

Product code: 36934

Physical electricity

General guidance for junior high school physics
and electricity teaching experiments

Instruction Manual for Junior High School Physics Equipment Introduction to "Physical Inquiry Tool Program"

This set of learning tools and the current curriculum standard "Physics" (full set of Soviet version).

It is suitable for inquiry-based course teaching mode, which can stimulate students interest in learning, cultivate and mobilize students.

At the same time, it enriches the teaching form, improves the teaching level and students achievement, and explores the students experimentation.

The study tool integrates teaching instruments, smart toys and student stationery.

Let students not be limited by time and space, and fully mobilize students subjective initiative in learning, which is the beginning of physics learning.

The teaching can not stimulate students' interest in learning physics, so many students feel physics, especially electricity/electromagnetism

Some abstractions are difficult to learn, and the physical performance cannot be improved, which affects the child's overall academic level.

"Physics Inquiry Learning Tool" is an effective solution for students to learn physics in junior high school

1. How to form a simple circuit

Learning target:

1. Master the basic components of the circuit and the functions of each part.
2. Master the three states of the circuit: closed circuit, open circuit, and short circuit.
3. Understand the harm caused by short circuit and the application of partial short circuit.

Equipment: battery box, battery, switch, small lamp holder, wire.



Fig. 1-1: Closed circuit

There are many electrical appliances in our family, and they can only work when they are connected into a circuit.

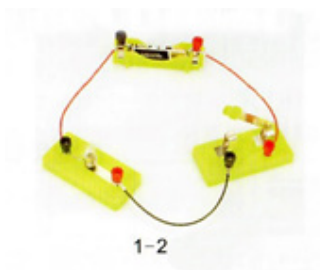


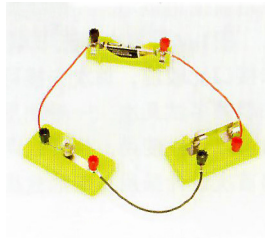
Fig. 1-2: Open Circuit



Fig. 1-3 Shortcircuit, damage of a battery

Experimental design:

1. Form a circuit as shown in Figure 1-1 and Figure 1-2, and close the switch to make the circuit work, understand what is a path.



What is an open circuit? Thinking: What parts does the most basic circuit consist of, and what is the function of each part?

2. Why is this connection method wrong as shown in Figure 1-3, and what will be the result? Think about and summarize the three types of circuits.

Expand experimental research:

As shown in Figure 1-4, first close switch S2 and observe the two lights.

Check the light-emitting condition of the bulb, then close the switch S1, and observe again.

The lighting conditions of the two bulbs are analyzed, and the observed phenomenon is analyzed.

Analyze the path of the current in different states of the switch.

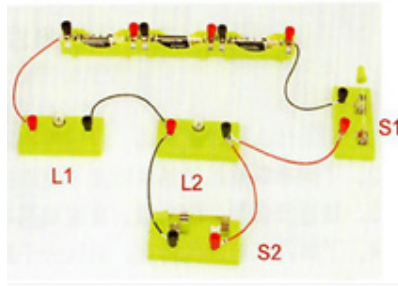


Fig. 1-4: with S1 and S2 closed, light bulb L2 is shorted, L1 lighting

Battery box usage tips:

In figure 1-4 three AA battery boxes are connected in series. When the battery boxes are connected in series, due to the plastic the card interface is relatively awkward, and the first card connection may not be smooth. This is normal. Please be patient and follow the steps in Figures 1-5.

The box can be used independently, or two or three sections can be connected in series or in parallel, which is free and flexible.

The method of connecting the battery boxes in series is shown in Figure 1-5, and the battery boxes are used in parallel as shown in Figure 1-6.

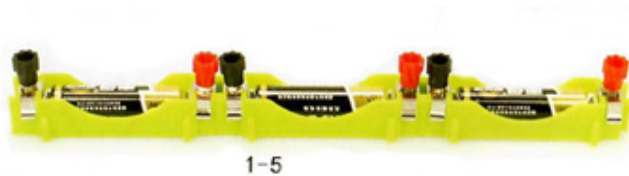


Fig. 1-5: Batteries connected in series



Fig. 1-6: Battery boxes are connected in parallel to form a battery pack with a more capacity and intensity of a current

2. Explore series circuit

Learning target:

1. Know what a series circuit is and how to connect series circuits.
2. Understand the basic characteristics of series circuits (the path of the current and the influence of the switch position on the circuit).
3. Know what is a parallel circuit and will connect basic parallel circuits.
4. Understand the characteristics of parallel circuits, be able to distinguish trunk circuits, branch circuits, and know the functions of trunk circuit switches and branch circuit switches.

Equipment: battery box, battery, switch, small light bulb, wire, small lamp holder

We put a small light bulb into the circuit to make up.

A most basic simple circuit, but real life, we all have many electrical appliances connected to the same circuit.

So, how can we connect multiple appliances to the same circuit?

What about the circuit? What connections are there?

Multiple small light bulbs represent multiple electrical appliances connected to the circuit.

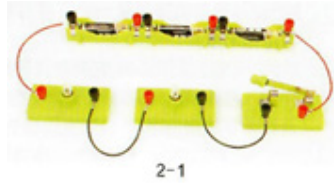


Fig. 2-1

See what connections are available.

Experimental design:

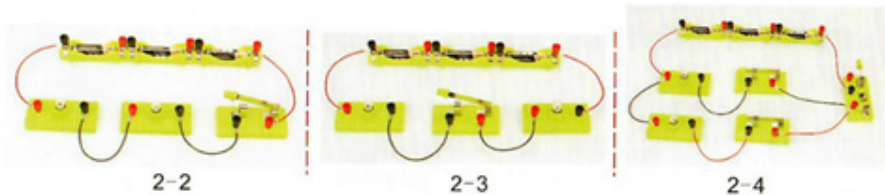
1. Form a circuit as shown in Figure 2-1, observe and explore the characteristics of the circuit (outside the power supply, the current always flows from the positive pole of the power supply to the negative pole through the circuit).

2. Then, according to Figure 2-1, Figure 2-3, change the connection method of the switch, study the switching function of the series circuit, and explore

3. Features of Series Circuits

4. Form a parallel circuit as shown in Figure 2-4, analyze the current flow; close each switch separately, see the parallel connection

The function of each switch in the circuit is analyzed to find out which part is the branch circuit and which part is the main circuit.



3. Exploring ranges

Learning target:

1. Know the measurement range of the two ranges of the ampermeter and the corresponding division value.
2. The ammeter can be correctly connected to the circuit, and it will count with different ranges. ,
3. Can summarize the applicable methods and precautions of the ammeter.
4. Cultivate the awareness and habit of selecting the range with test touch estimation and so on.

Equipment: battery box, battery, switch, ammeter, small light bulb, wire, small lamp holder.

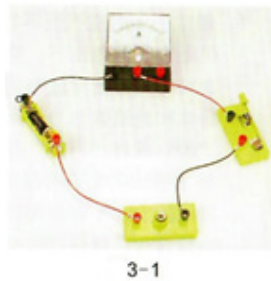
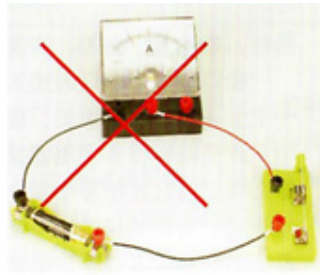


Figure 3-1

Experimental design:

1. Connect the circuit as shown in Figure 3-1 to measure the current of a light bulb, and learn to read the ammeter.
2. The connection method as shown in Figure 3-2 is wrong, and the ampermeter is not allowed to directly sample access circuit. Note: Observe the pointer before using the ampermeter.

Whether to refer to the zero knob for zero adjustment.



3-2

Figure 3-2

4. Conductors and insulators

Learning target:

1. Know what conductors and insulators are, and can distinguish which common objects are insulators and which are conductors.

2. Know that there is no strict boundary between conductors and insulators, and they can be converted into each other under certain conditions.

3. Understand what semiconductors are and their applications.

Equipment: battery box, battery, switch, ammeter, small light bulb, wire, small lamp holder.

All kinds of electrical appliances, switches, and the outside we see in life are all plastic and rubber, and the inside is copper and aluminum.

When it is made of metal, the outside of the wire is also a layer of rubber, and the inside is a copper core. Why?

Experimental design:

As shown in Figure 4-1, common school supplies, such as erasers, small knives, coins, rulers are connected to the circuit to see the light bulb

Whether it emits light to judge whether these objects connected to the circuit can conduct enough electricity to understand conductors and insulators

Knowledge development: rubber-plastic ruler

1. Usually dry air is not easy to conduct electricity, it is an insulator,

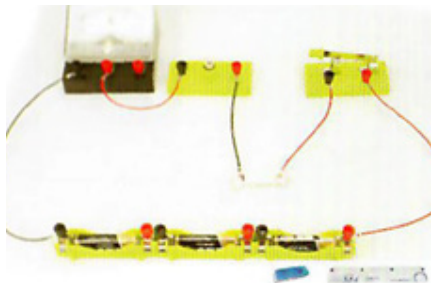


Figure 4-1

But under very high voltage, the air can also break down and conduct electricity. For example, lightning that occurs between clouds.

Between the air is breakdown discharge. This shows that there is no strict boundary between conductors and insulators, generally.

The division of conductors and insulators is in general terms, so the definition of conductors and insulators depends on whether “can” or “can't” conduct electricity to distinguish.

2. According to whether the object is easy to conduct electricity, it can be divided into conductors and insulators.

The electrical conductivity which is between conductors and insulators, called semiconductors. Due to their unique properties, semiconductors have unique application.

5. Circuit diagram

Learning target:

1. Know the circuit diagram symbols of common electrical components, and be able to draw circuit diagrams accurately and standardized.

2. Be able to draw the corresponding circuit diagram according to the real object, and be able to connect the physical circuit according to the circuit diagram.

3. Preliminarily have the ability to analyze circuits, and can analyze circuits with the idea of equivalent circuits.

Equipment: battery box, battery, switch, ammeter, small light bulb, wire, small lamp holder.

The circuit diagram is represented by the symbols agreed by everyone.

The circuit connection diagram is easier to communicate than the physical diagram, and can reflect the circuit connection more clearly and intuitively.

In this part of physical electricity in junior high school, learning to identify circuit diagrams, designing and drawing circuit diagrams is an important part of learning electricity.

Through the circuit diagram, we can see the various states of the circuit, the connection method, and the relationship between the various electrical physical quantities can be reversed.

Recognize the circuit diagram symbols of each component of the circuit:

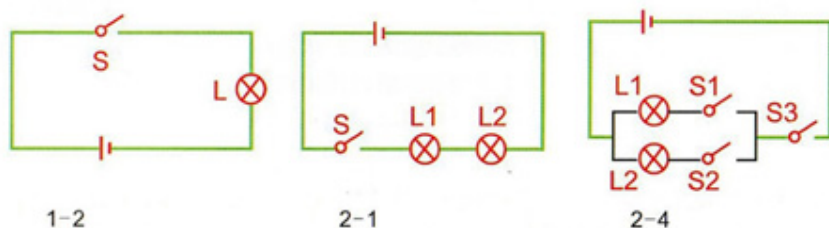


The symbols of No. 1 dry battery and No. 5 dry battery in the circuit are the same, because their functions are the same.

Draw the circuit diagram according to the physical circuit connection:

In the front, we used the physical circuit connected by the physical equipment, and now we can also use the above symbols.

The circuit is represented by a circuit diagram on paper. The circuit diagram corresponding to the previous individual actual circuit is as follows:

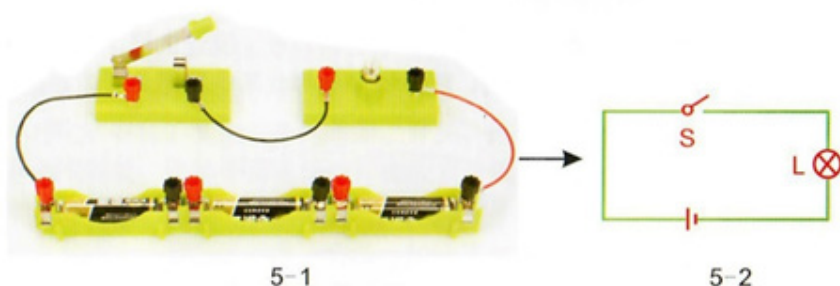


The circuit diagram corresponding to Figure 1-2 The circuit diagram corresponding to Figure 2-1 The circuit diagram corresponding to Figure 2-4

From the above circuit diagram, we can see that the wires in the circuit are represented by straight lines in the circuit diagram.

It is necessary to draw horizontal and vertical lines, so that the entire circuit diagram is square, which is not only beautiful, but also the key is more clear and standardized.

It is convenient for communication. The wires in the circuit diagram do not represent the actual length. In order to better understand the circuit drawing method, it must be practice more.



For relatively simple physical circuits, it is relatively easy to draw circuit diagrams for basic series-parallel circuits.

If the circuit diagram can correctly reflect the connection mode of the circuit and the sequence of the current flowing through the various components, the circuit diagram can be accurately drawn.

After the idea is simplified, draw the corresponding circuit diagram

Figure 5-1, Figure 5-2 can be analyzed and simplified according to this process, and finally the circuit diagram is drawn.

Knowledge point:

1. The circuit diagram must be accurate and standardized
2. The process of drawing a circuit diagram is not a simple drawing, but a process of analyzing the circuit, and it is also the knowledge of electricity.

6. Study the current law of series circuit

Learning target:

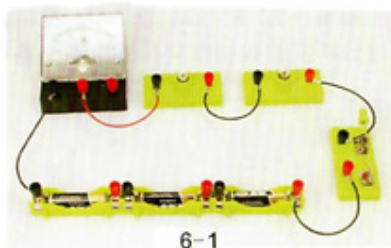
1. Master the regularity of the current size in all parts of the series circuit. Will use the current law of series circuit to construct circuit.

3. Earlier we learned the connection method of series circuit, Some specialties of series circuits are initially explored. Figure 6-1

Now let's use the anemometer to further quantitatively explore what other special features of the series circuit are.

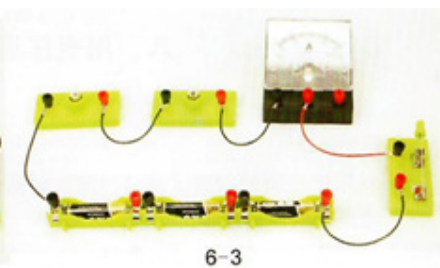
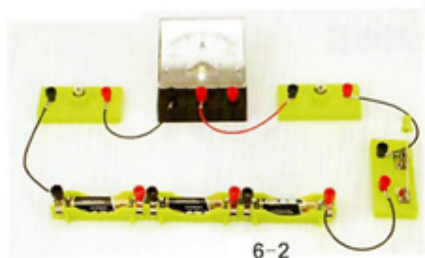
Equipment: battery box, battery, switch, ammeter, small light bulb, wire, small lamp holder.

Experimental design:



As shown in Figure 6-2 and Figure 6-3, connect the ammeter to several different places in the series circuit to explore the series circuit.

What are the characteristics?



7. Study the current law of parallel circuit

Learning target:

1. Master the law of parallel circuit and the current size of each branch.
2. Learn to use the law of parallel circuit current to calculate.
3. We have learned the connection method of series circuit earlier.

Use the amperemeter you have learned to further quantitatively explore what are the characteristics of series circuits.

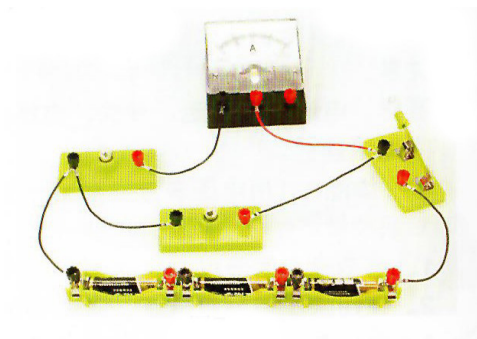


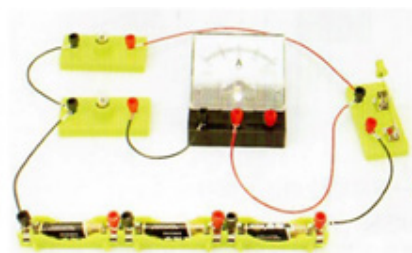
Figure 7.1

Equipment: battery box, battery, switch, ammeter, small light bulb, wire, small lamp holder.

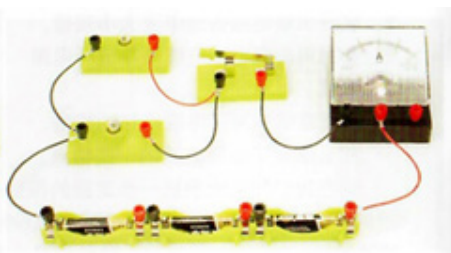
Experimental design:

As shown in Figure 7-1, Figure 7-2, Figure 7-3, connect the ammeter to the main circuit and each branch circuit of the parallel circuit respectively,

By analyzing the experimental data, the relationship between the main circuit current and each branch current of the parallel circuit is explored.



7-2



7-3

8. Use a voltmeter to measure the voltage

Learning target:

1. Know the scale of the voltmeter and the two quantities of the voltmeter range and the corresponding graduation value.
2. The voltmeter can be correctly connected to the circuit.
3. Further develop the habit of testing and estimating the selection range.
4. Summarize the usage and precautions of the voltmeter.
5. Know the voltage of the series battery pack and the voltage between each cell relation.

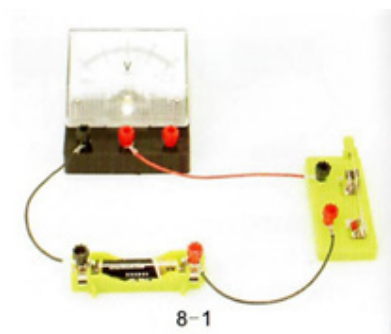


Figure 8-1

Equipment: battery box, battery, switch, voltmeter, small light bulb, wire, small lamp holder.

Experimental design:

As shown in Figure 8-1, use a voltmeter to measure the voltage of one battery, the voltage of two batteries, and the voltage of three batteries.

Knowledge skill points:

1. Two or more batteries are connected end to end to form a series battery pack;
2. When using a voltmeter to measure the voltage, the different ranges

of the voltmeter should be selected in consideration of the size of the voltage, and the test should be carried out;

3. The zero adjustment of the voltmeter pointer is the same as that of the ammeter.

9. Explore the voltage law of series circuit

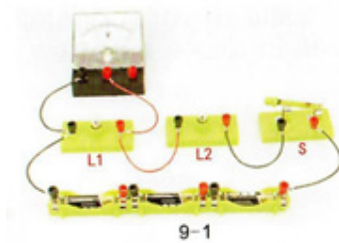
Learning target:

1. Further proficient in using a voltmeter to measure voltage.
2. Master the voltage of each part of the series circuit and the total voltage of the circuit

Will apply the voltage law of series circuit for circuit calculation.

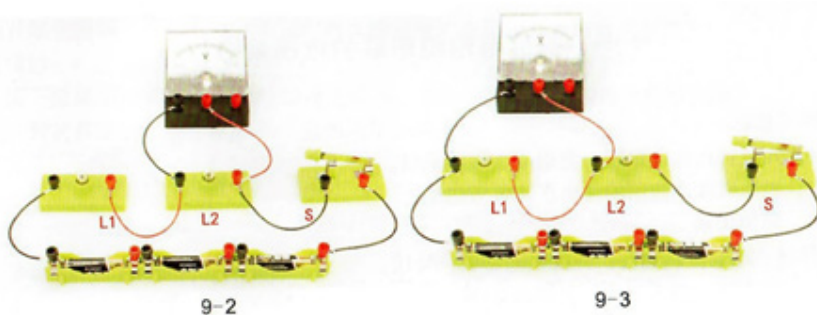
Earlier we studied the law of current in a series circuit,

So what is the law of series circuit voltage?



Equipment: battery box, battery, switch, voltmeter, small light bulb, wire, small lamp holder.

Experimental design:



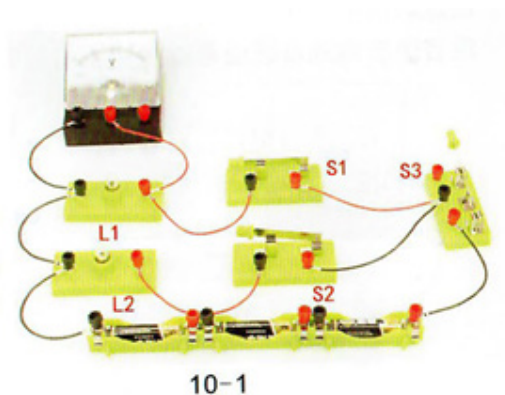
As shown in Figure 9-1, Figure 9-2, and Figure 9-3, the voltmeters measured the voltage across L1 and the voltage across L2.

The total voltage of the circuit, analyze the experimental data, and summarize the rules.

10. Explore the voltage law of parallel circuits

Learning target:

1. Master the voltage at both ends of each branch of the parallel circuit and the overall circuit voltage



Will use the parallel circuit voltage to perform circuit calculations in parallel.

The current characteristics of the circuit, we already know the main

circuit.

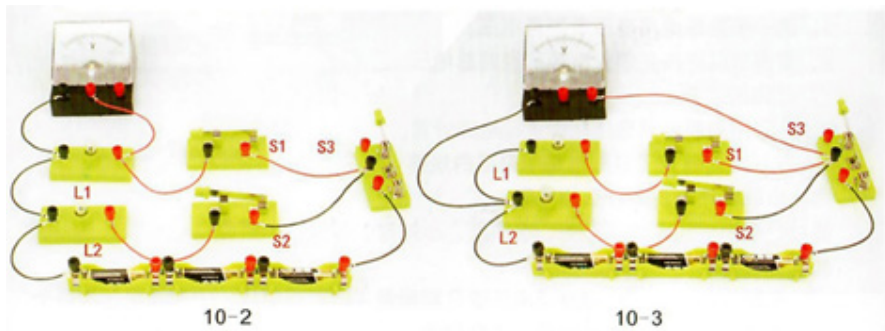
The current is equal to the sum of the currents of each branch, then the parallel circuit S2

What are the characteristics of voltage?

Experimental design:

As shown in Figure 10-1, measure the voltage U_1 across the bulb L_1 , and then measure the voltage U_2 across L_2 as shown in Figure 10-2.

10-3 Measure the voltage U of the parallel circuit and record it separately, and summarize the voltage law of the parallel circuit.



11. Explore the voltage law of battery packs in series

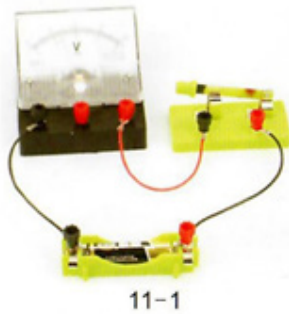
Learning target:

1. Know what is the current form a series battery pack.
2. Know the total voltage of the series battery pack and the difference between each battery.

Equipment: battery box, battery, switch, voltmeter, wire.

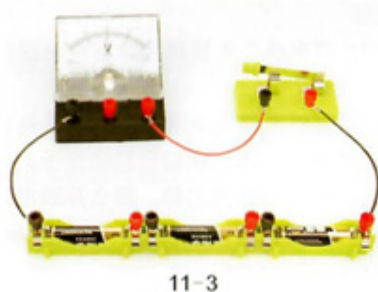
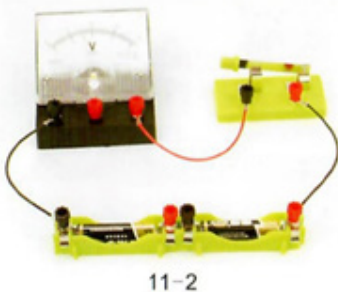
In the circuit usually is used dry battery as power supply.

We know that the voltage of a dry cell is about 1.5V.



But what about circuits that usually require different voltages? In fact, we have solved this problem in the previous experiments,

Using several batteries in series can provide different voltages, let's use experiments to explore this problem.



Experimental design:

As shown in Figure 11-1, use the voltage to measure the voltage of the 2-1-series battery, and then connect 2 of them in series to measure the voltage (as shown in Figure 11-2), analyze the relationship between the total voltage of two batteries in series and the voltage of each battery; then as shown in Figure 11-3, measure the relationship between the total battery voltage and the voltage of each cell formed by combining three cells.

Matters needing attention: The battery boxes are connected together in series. Pay attention to the methods and skills when assembling and disassembling.

12. Explore the voltage law of parallel connection of battery packs

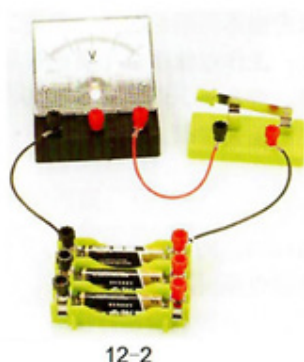
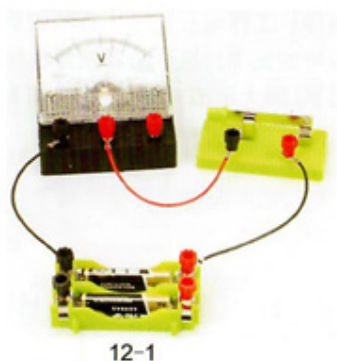
Learning target:

1. Know what is the parallel connection of batteries and the conditions for parallel connection of batteries.
2. Know the relationship between the total voltage of the parallel battery pack and each battery.

In the circuit we learned, it is more common to form a battery pack in series with a battery to supply power to the circuit.

Can it be used in parallel? What are the characteristics of the voltage of parallel battery packs? Where can it be used?

Figure 12-1 Battery pack composed of two cells in parallel Figure 12-2 Battery pack composed of three cells in parallel



Experimental design:

Measure the voltage of one battery according to the method shown in Figure 12-1 below, and then connect batteries of the same voltage in parallel.

As shown in the figure, the relationship between the voltage after par-

allel connection and the original voltage of each battery is analyzed.

Knowledge expansion:

It can be seen from the experiment that the total voltage of the parallel battery pack is unchanged after the batteries with the same voltage are connected in parallel.

Connecting batteries in parallel cannot increase the voltage, but connecting batteries of the same voltage in parallel can reduce the internal resistance of the battery pack.

The size of the output current; the power supply for electric vehicles is the battery pack, usually each 12V battery is connected in series

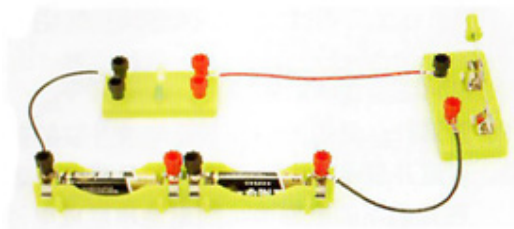
By increasing the voltage, a larger current can be output through parallel connection, which increases the battery capacity; another example is the current solar power

The output voltage of each cell is low, and the output current is very small. In actual use, multiple solar cells are often connected in series.

Increase the voltage in parallel, and increase the output current in parallel.

13. Measure the working current of light-emitting diodes

1. Understand the unidirectional conductivity of diodes
2. By measuring the characteristics of energy saving and environmental protection of light-emitting diodes
3. Understand the wide use of light-emitting diodes and their use as a green energy.



13-1

Equipment: battery case, battery, switch, ammeter, and wires, diodes.

Light-emitting diode, referred to as LED, is a high-efficiency light-emitting semiconductor(dopped crystal) device that can convert electrical energy into visible light.

It is made of materials such as gallium-arsen(Ga-As), silicon with impurity; in the production, the materials used are different, that it can emit light of different colors.

The characteristics of light-emitting diodes are: the working voltage is low (1.8...3.1V); the working current is very small (4...40 mA);

High reliability and long life, widely used in various instrument indicators, LED large screen; especially LED is a light source in a home lighting and street lighting.

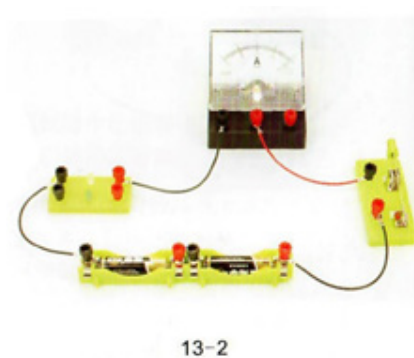
Experimental design:

As shown in Figure 13-1, connect one of the LEDs to the circuit (note that the power supply uses two batteries in series, about 3V voltage).

When the voltage is high, the diode will break down and burn out.

Observe the light emission of the diode.

As shown in Figure 13-2, use an ampermeter to measure the working current.

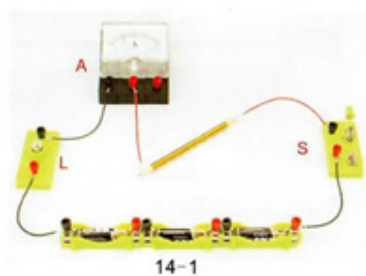


14. Explore the factors that affect the resistance of conductors

Learning target:

1. Know that resistance is a fundamental property of conductors
2. Say several factors that affect the resistance of the conductor

Equipment: battery box, battery, switch, ampermeter, wire, bring your own pencil.



The electrical resistance of a conductor is a measure of its opposition to the flow of electric current under the same voltage, conductors with different resistances carry larger currents

Small is not the same; the higher the resistance, the lower the current through it, so we can compare the conductor resistance by comparing the passing current at the same voltage.

What factors are related to it? Let's explore it through experimental design:

1. Use a pencil (bring your own) to connect to the circuit as shown, change the length of the pencil lead, and observe the ampermeter and lamp

Changes in bubble brightness.

2. The above circuit can also be used to connect different lengths of iron wire, copper wire), etc., observe the circuit current change.

15. Use a sliding rheostat to change the brightness of the light bulb

Learning target:

1. Understand the structure of sliding rheostat and the principle of sliding.
2. Be able to use the sliding rheostat correctly and know the characteristics of the six connection methods of the sliding rheostat.
3. Understand the function of the sliding rheostat in the circuit through experimental exploration.

Equipment: battery box, battery, switch, sliding rheostat, lead wire

Through the experiment of the fourteenth subject, Figure 14-1, we can see that changing the length of the pencil lead to change the current.

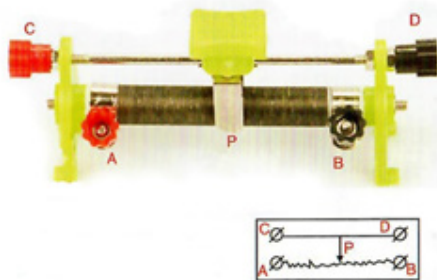
The size of the input resistance changes the current. In fact, there is a special similar experimental element called a sliding rheostat.

It can better achieve this effect, as shown in the figure, let us understand the structure and usage of the sliding rheostat law.

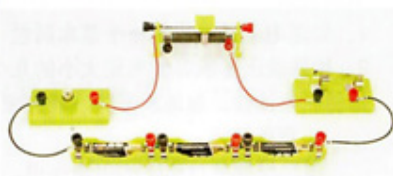
Experimental design:

Connect the circuit as shown in Figure 15-2, move the sliding rheostat to observe the brightness change of the bulb.

Think about how current flows through a sliding rheostat? How does a sliding rheostat change the resistance connected to the circuit?



15-1



15-2

Structure diagram of sliding rheostat Figure 15-1

Expand your research:

The sliding rheostat has a total of four binding posts, and every two binding posts are connected to the circuit in pairs, so there are six types of connections.

Then, what are the differences between these six connection methods? What are the connection methods that can change the size of the resistance?

What are the characteristics of the connection method that can change the resistance value?

16. Current, voltage and resistance - Ohms law

Learning target:

1. Master the relationship between the current passing through the conductor and the voltage across the conductor through exploration
2. The relationship between current, voltage and resistance in circuit to understand ohms.
3. Use Ohm's law formula for circuit calculations (combining the current and voltage characteristics of series circuits).

Equipment: sliding rheostat, ammeter, voltmeter, resistor, battery box, battery, switch, wire.

Current (I), voltage (U), and resistance (R) are the three most basic

physical quantities in electricity.

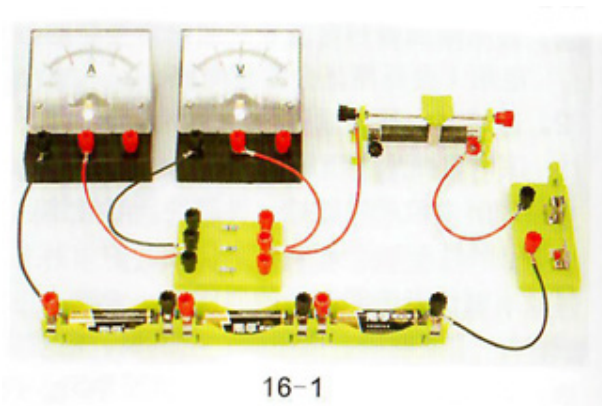
In many experiments, we will think that the voltage of the current through the circuit is related to the voltage. The higher the voltage, the greater the current may be.

If the current and voltage remain unchanged, if we add a sliding rheostat to the circuit to increase the resistance, the circuit current will decrease.

The smaller the flow, what is the relationship between the current, voltage and resistance through the circuit? How to represent the three relationship between?

The relationship between current and voltage: the higher the voltage added to the same circuit, the greater the current.

The relationship between current and resistance: When the voltage is constant, the circuit resistance is large and the current may be smaller.



Experimental design:

Through the previous experimental phenomenon, we guessed that the current size may be affected by the resistance and may also be affected by the voltage.

The effect of resistance size, when we design experiments to quantitatively study the relationship between current size, voltage and resistance

Next, we use a fixed-value resistor instead of a conductor or a circuit

to explore.

Study the relationship between these three physical quantities.

1. As shown in Figure 16-1, we study through the fixed value

Resistor R (leave $R = 10$ ohms constant) on passing current, by changing the sliding rheostat to change the voltage across the fixed value resistor (best measure several times the voltage changes into integer multiples), and simultaneously measure the current.

Quantitatively record the magnitude of the current passing through the fixed-value resistor,

2. Also use the circuit as shown in Figure 16-1, connect 5 ohm and 15 ohm resistors respectively, and adjust the sliding rheostat each time to make the voltage across the R value remains unchanged, while measuring and recording the change of the current in the circuit, summarizing the current and resistance relationship respectively.

In the above experiments, the current through the conductor is affected by both the voltage and the resistance,

So when studying the relationship between current and voltage, when we change the voltage across the circuit, we should keep the resistance unchanged. When studying the relationship between current and resistance, the voltage should be kept unchanged. This method is called control variable method.

17. Using a voltmeter and measuring resistance

1. Will measure a conductor resistance with a voltmeter and an ammeter.

2. Calculate the average value through multiple measurements to reduce the error.

3. Understand that resistance is a property of conductors, and conductors it doesn't matter if the resistor is energized or not.

4. Master the principle of measuring resistance by voltammetry

Equipment: Voltmeter, ammeter, battery boxes, batteries, switches, sliding rheostats, wires.

It is the basis of the experiment. Through the previous study, we know

that the magnitude of the current can be quantified by the ampermeter.

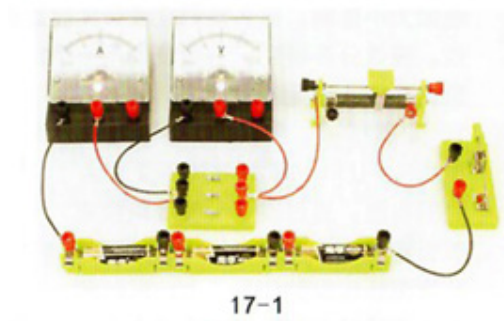
Is there any other way to measure the physical quantity of resistance? In fact, after learning Ohm's law, it is a reasonable method to indirectly measure the resistance of a conductor.

Experimental design:

As shown in Figure 17-1, use one of the fixed-value resistors as the unknown resistance X , measure the voltage across it and the passing current.

The magnitude of the current is recorded in the table. In order to reduce the error, the measured current can be changed by adjusting the sliding varistor.

The voltage and current across the resistor are measured several times, and the measurement data is recorded in the following table:



18. Use voltmeter and ammeter to measure the power of small light bulbs

Learning target:

1. Know the principle of measuring the power of small light bulbs, be able to connect circuits, and draw circuit diagrams.
2. Master the relationship between the brightness of the small light bulb and the actual power of the light bulb.
3. Further understand the difference between the rated power and the actual power of the bulb.

4. Measure the resistance of small light bulbs under different working voltages, and analyze the reasons.

Equipment: sliding rheostat, ampermeter, voltmeter, small light bulb, battery box, battery, switch, wire, small lamp holder.

Power (P) is a physical quantity of how much electrical energy is consumed by an electrical appliance at a certain time.

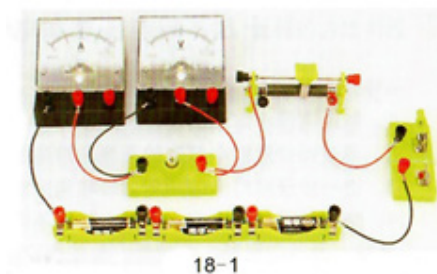
It is very helpful for us to understand the rated power and actual power, the resistance of light bulb to measure the power of a light bulb.

Experimental design:

Observe the numbers on the light bulbs and identify the normal working voltage of the light bulbs (that is, the rated voltage)

The rated voltage of small light bulbs commonly used in experiments is generally 2.5V and 3.8V. As shown in Figure 18-1 to adjust the sliding variable resistor, first let the voltage across the bulb reach its working voltage, and at the same time measure the working current through the small bulb.

Note: the current passing through the bulb under the normal working voltage is also called the rated current); observe the brightness of the bulb; then readjust the bulb voltage higher than its rated voltage (should not exceed 1.2 times its normal working voltage, otherwise it will easy to burn out) Measure and record the bulb current and observe the light emission, and then change the bulb voltage below its rated power Voltage to measure current and observe bulb brightness. Observe that the voltage rating of the small light bulb.



19. Understand simple magnetic phenomena

Learning target:

1. Know the magnetic poles of magnets and know what is magnetism.
2. Through experimental exploration, summarize the interaction law between the magnetic poles.
3. Know what is magnetization and its application, know what is magnetic material and its application.

The compass is one of the four great inventions in ancient China. The compass uses a property of magnets.

The understanding of magnetic phenomena is relatively early, and there are high achievements. Many students have played with magnets. Now we will go deeper into the control.

Experimental design:

As shown in Figure 20-1 and Figure 20-2, place a bar magnet or a horse pound magnet on the configured iron powder box and observe

Which part of the magnet attracts the most iron filings? By exploring, think about the different magnetic properties of the different parts of the magnet.

How's it going? The pole of a magnet refers to which part of it.

Hang the magnet with a thin wire, it can swing freely in the horizontal plane, and then observe the magnet still

Where do the rear ends point to?

Take a magnet and place the sections marked N and S close to each other, and feel the presence of the magnetic force between them.

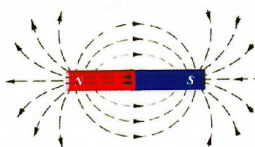
20. Magnetic Field and Magnetic Field Lines

Learning target:

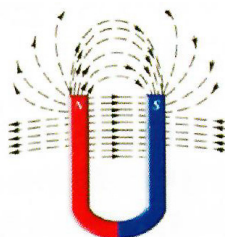
1. Recognize the existence of a magnetic field and know that the magnetic field has a direction.
2. Know what magnetic field lines are, and can draw magnetic fields around common magnets.



20-1



20-2



20-3

Sense lines to describe the magnetic field.

Equipment: U-shaped magnet, iron powder box.

In the previous exploration experiments, we know that the magnet can act without touching the iron nail, and the attraction and repulsion of the magnetic poles of the magnet are also powerful without contact. There is an invisible and intangible special substance called the magnetic field around the magnet.

Experimental design:

1. Put a small magnetic needle next to the magnet, and then constantly change the direction of the small magnetic needle and the magnet, and think about what this phenomenon shows (Fig 20-1).
2. According to Figure 20-2 and Figure 20-3, put the bar magnet and U-shaped magnet on the iron powder box, respectively hold the magnet with your hand, first gently shake the iron powder box in the horizontal direction, and then use your fingers. Tap the iron powder box lightly, and finally observe the situation of the iron filings in the iron powder box, analyze and think about the law of the magnetic field division around the bar magnet and the U-shaped magnet?

Knowledge point:

1. By observing the change of the direction of the small magnetic needle in different places around the magnet, it shows that the small magnetic needle is subjected to the force of the magnetic field of the magnet, which shows that the magnetic field has a direction, and the direction of the magnetic field is generally different in different places around the magnet.

2. The magnetic field can be better understood by observing the iron filings of the iron powder box, because after the iron filings are magnetized by the magnetic field of the magnet, each tiny iron filing can be regarded as a tiny small magnetic needle, and the direction of the arrangement of the iron filings can be seen. The direction of the magnetic field is different, and the place with more iron filings indicates that the magnetic field is more strong.

3. Through experimental exploration, we found that the magnetic field has a direction. In order to better describe the magnetic field, scientists were inspired by the image of iron filings being magnetized and arranged, and proposed the method of magnetic field lines, which is to draw some imaginary curves in the magnetic field. , the tangent direction of each point on the curve represents the magnetic field direction at that point, and the sparseness of the ground line with a strong magnetic field indicates a weak magnetic field.

21. Oster experiment

Learning target:

1. Know the Oster experiment and its significance.
2. Know the factors that affect the direction of the current magnetic field.

Equipment: battery case, battery, compass, switch.

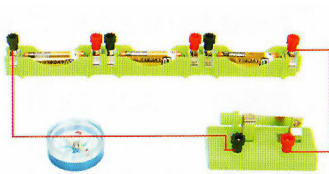
Humans have long recognized magnetic and electrical phenomena, but before the 19th century, scientists believed that electrical phenomena and magnetism were isolated, they were all studied separately, but

were first discovered by the Danish scientist Oster in the 1820s.

The connection between electrical and magnetic phenomena has since opened up the science of electromagnetic phenomena one after another for mankind.

It was found that, in order to lay the foundation for mankind to enter the era of electricity, let's get to know the Oster experiment.

Experimental design:



21-1

As shown in Figure 21-1, place the wire above the small magnetic needle along the N and S pole directions of the small magnetic needle, and then quickly close the switch.

Quickly disconnect, observe the reaction of the small magnetic needle at the moment of power-on, then change the direction of the current through the wire, and then observe small magnetic needle reaction.

22. Solenoids and Ampere's Law

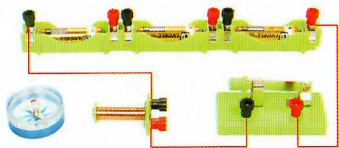
Learning target:

1. Understand the magnetic field distribution of the energized solenoid.
2. Know the relationship between the magnetic pole of the energized solenoid and the direction of the current.

Oersted's experiment was originally a study of a straight wire that was energized around it.

The surrounding current magnetic field, after the success of the Oersted experiment, Ampere turned the electrical conductors are bent into loops and later wound into multiple pairs of helical coils.

Its magnetic field distribution is explored, and now we will explore the ampere of energized solenoid magnetic field conditions.



22-1

Equipment: Solenoid, battery box, battery, compass, wire, switch.

Experimental design:

As shown in Figure 22-1, different parts of the energized solenoid are close to the small magnetic needle to judge the magnetic field of the solenoid.

Turn on the N and S poles of the solenoid, then change the direction of the current passing through the solenoid, and observe whether the magnetic pole of the solenoid changes.

Knowledge point:

Through a large number of experimental investigations, it can be seen that the magnetic field distribution of the energized solenoid is similar to that of the bar magnet.

The magnetic pole is related to the current direction.

Judging by the method shown in the figure, hold the solenoid with the right hand, four fingers square.

If the direction is consistent with the direction of the energized current, the thumb points to the solenoid N.

This method is called Ampère's law.



22-2

23. Electromagnet

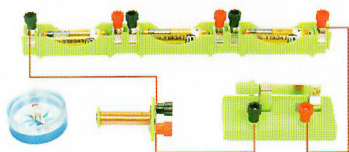
Learning target:

1. Know the structure and principle of electromagnet.
2. Know what factors are related to the magnetic field size of the electromagnet.

3. Understand the application of electromagnets in various occasions.

After Chapter 22 - Solenoids and Ampere's Law, a magnetic field will be generated, which is similar to a bar magnet.

But the magnetism is limited, so how to increase the magnetism of the solenoid

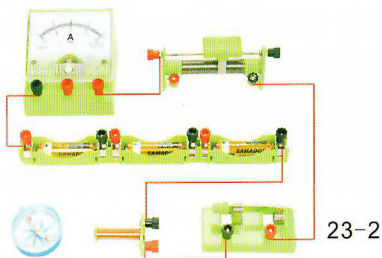


23-1

Equipment: ampermeter, solenoid, battery box, battery, sliding rheostat, compass, wire, switch, auto.

Prepare tracks.

Experimental design:



23-2

As shown in Figure 23-2, Figure 23-3 compares its magnetic changes by adjusting the sliding rheostat.

24. Understand the principle and use of electric bells

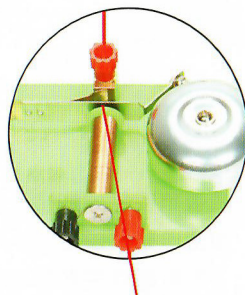
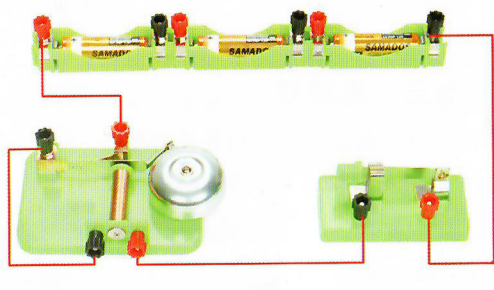
Learning target:

1. Understand the composition and function of the electric bell;
2. The basic control circuit that can be composed for electric bells;
3. Understand the application of electric bell.

Principle: magnetic effect of current: when the electricity is turned on, the electromagnet will have current passing through it, which will generate magnetism.

The armature of the electric bell is sucked in, so that the small hammer hits the electric bell and makes a sound. At the same time, the circuit is disconnected, and the electromagnet loses its magnetism.

The small hammer is bounced back, the circuit is closed, and it repeats continuously, and the electric bell emits a continuous beating sound, as shown in Figure 24-1.



24-1

25. The effect of magnetic field on current-carrying conductors

Learning target:

1. Know the powerful effect of magnetic field on energized conductors;
2. Know that the direction of force acting on the current-carrying conductor is related to those factors.

Equipment: Copper metal rail, battery box, battery, switch.

Using the principle of electromagnetic induction, humans invented generators to provide us with a large amount of electricity, and then use electricity

It can be converted into other energy for our use, such as heat energy through electric heaters, light through electric lamps

So how can we get a lot of kinetic energy (mechanical energy) from electrical energy in our life and industrial life?

Of course, this requires a motor, so why can a motor convert electrical energy into mechanical energy? Let's control the study how electrical energy is converted into kinetic energy.

Experimental design:

As shown in Figure 25-1, we know the names of each part by comparing the exploration equipment.

The copper guide rails are on the same level, and the small copper needle is placed between the upper and lower magnet poles.

Turn on the power supply to form a circuit, and quickly try to touch the switch at the beginning of the experiment (that is, open immediately after closing).

A large instantaneous current is generated through the guide rail and copper needle, and the phenomenon that occurs is observed.

Three new AA batteries are connected in series to form a battery pack

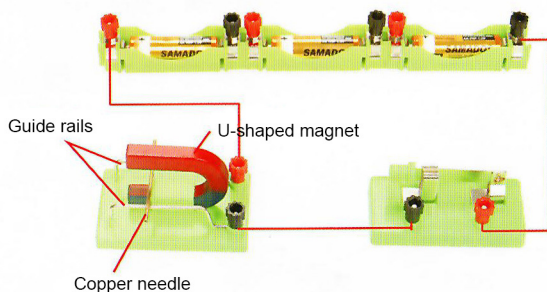


Figure 25-1 Composition of the experimental setup for the effect of the magnetic field on the force of the current-carrying conductor

26. Know the mobile generator

Learning target:

1. Understand the basic structure of DC hand generator;
2. Know the basic principles of generators.

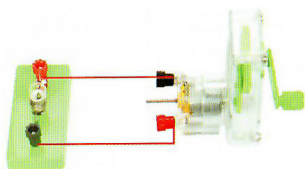
Equipment: lamp holder, light bulb, wire, hand generator, ammeter, voltmeter.

As shown in Figure 26-1, rotate the generator and observe whether it emits light.

2. As shown in Figure 26-2, observe whether the pointer of the ammeter rotates? And investigate whether the direction of rotation affects the direction of the current?

Note:

Connect the ammeter to “-” “0.6A” otherwise the ampermeter will burn.

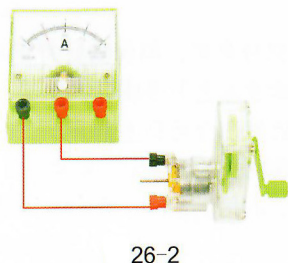


26-1

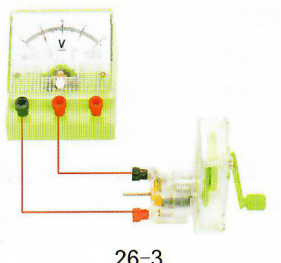
Figure 26-1

3. As shown in Figure 26-3, observe whether the pointer of the voltmeter will rotate? And study how much V can be reached by the rotation?

Note that the ammeter is connected to “-” “15V” or the voltmeter will burn out.



26-2



26-3

27. Explore the resistance law experimenter

Resistance law Experimenter:

1. Equipment: sliding rheostat, battery, battery box, switch, ammeter, voltmeter, wire.

The following experiments can be done:

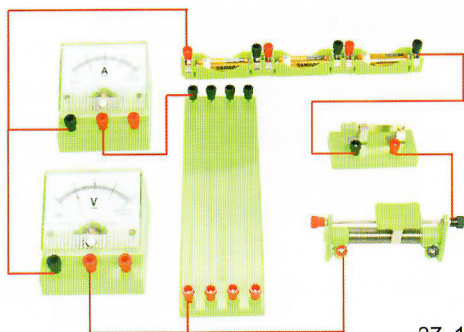
1. Definition of conductor resistance
2. Verify the resistance law
3. Determination of conductor resistivity
4. Study the series and parallel connection of conductors

2. Structure: the instrument consists of two nickel-chromium wires and one copper wire, which are arranged on a plastic bottom plate.

3. How to use: as shown in Figure 27-1

- Pay attention to protect the metal wire to prevent breakage.
- Pay attention to the cleanliness of the terminals and keep them in good contact.

- The power supply voltage should not be too high during use, and the power-on time should not be too long to avoid changing the value.
- It should be placed in a dry and cool place at the same time to avoid moisture deterioration.



27-1

28. Know the DC motor

Learning target:

1. Know the structure of DC motor and the names of each part;
2. Know the working principle of the motor and the energy conversion process;
3. Explore the reasons that affect the rotation direction and rotation speed of the motor.

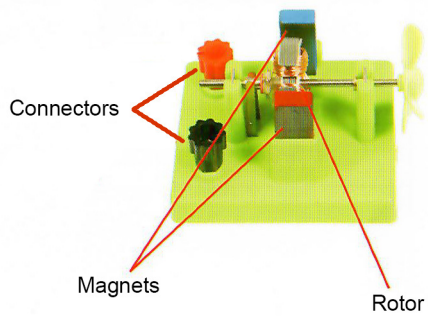
Equipment: electric motor, ammeter, battery box, battery, switch, wire.

Fans, washing machines, air conditioners, many of these electrical appliances in life use motors to work.

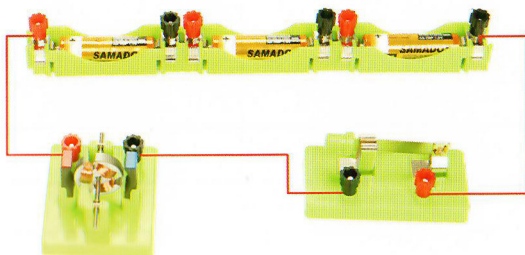
The small motor on the four-wheel-drive car played by classmates, the razor for men, the electric locomotive on the high-speed railway.

All kinds of car orders in the industry, and water pumps in agriculture are inseparable from all kinds of electric motors.

It is an important tool to convert it into kinetic energy. Let's understand its structure and structure from the small motor in our hands.



28-1



28-2