PC1 - PC73 Manual	$9.95	$___.__
	753294	Student Guide Junior	$9.95	$___.__
	753303	Manual Snaptricity®	$9.95	$___.__
	753305	Deluxe Snap Rover® Manual	$9.95	$___.__
	753307	Student Guide	$24.95	$___.__
	753316	Think Green Manual	$9.95	$___.__
	753317	Green Projects Manual	$9.95	$___.__
	753318	3D Illumination Manual	$9.95	$___.__
	9ACSNAP	AC Power Supply	$19.95	$___.__
	9ACSNAPUK	AC Power Supply for UK	$19.95	$___.__
	9CI73	Computer Interface 73 Experiments	$19.95	$___.__
	9SCJW10	Snap-to-Pin Set, 10 pcs.	$9.95	$___.__
	9SCJW20	Snap-to-female Set, 10 pcs.	$9.95	$___.__
	9SCM400	Snap-Micro™ I	$119.95	$___.__
	9SNAPCASE7	Deluxe Case w/ Foam Inserts	$69.95	$___.__
	9SNAPCASE8	Same as Above w/o Parts ID	$69.95	$___.__
	9TLCI73	Computer Interface Cable	$9.95	$___.__
	9TLSCST	Stereo Cable	$5.95	$___.__
	9TLSCUSBAB	USB cable, A-male to B-male	$9.95	$___.__
	9UC30	Upgrade Kit SC-100 to SC-300	$34.95	$___.__
	9UC40	Upgrade Kit SC-100 to SC-500	$69.95	$___.__
	9UC50	Upgrade Kit SC-300 to SC-500	$34.95	$___.__
	9UC60	Upgrade Kit SC-100 to SC-750	$109.95	$___.__
	9UC70	Upgrade Kit SC-300 to SC-750	$69.95	$___.__
	9UC80	Upgrade Kit SC-500 to SC-750	$39.95	$___.__

Revised 12/03/18 **Warning - CHOKING HAZARD - These products contain small parts. Not for children under 3 years.**

SNAP CIRCUITS® GEAR & Upgrade Kits

UC-50 Upgrade Kit
Converts SC-300 Snap Circuits® into SC-500 Snap Circuits® Pro

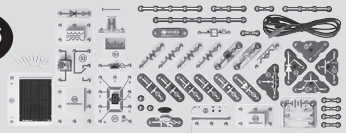
includes 12 new parts (recording IC, transformer, FM radio, meter, & more) and 200 projects!

$34.95

UC-60 Upgrade Kit
Converts SC-100 Snap Circuits® Jr. into SC-750 Snap Circuits® Extreme

includes 48 new parts, CI-73 computer interface, solar panel, and more than 650 projects!

$109.95



Custom Storage Case
Heavy duty plastic case with 2 custom foam inserts for housing your Snap Circuits® parts. Easy to identify missing components. Includes a case to hold the small loose parts.

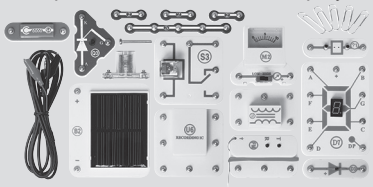
SNAPCASE7
(for use with SC-300, SC-500, and SC-750)

SNAPCASE8
(Same as above, but without parts ID printing on foam)

$69.95

UC-70 Upgrade Kit
Converts SC-300 Snap Circuits® into SC-750 Snap Circuits® Extreme

includes 19 new parts, CI-73 computer interface, solar panel, and more than 450 projects!

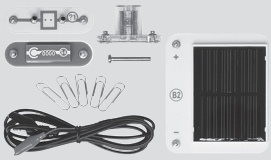


$69.95

UC-80 Upgrade Kit
Converts SC-500 Snap Circuits® Pro into SC-750 Snap Circuits® Extreme

includes 7 new parts, CI-73 computer interface, solar panel, and more than 250 projects.

$39.95



Student Guides
Educational Series - Teaches about Basic Electricity & Electronics in the everyday world using our Learn By Doing® concept!

Student Guide Junior – 753294
48 full-color pages *(for use with SC-100 set)*

$9.95

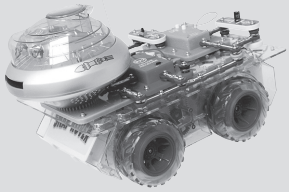
Student Guide – 753307
140 full-color pages *(for use with SC-300/500/750 sets) for projects 1-692 [does not require Student Guide Jr.]*

$24.95

UC-90 Deluxe Snap Rover® Upgrade Kit
Upgrade your Snap Rover® to a Deluxe Snap Rover®! Includes the disc launcher, parts, and manual for over 40 new projects.

$45.95

SCROV-10 with UC-90 upgrade shown.



9SCJW10 Snap-to-Pin Set
9SCJW20 Snap-to-Female Set
Lets you connect Snap Circuits® to a breadboard. 10 wires with reinforced pins, 5 colors, 10" length, and unlimited possibilities!

$9.95

STONEWASHED BLACK CAP
Part # 6CAPS1

- Blue/white Snap Circuits® logo on the front.
- 100% cotton.
- One size fits all.

$12.95

AC-SNAP AC Power Supply
Replaces the batteries in Snap Circuits®.

$19.95

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For more info: www.snapcircuits.net
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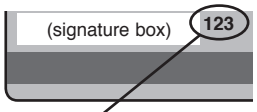

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