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暨南大学本科实验报告专用纸

课程名称 Physics Experiment　成绩评定 ______

实验项目名称 The characteristic curve of the semiconductor diode　指导教师 Zhang

实验项目编号 Ep 04　实验项目类型 ____ 实验地点 ______

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实验时间 2022 年 9 月 26 日 上午～__月__日 __午 温度__℃湿度____

Ohm's Law is the following statement: "The resistance of a particular circuit element is constant for a wide range of voltage." Unlike many physical laws (such as Newton's Laws, the Ideal Gas Law, etc), Ohm's Law does not always hold, even under ordinary ~~labt~~ laboratory conditions. Certain objects obey Ohm's Law, and others do not. The physical size and shape of an object, as well as the material it is made of, can determine its adherence to Ohm's Law. For instance, a large block of material is more likely to be ohmic than a fine wire made out of the same material. In a sense, Ohm's "law" is really Ohm's guideline.

OBJECTIVE:

To examine how current varies as a function of voltage for a semiconductor diode, and to plot the corresponding I ~ V curve in forward and reverse bias.

THEORY:

In this lab, you will measure the characteristic curve of the semiconductor diode and you will know whether the components obey ~~ob~~ the ohm's law.

Using one of the circuit diagrams described later (Fig. 2), the p.d V across a component can be varied and the corresponding current I measured. A graph of I against V shows the relationship between the two quantities and is called the characteristic curve of the component. It summerizes pictorially how the components behaves.

If the I-V graphs are straight lines through the components, the ones are called linear or ohmic conductors (Fig. 3). For them $I \propto V$ and it follows that $V/I = C$ (C is a constant). They obey Ohm's law. If their I-V graphs are not straight lines or that $V/I \neq C$, the components are non-ohmic or non-linear conductors. A diode is a non-linear component, and its typical I-V graph is showed in Fig. 4.

The semiconductor diode (symbol -▷|-) is an interesting circuit element. Diodes are designed to pass current in only one direction. They are essential in many electronic devices, such as rectifiers, which ~~turn~~ turn AC currents into DC currents. Our diode was formed by joining two different types of semiconductor together. Diodes that are connected in the direction of current flow are said to be connected with

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"forward bias", while those hooked up to oppose current flow ~~in~~ are in "reverse bias". This can be shown on a circuit diagram as in Figure 1. You can think of the ~~tra~~ triangle in the diode symbol as pointing in the direction of allowed current flow.

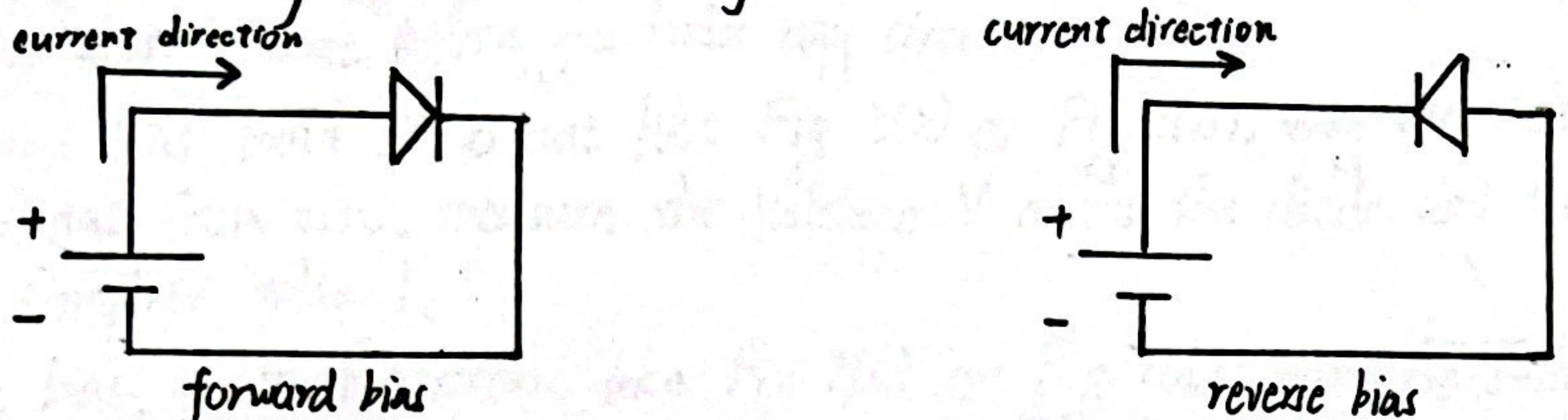

Fig 1. Standard circuit diagrams showing a battery (or other DC voltage source) and a diode in forward bias and reverse bias

To study the characteristic curve of the semiconductor diodes one has to measure both V and I at the same time. There are two possible circuits to choose for forward bias and reverse bias.

"+" sign and "-" sign specify the directions of voltage and current in the semiconductor diode.

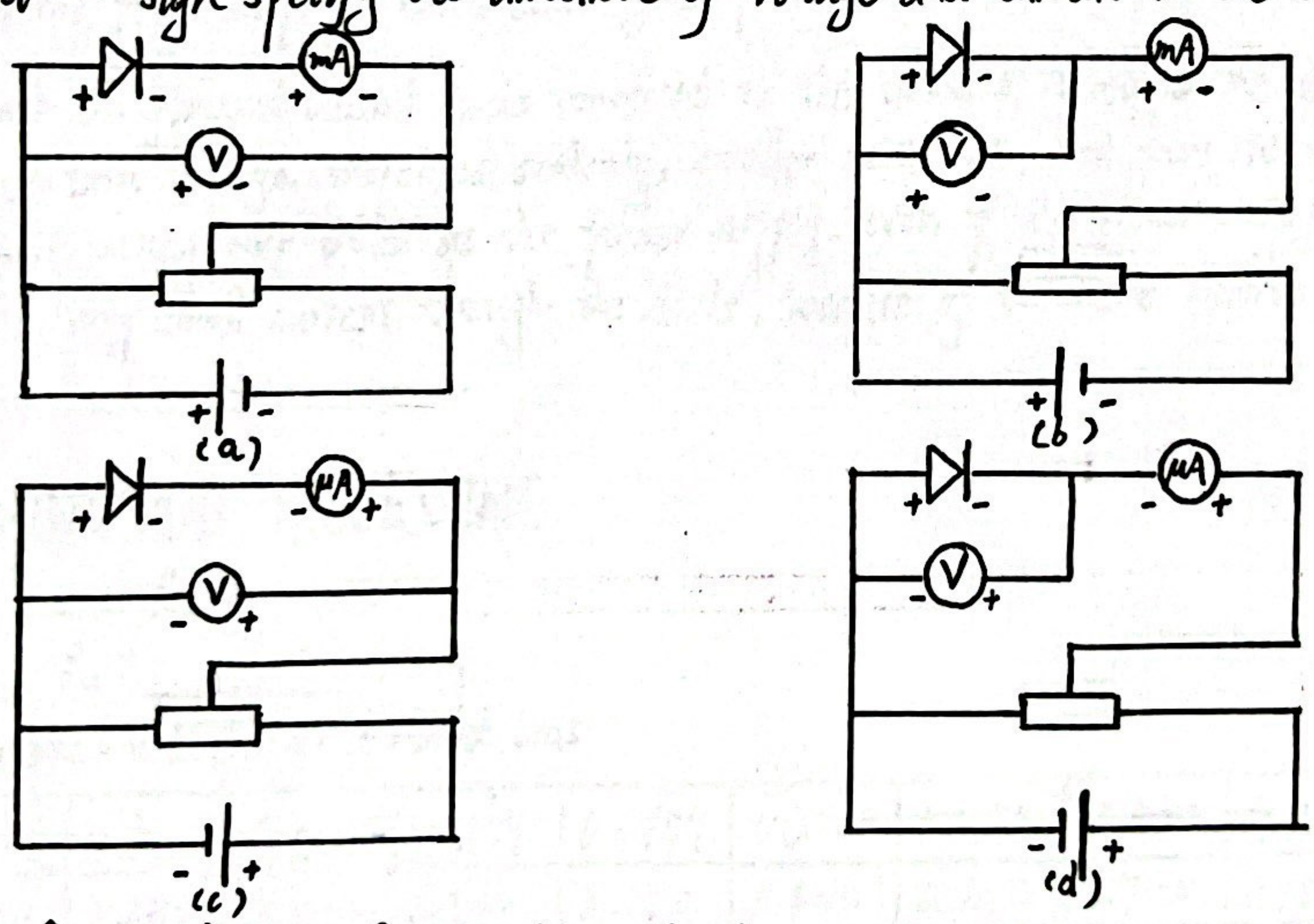

Fig 2 Circuit diagrams Circuits in experiment

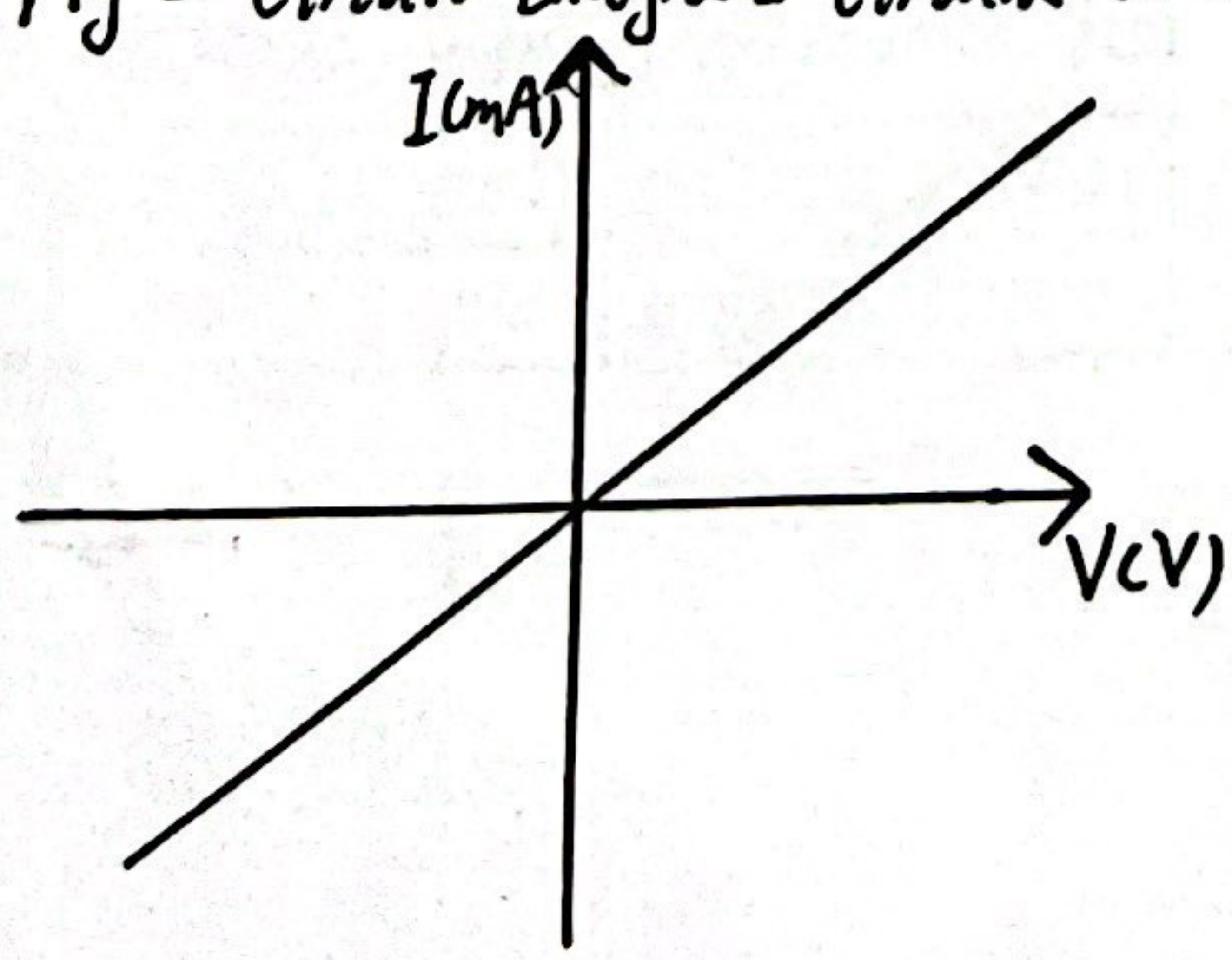

Fig 3 I-V curve of linear conductor

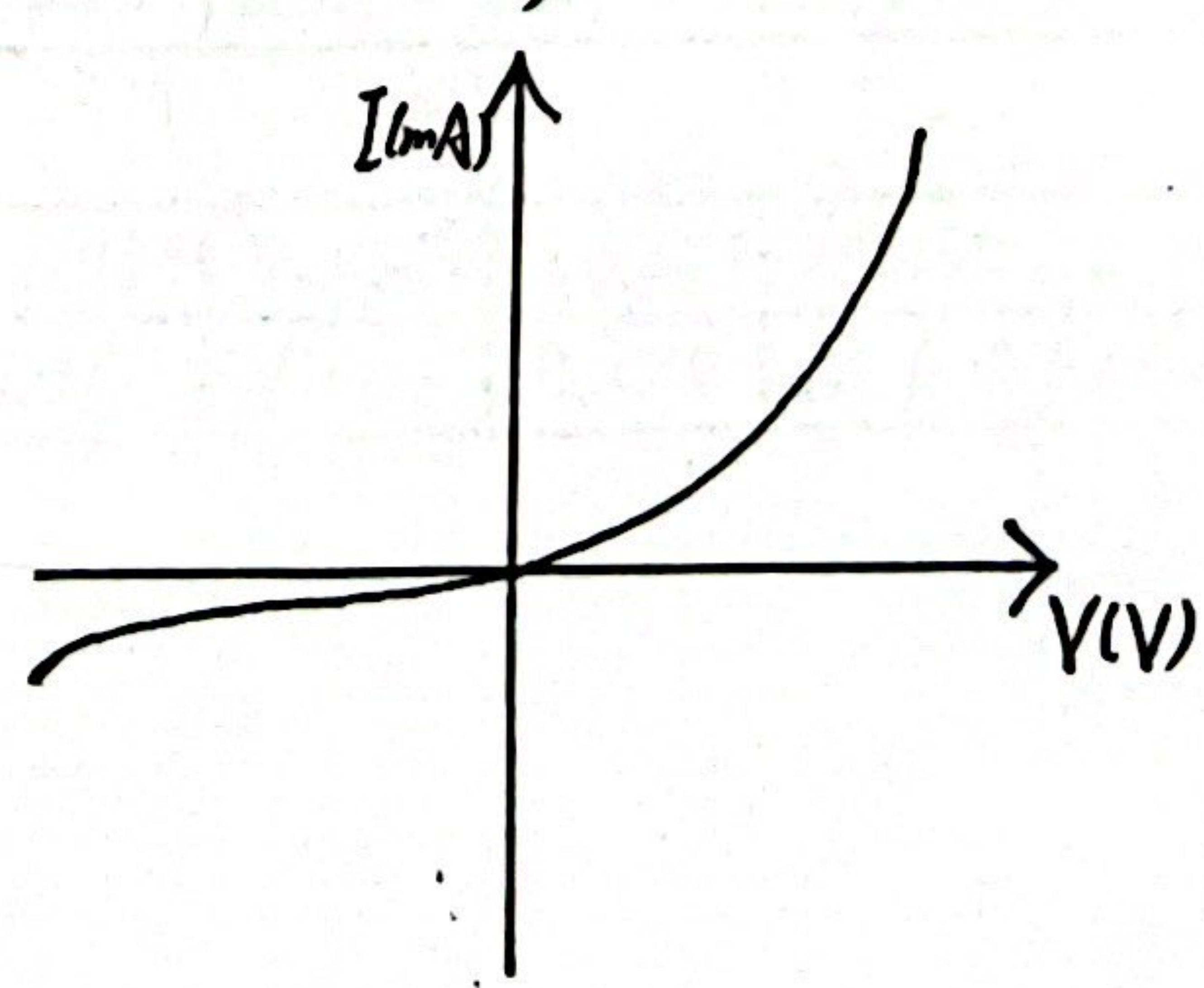

Fig 4 I-V curve of a diode

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PROCEDURE:

A. Measure resistance R1 of the semiconductor diode in forward bias and resistance R2 in reverse bias using the ohm's setting of a multimeter and write down them, then judge if the diode can work normally. This must be done before you build any circuits.

B. ~~in~~ In forward bias, build the circuit like Fig.2(a) or Fig 2(b), vary the sliding contact of the variable rheostat from zero, measure the Voltage V across the diode and the corresponding current I. Complete table 1.

C. In reverse bias, build the circuit like Fig 2(c) or Fig 2(d), vary the sliding contact of the variable rheostat from zero, measure the Voltage V across the diode and the corresponding current I. Complete table 2.

PRE-QUESTIONS

What do you think the voltage, current and resistance would change if you switch the positive and negative cables at the power supply? Write down your prediction.

At first we use the forward biased diode connected to the circuit, through the diode current can under ~~the~~ a certain voltage increases suddenly, smaller resistance, and thus it was lit, if change the positive and ~~n~~ negative cables at the power supply, even if the power supply voltage is very ~~hig~~ high, it still very small current through the diode, because of the diode reverse bias resitance will be very large.

DATA RECORDING AND PROCESSING

(A) Write down R_1 and R_2

R_1 = ________ , R_2 = ________

(B) Table 1 current-voltage in forward bias

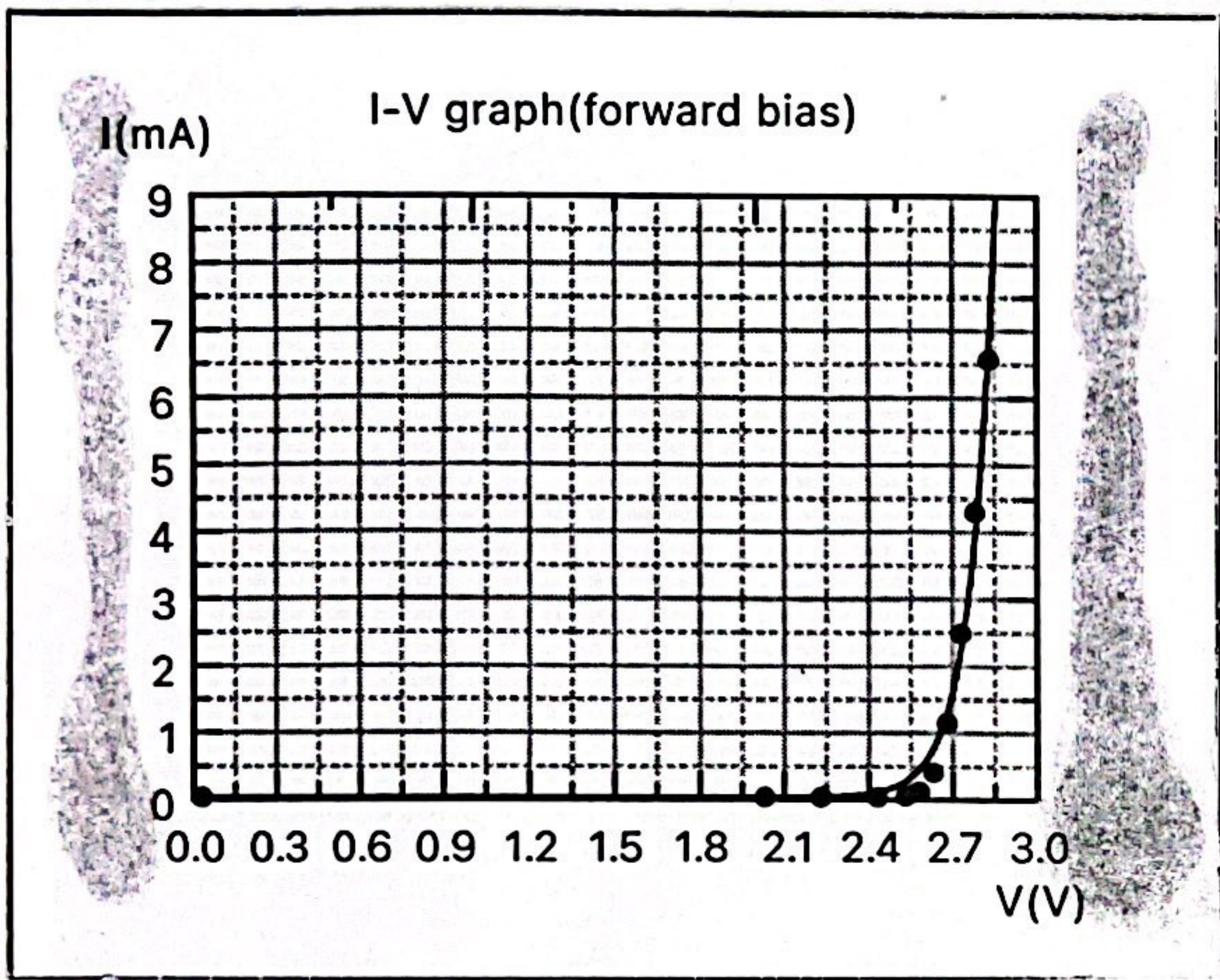
I(mA)	0.0020	0.0022	0.0030	0.0199	0.0899	0.3720	1.1136	2.456	4.264	6.536
V(V)	2.000	2.200	2.400	2.500	2.550	2.600	2.650	2.700	2.750	2.800

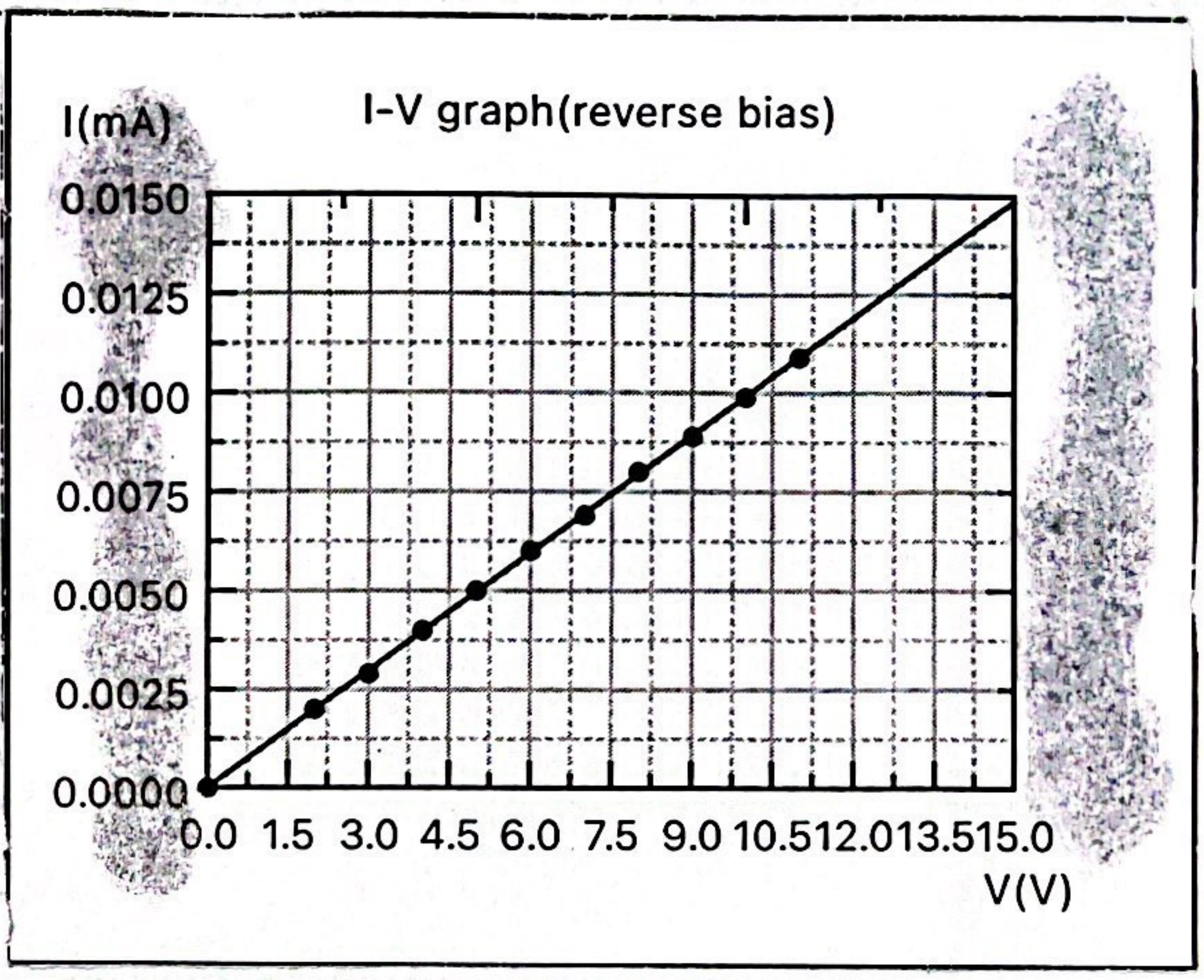
(C) Table 2 current-voltage in reverse bias

I(mA)	0.0020	0.0029	0.0040	0.0050	0.0060	0.0069	0.0080	0.0089	0.0099	0.0109
V(V)	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000	11.000

QUESTIONS

1. Make a titled, labeled graph of voltage versus current what is the relationship between the current through the diode and the voltage drop across the diode in forward bias and reverse bias state.





2. Describe the diode's behave quantitatively. Does it obey ohm's law? Can you think of anything a diode would be useful for?

From the graph in QUESTION 1, we can see that:

When the diode is switched on with forward bias, before a certain voltage (about 2.6 volt in this graph), the resistance of the diode is very large and basically in the state of no conduction. When this voltage is reached, the forward bias resistance of the diode decreases sharply, so that the conduction current rises rapidly and the circuit enters the state of conduction. In the state of conduction, the volt-current characteristics of the diode do not meet Ohm's law.

When the diode is ~~switch~~ switched on by reverse bias, the resistance of the diode is always very large, the current is very small, and it is basically not in the state of conduction. Under high-precision measurement, it can be found that the relationship between voltage and current in the circuit meets Ohm's law.

Application of Diode:

1. Using the switching characteristics of diodes, various logic circuits can be composed.
2. Light-emitting diode is a kind of semiconductor display device that directly converts ~~electric~~ electric energy into light energy. Used on DVD, calculator and other displays.

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