Electric current, voltage, resistance

1. a) The larger the resistance (at equal voltage), the **smaller** the electric current.

   b) The larger the voltage (at equal resistance), the **larger** the electric current.

   c) The smaller the resistance (at equal voltage), the **larger** the electric current.

   d) The smaller the voltage (at equal resistance), the **smaller** the electric current.

2.

	voltage	current	resistance	charge	time
a)	$U = R \cdot I = \underline{\underline{24\ \text{V}}}$	2.00 A	12.0 Ω	$Q = I \cdot t = \underline{\underline{240\ \text{C}}}$	2.00 min
b)	150 V	6.00 A	$R = \frac{U}{I} = \underline{\underline{25\ \Omega}}$	$Q = I \cdot t = \underline{\underline{480\ \text{C}}}$	80.0 s
c)	220 V	$I = \frac{U}{R} = \underline{\underline{1.1\ \text{A}}}$	200 Ω	$Q = I \cdot t = \underline{\underline{5.5\ \text{C}}}$	5.00 s
d)	$U = R \cdot I = \underline{\underline{6'000\ \text{V}}}$	10.0 A	600 Ω	25.0 C	$t = \frac{Q}{I} = \underline{\underline{2.5\ \text{s}}}$
e)	4.00 V	$I = \frac{Q}{t} = \underline{\underline{5\ \text{A}}}$	$R = \frac{U}{I} = \underline{\underline{0.8\ \Omega}}$	300 C	1.00 min
f)	$U = R \cdot I = \underline{\underline{4.5\ \text{V}}}$	20.0 mA	225 Ω	1728 C	$t = \frac{Q}{I} = \underline{\underline{86'400\ \text{s}}}$

3. a) Battery: «I am a voltage source for **direct** current. I push the electrons **always in the same direction**. My positive and my negative pole **remain in the same place**.»

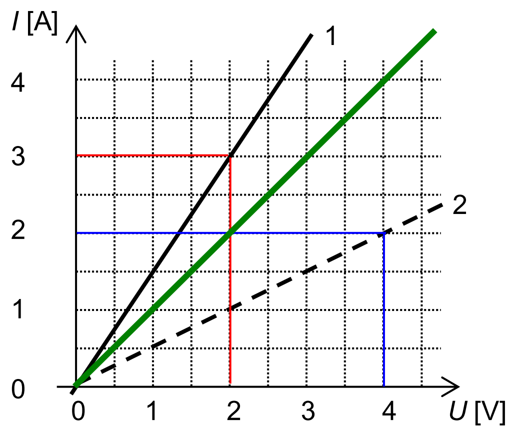
   b) Power outlet: «I am a voltage source for **alternating** current. I push the electrons **back and forth**. My positive and my negative pole **change places all the time**.»

4. a) $R = \frac{U}{I} = \frac{40.0\ \text{V}}{0.100\ \text{A}} = \underline{\underline{400\ \Omega}}$

   b) $Q = I \cdot t = 0.100\ \text{A} \cdot 60.0\ \text{s} = \underline{\underline{6.00\ \text{C}}}$

   c) $W = U \cdot Q = 40.0\ \text{V} \cdot 6.00\ \text{C} = \underline{\underline{240\ \text{J}}}$

5\.



a) **2**; e.g. at 2.0 V the current in wire 2 is only 1.0 A while the current in wire 2 ist 3.0 A (less current -> more resistance)

b) 2 V (see graph to the left, red lines)

c) Calculate the resistance using e.g. point 2.0 A / 4.0 V (see graph, blue lines): $R = \frac{U}{I} = \frac{4.0\text{ V}}{2.0\text{ A}} = 2.0\ \Omega$

Now calculate the current:

$I = \frac{U}{R} = \frac{13\text{ V}}{2\ \Omega} = \underline{\underline{6.5\text{ A}}}$

d) Calculate the voltage for a suitable value of the current, e.g. for I = 3.0 A:
$U = R \cdot I = 1.0\ \Omega \cdot 3.0\text{ A} = \underline{3.0\text{ V}}$
Draw a straight line through 0/0 and the point 3.0 A / 3.0 V (see graph, green line)

6\. $I = \frac{U}{R} = \frac{4.5\text{ V}}{90.0\ \Omega} = 0.050\text{ A}$

10’000 electrons carry a charge of $Q = 10'000 \cdot 1.6 \cdot 10^{-19}\text{ C} = 1.6 \cdot 10^{-15}\text{ C}$

$t = \frac{Q}{I} = \frac{1.6 \cdot 10^{-15}\text{ C}}{0.050\text{ A}} = \underline{\underline{3.2 \cdot 10^{-14}\text{ s}}} = \underline{\underline{0.000000000000032\text{ s}}}$

7\. a) In wire 3.

b) wire 1: R at 75 V: 1500 Ω, R at 150 V : 600 Ω ⇒ decreases
wire 2: R at 75 V: 375 Ω, R at 200 V : 667 Ω ⇒ increases

c) 1: carbon 2: metal 3: constantan

d) $R = \frac{U}{I}$

	75 V	125 V	0.10 A
1:	1500 Ω	833 Ω	1100 Ω
2:	375 Ω	500 Ω	250 Ω
3:	1500 Ω	1500 Ω	1500 Ω