The left side of Figure 3.1 shows a circuit element representation of a resistor, of resistance R. Whenever we define voltage, we must clearly specify the two points across which the potential is defined. Typically we label voltages with + and –, defining the voltage V as the potential to produce current from the + down to the –. When defining current we draw an arrow signifying the direction of the current. If the voltage V is positive, then the current I will be positive meaning the current is down in this figure. However, because electrons have negative charge, the electrons are actually flowing up. According to the passive sign convention, we define positive current as the direction of the flow of positive charge (or the opposite direction of the flow of negative charge). The middle of Figure 3.1 shows a circuit with a 1 kΩ resistor placed across a 3.7V battery. 1 kΩ exactly the same as 1000 Ω, just like 1 km is the same as 1000 m. According to Ohm's Law, 3.7 mA of current will flow down across the resistor. 1 mA exactly the same as 0.001 A, just like 1 mm is the same as 0.001 m. In this circuit, current flows clockwise from the + terminal of the battery, down across the resistor, and then back to the – terminal of the battery.
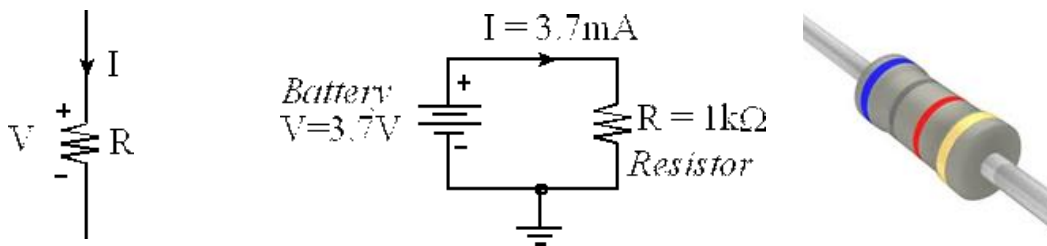

Figure 3.1. The voltage and current definitions; a circuit with a battery; and a drawing of a resistor.

CHECKPOINT 3.1

There is 1 V across a resistor, and 5 mA is flowing. What is the resistance?

Hide Answer

Ohm's Law R=V/I = 1V/0.005A = 200Ω.

CHECKPOINT 3.2

There is 2 V across a 100Ω resistor. How much current is flowing?

Hide Answer

Ohm's Law I=V/R = 2V/100Ω = 20mA.

CHECKPOINT 3.3

What happens if you place a wire directly from + terminal to the –terminal of a battery?

Hide Answer

Theoretically, the current will be infinite, but practically there will be sparks.

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