# Lascells Free Experiments - IV Characteristics

## The aim of this experiment is to understand what happens to the current through a circuit component when the potential difference across it changes.

The three components under investigation are a filament bulb, a diode, and a resistor at constant temperature. The circuit symbols for these components are given in Figure 4.
Figure 4:

Symbols for circuit components where


**Figure 4:** Symbols for circuit components where (a) is a resistor, (b) is a lamp/bulb, and (c) is a diode.

The circuits required for this experiment are shown in Figure 5.

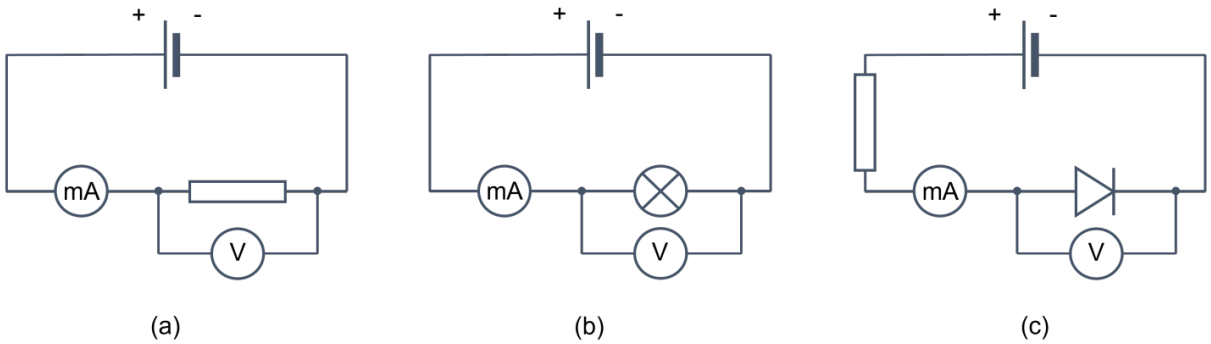


**Figure 5:** Circuits for IV characteristics.

The equipment needed for this experiment is listed below. For this investigation, we will use variable power supplies. This removes the need for a variable resistor, as we can adjust the supply voltage directly on the power supply. We will also swap out an ammeter for a milliammeter to provide a better resolution for the IV curves.


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## Equipment

S100-905 Lascells Precision Variable Power Supply
LA10-155 Lascells Digital Milliammeter
LA10-140 Lascells Digital Voltmeter
SX100-045 Mounted Component MES Lampholder with Bulb
SX100-040 Mounted Component Diode
SX100-010 Mounted Component 10 Ω Resistor
SX100-013 Mounted Component 100 Ω Resistor

## Resistor

1. Set up the circuit for the resistor as shown in Figure 5(a). If you need help:
(a) Connect the positive side of the power supply to the positive terminal of the milliammeter.
(b) Connect the negative side of the milliammeter to the left of the resistor.
(c) Connect the right side of the resistor to the negative side of the power supply.
(d) Now connect the voltmeter in parallel. Connect the negative side of the voltmeter to the right of the resistor.
(e) Connect the positive side of the voltmeter to the left of the resistor.
2. Turn both the voltmeter and milliammeter on.
3. Adjust the power supply voltage to 2 V. Take readings off the voltmeter and milliammeter and record these in a table.
4. Increase the voltage on the power supply in 2 V increments, and take current and voltage readings at each.
5. To record negative readings, swap the connections to the power supply, e.g. take the lead from the negative terminal and put it in the positive, and take the lead from the positive terminal, and put it in the negative. This should give you negative readings on both the voltmeter and milliammeter.
6. Adjust the power supply in 2 V increments again, and note the voltage and current readings off the meters for each.


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## Sample data

| Voltage (V) | Current (mA) | Current (A) |
|---|---|---|
| -1.93 | -19 | -0.019 |
| -3.79 | -38 | -0.038 |
| -5.66 | -57 | -0.057 |
| -7.58 | -77 | -0.077 |
| -9.67 | -98 | -0.098 |
| 1.93 | 20 | 0.020 |
| 3.78 | 38 | 0.038 |
| 5.67 | 57 | 0.057 |
| 7.59 | 77 | 0.077 |
| 9.68 | 98 | 0.098 |

**Table 5:** Sample data for IV characteristics of a resistor. Current in mA has been converted to Current in A by dividing by a factor of 1000.

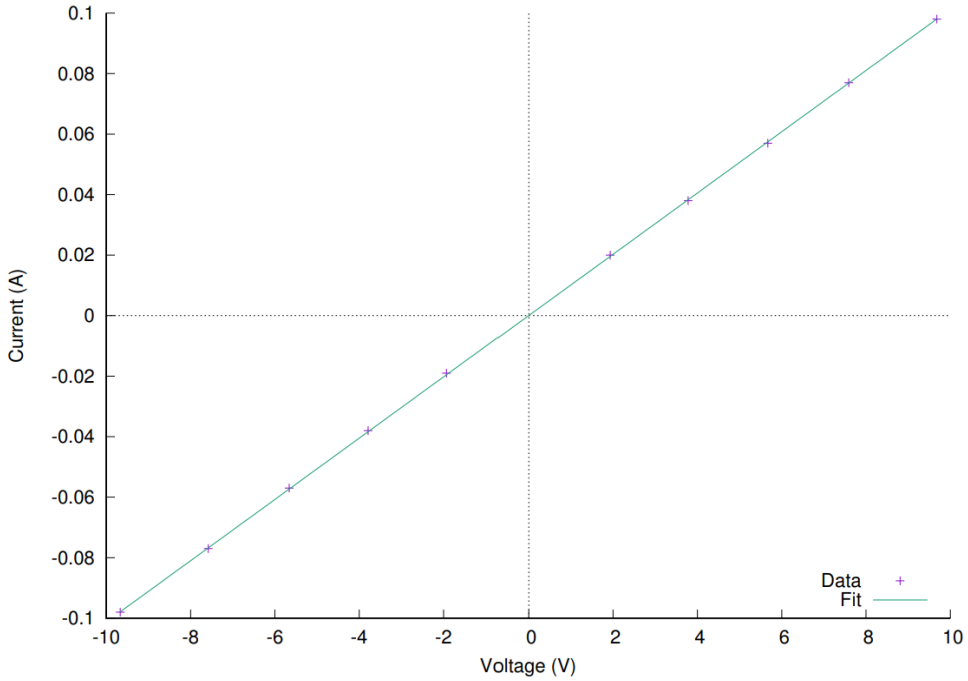


**Figure 6:** Plot of sample data for IV characteristics of a resistor. Data has been linearly fitted.


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## Bulb

1. Set up the circuit for the bulb as shown in Figure 5(b). If you need help
   (a) Connect the positive side of the power supply to the positive terminal on the milliammeter.
   (b) Connect the negative terminal on the milliammeter to the left side of the bulb.
   (c) Connect the right side of the bulb to the negative terminal on the power supply.
   (d) Now connect your voltmeter in parallel. Connect the negative terminal on the voltmeter to the right side of the bulb.
   (e) Connect the positive terminal on the voltmeter to the left side of the bulb.
2. Turn both the voltmeter and milliammeter on.
3. Ensure the power supply voltage is set to 0 V. Turn on the power supply.
4. Slowly, turn the power supply voltage up so that the voltage on the voltmeter reads ~1 V. Take readings off the voltmeter and milliammeter and record these in a table.
5. Increase the voltage on the power supply in ~1 V increments UP TO 6 V on the voltmeter, and take current and voltage readings at each. DO NOT EXCEED 6 V THROUGH THE VOLTMETER. Take further readings around the 0-1 V region to model the response better at low voltages.
6. To record negative readings, swap the connections to the power supply, e.g. take the lead from the negative terminal and put it in the positive, and take the lead from the positive terminal, and put it in the negative. This should give you negative readings on both the voltmeter and milliammeter.
7. Adjust the power supply in 1 V increments again up to - 6 V through the voltmeter, and note the voltage and current readings off the meters for each. Take more readings around the 0 - -1 V region to model this area better.
8. Plot your data on a graph, plotting voltage on the x-axis, and current on the y-axis.


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## Sample data

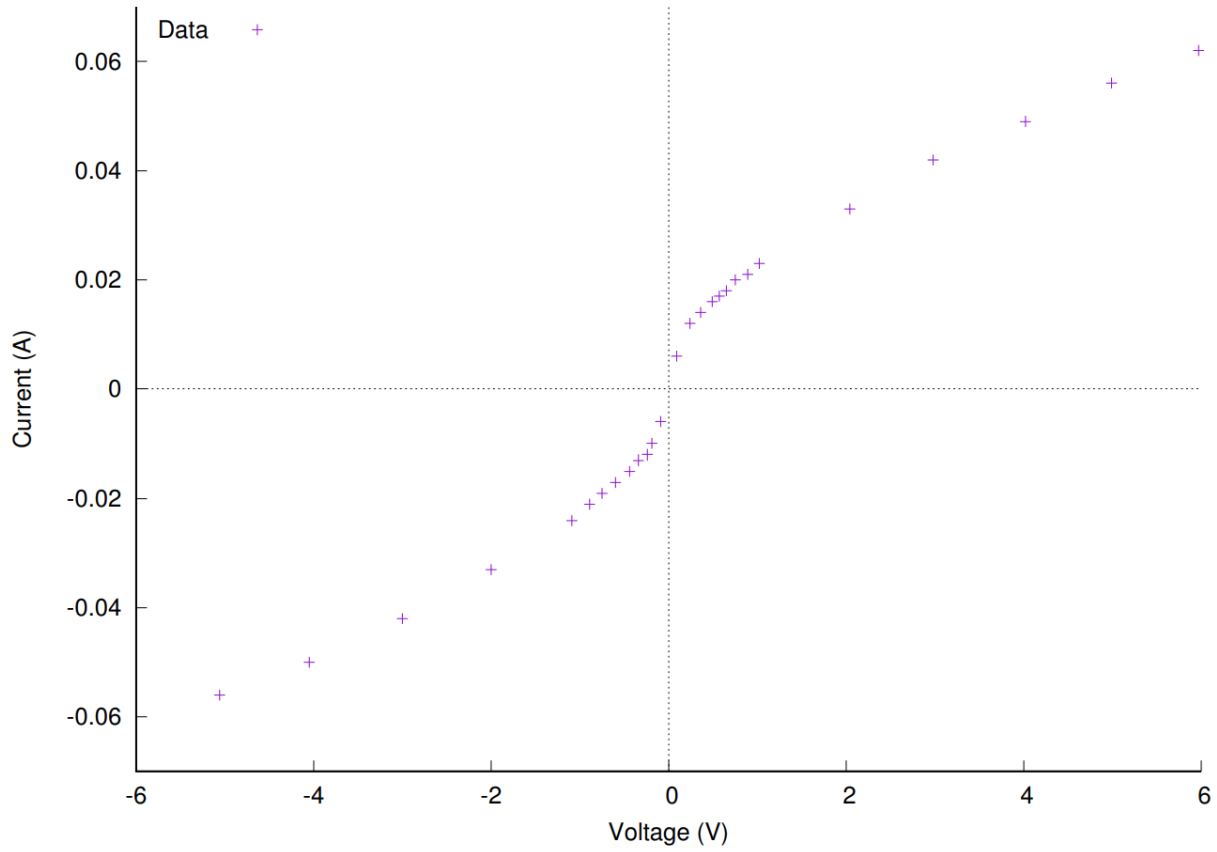


**Figure 7:** Plot of sample data for IV characteristics of a filament bulb.


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| Voltage (V) | Current (mA) | Current (A) |
|---|---|---|
| -6.01 | -62 | -0.062 |
| -5.06 | -56 | -0.056 |
| -4.05 | -50 | -0.050 |
| -3 | -42 | -0.042 |
| -2 | -33 | -0.033 |
| -1.09 | -24 | -0.024 |
| -0.89 | -21 | -0.021 |
| -0.75 | -19 | -0.019 |
| -0.6 | -17 | -0.017 |
| -0.44 | -15 | -0.015 |
| -0.34 | -13 | -0.013 |
| -0.24 | -12 | -0.012 |
| -0.19 | -10 | -0.010 |
| -0.09 | -6 | -0.006 |
| 0.09 | 6 | 0.006 |
| 0.24 | 12 | 0.012 |
| 0.36 | 14 | 0.014 |
| 0.49 | 16 | 0.016 |
| 0.57 | 17 | 0.017 |
| 0.65 | 18 | 0.018 |
| 0.75 | 20 | 0.020 |
| 0.89 | 21 | 0.021 |
| 1.02 | 23 | 0.023 |
| 2.04 | 33 | 0.033 |
| 2.98 | 42 | 0.042 |
| 4.02 | 49 | 0.049 |
| 4.99 | 56 | 0.056 |
| 5.97 | 62 | 0.062 |

**Table 6:** Sample data for IV characteristics of a bulb. Current in mA has been converted to Current in A by dividing by a factor of 1000.


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## Diode

1. Set up the circuit for the diode as shown in Figure 5(c). The resistor in this circuit is a protective resistor at 10 Ω. If you need help:
   (a) Connect the positive side of the power supply to the left side of the resistor.
   (b) Connect the right side of the resistor to the positive terminal on the milliammeter.
   (c) Connect the negative terminal on the milliammeter to the positive side of the diode.
   (d) Connect the negative side of the diode to the negative terminal on the power supply.
   (e) Now connect your voltmeter in parallel. Connect the negative terminal on the voltmeter to the negative side of the diode.
   (f) Connect the positive terminal on the voltmeter to the positive side of the diode.
2. Turn both the voltmeter and milliammeter on.
3. Ensure the power supply voltage is set to 0 V. Turn on the power supply.
4. Slowly, turn the power supply voltage up so that the voltage on the voltmeter reads ~0.2 V. Take readings off the voltmeter and milliammeter and record these in a table.
5. Increase the voltage on the power supply in ~0.1 V increments UP TO 0.8 V on the voltmeter, and take current and voltage readings at each. DO NOT EXCEED 0.8 V THROUGH THE VOLTMETER as at this voltage, a very high current will flow and may damage components. You will notice that you will see a steep rise in current over a small change in voltage. If needed, take more readings around this area to model the response more accurately, without exceeding 0.8 V through the voltmeter.
6. To record negative readings, swap the connections to the power supply, e.g. take the lead from the negative terminal and put it in the positive, and take the lead from the positive terminal, and put it in the negative. This should give you negative readings on both the voltmeter and milliammeter.
7. Adjust the power supply in 0.2 V increments up to 1 V through the voltmeter, and note the voltage and current readings off the meters for each.
8. Plot your data on a graph, plotting voltage on the x-axis, and current on the y-axis.


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## Sample data

| Voltage (V) | Current (mA) | Current (A) |
|---|---|---|
| -1.02 | 0 | 0 |
| -0.85 | 0 | 0 |
| -0.67 | 0 | 0 |
| -0.43 | 0 | 0 |
| -0.24 | 0 | 0 |
| -0.06 | 0 | 0 |
| 0.24 | 0 | 0 |
| 0.38 | 0 | 0 |
| 0.40 | 0 | 0 |
| 0.50 | 0 | 0 |
| 0.65 | 4 | 0.004 |
| 0.71 | 14 | 0.014 |
| 0.73 | 24 | 0.024 |
| 0.74 | 31 | 0.031 |
| 0.75 | 41 | 0.041 |
| 0.77 | 56 | 0.056 |
| 0.79 | 96 | 0.096 |

**Table 7:** Sample data for IV characteristics of a diode. Current in mA has been converted to Current in A by dividing by a factor of 1000.

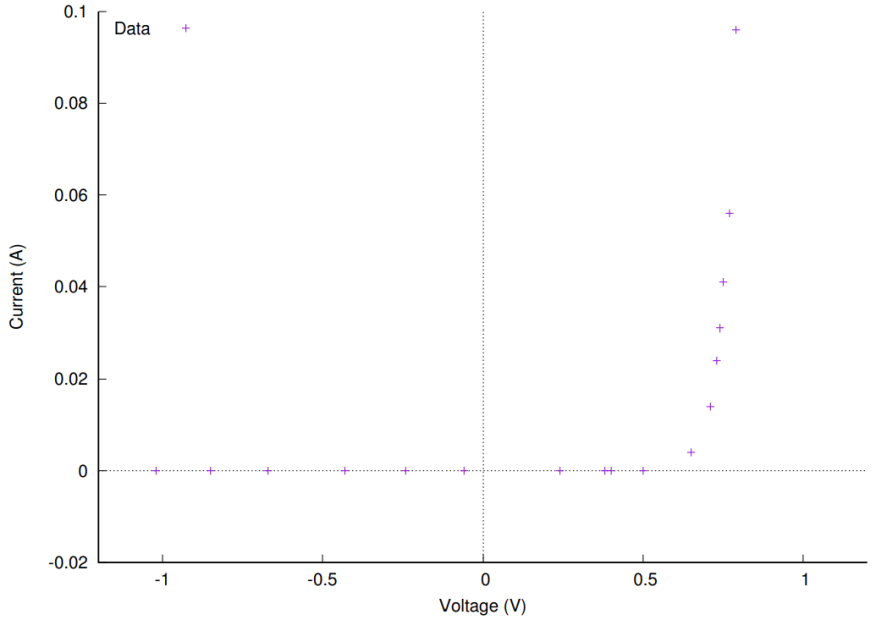


**Figure 8:** Plot of sample data for IV characteristics of a diode.

*The suitability of this experiment for a particular learning activity is up to the end user to assess based on their knowledge of the participants and the equipment, resources and safety standards available. While every experiment has been tested, by undertaking the activity, the end user accepts any and all risk. It is recommended that a risk assessment be conducted prior to any experimental activity being undertaken.*


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