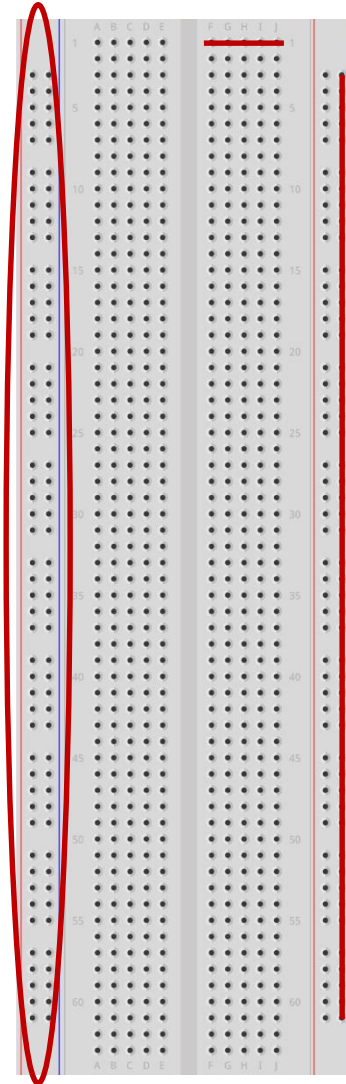


# Kirchoff's Current and Voltage Laws

ME 120

# Components: breadboard

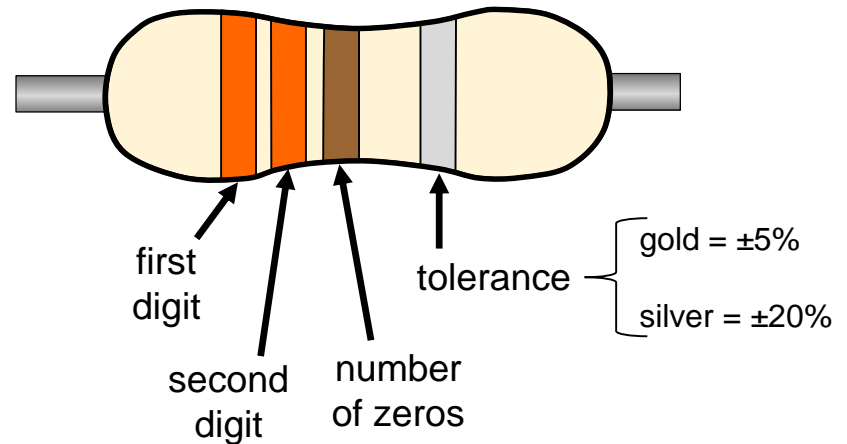


# Components: Resistors

- Select a resistor
- No direction: current can go both ways

# Select Resistors

color	digit
black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
gray	8
white	9



*Example: 330 $\Omega$  resistor:*

*3 = orange*

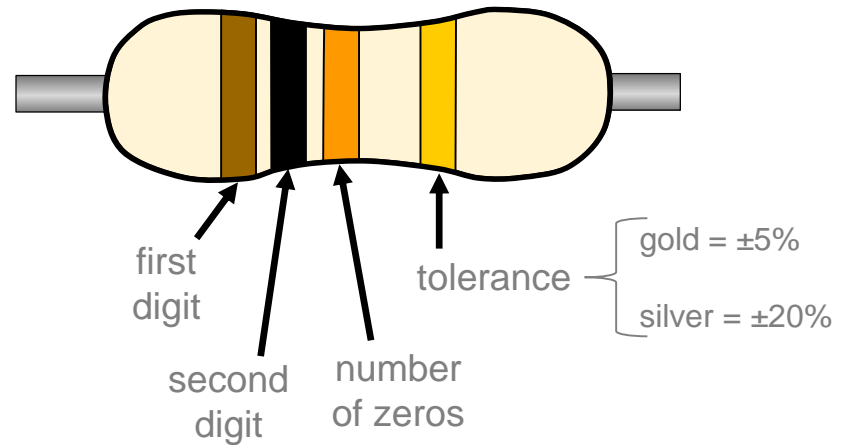
*3 = orange*

*Add 1 zero to 33 to make 330, so 1 = brown*

*So, 330 = orange, orange, brown*

# Select Resistors

color	digit
black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
gray	8
white	9



*Example: 10k $\Omega$  resistor:*

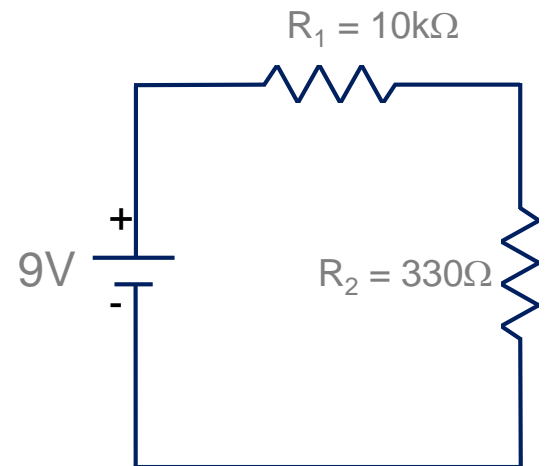
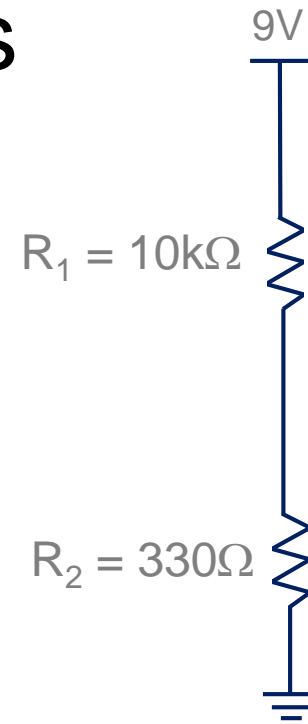
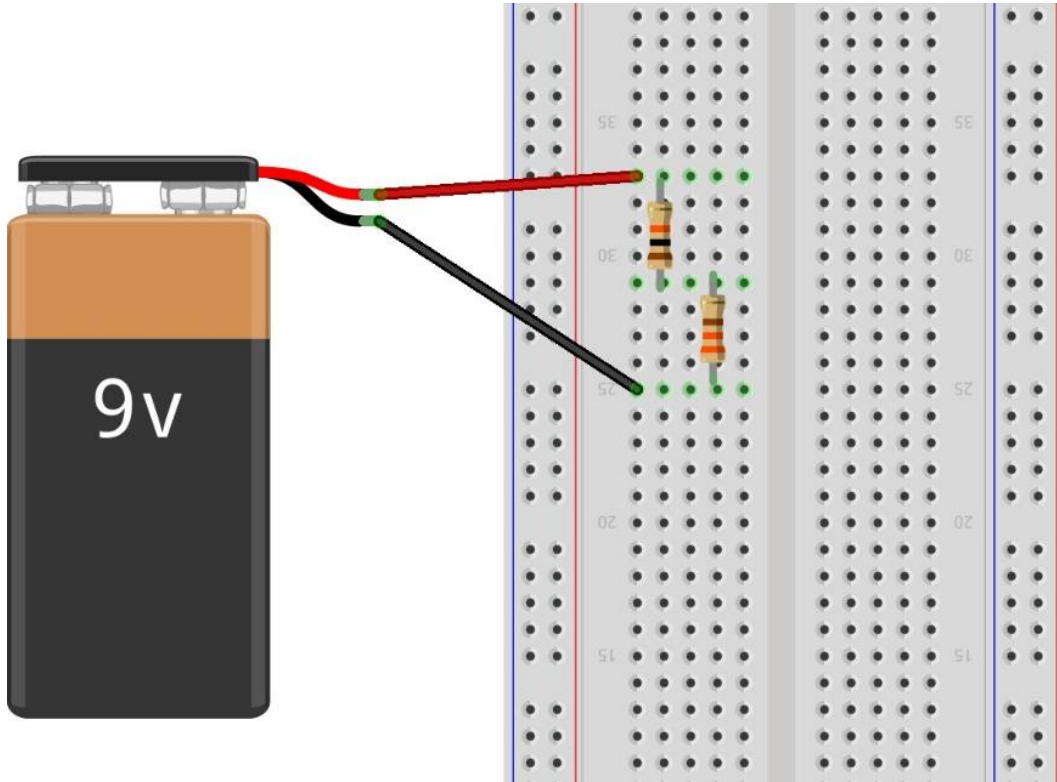
*1 = brown*

*0 = black*

*Add 3 zeros to 10 to make 10 000, so 3 = orange*

*So, 10k $\Omega$  = brown, black, orange*

# Resistors in Series



All of these circuits are the SAME!!

# Resistors in Series

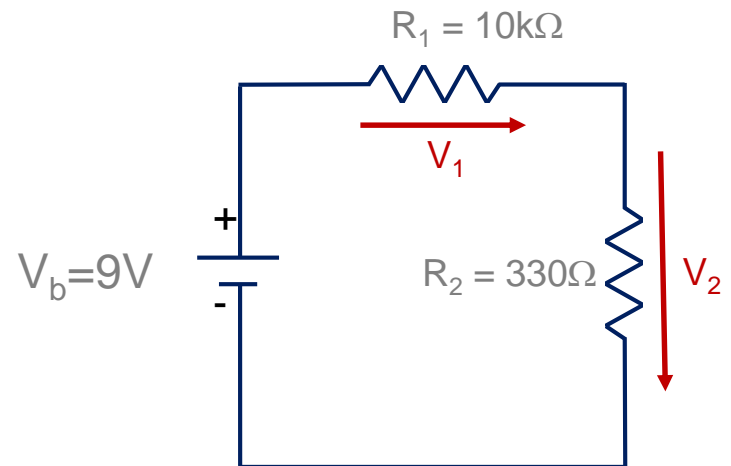
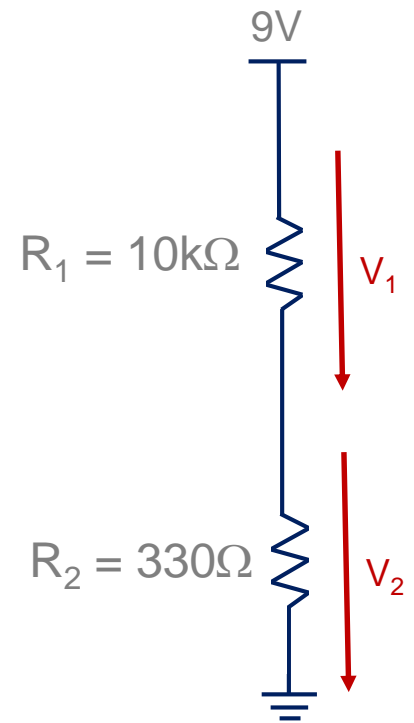
## Kirchoff's Voltage Law:

$$V_b = V_1 + V_2$$

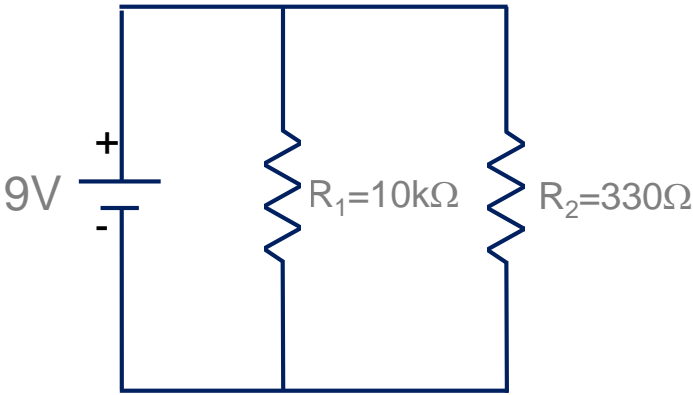
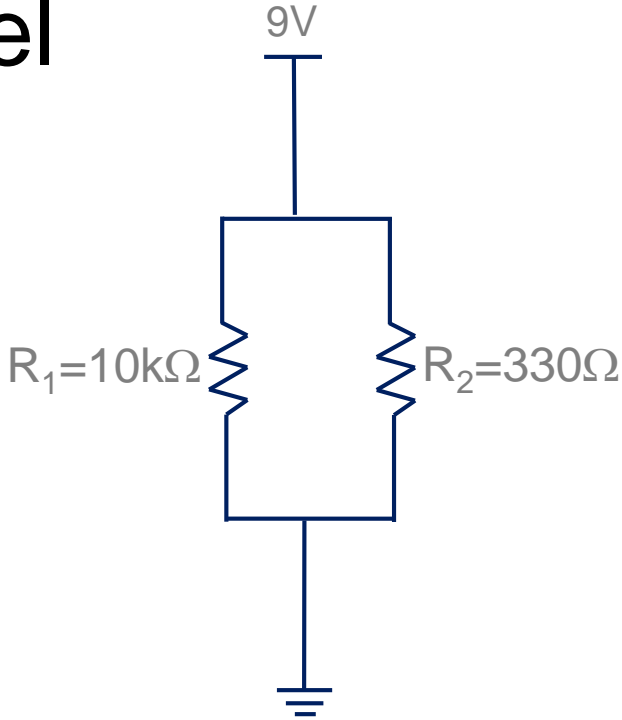
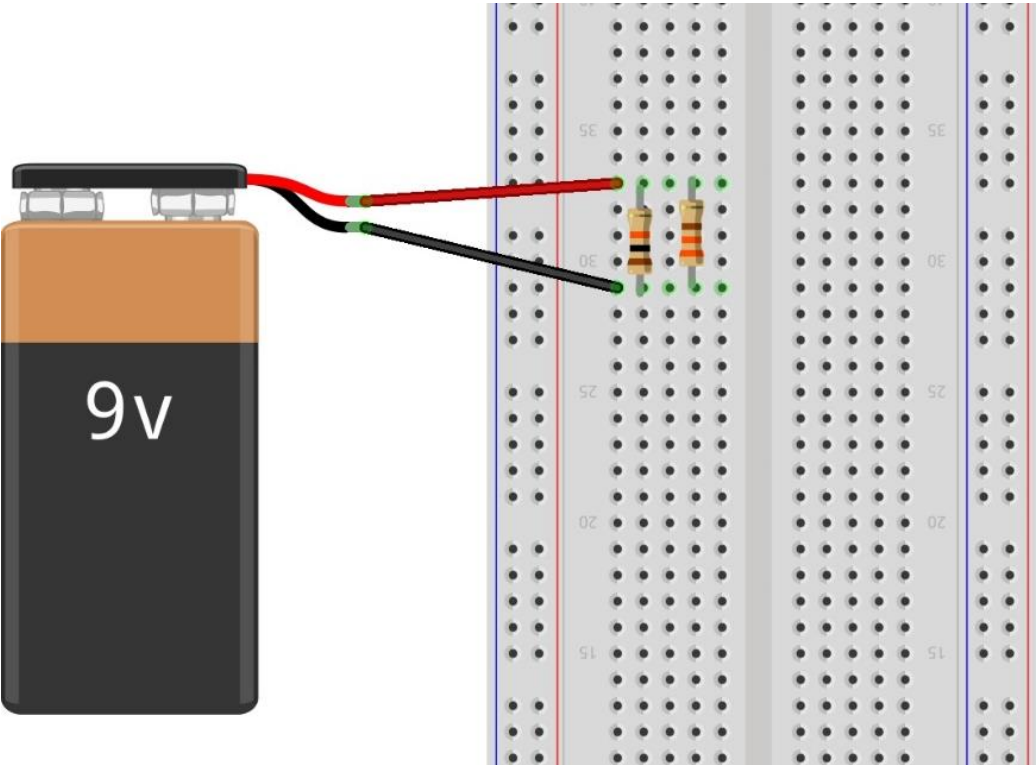
↔ “the sum of all voltage drops equals the sum of all voltage rises”

$$\leftrightarrow V_1 + V_2 - V_b = 0$$

↔ “the algebraic sum of voltages around any closed loop in a circuit is zero”



# Resistors in Parallel



All of these circuits are the SAME!!



# Resistors in Parallel

## Kirchoff's current law

$$I_b = I_1 + I_2$$

↔ “at any node in an electrical circuit, the sum of currents flowing into that node is equal to the sum of currents flowing out of that node”

$$\leftrightarrow I_1 + I_2 - I_b = 0$$

↔ “the algebraic sum of currents in a network of conductors meeting at a point is zero”

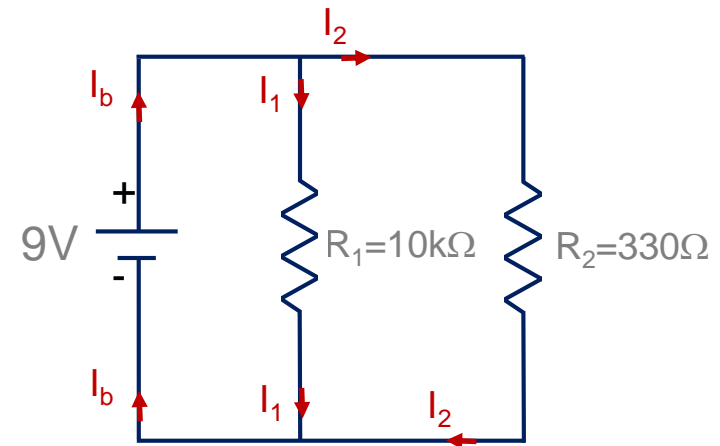
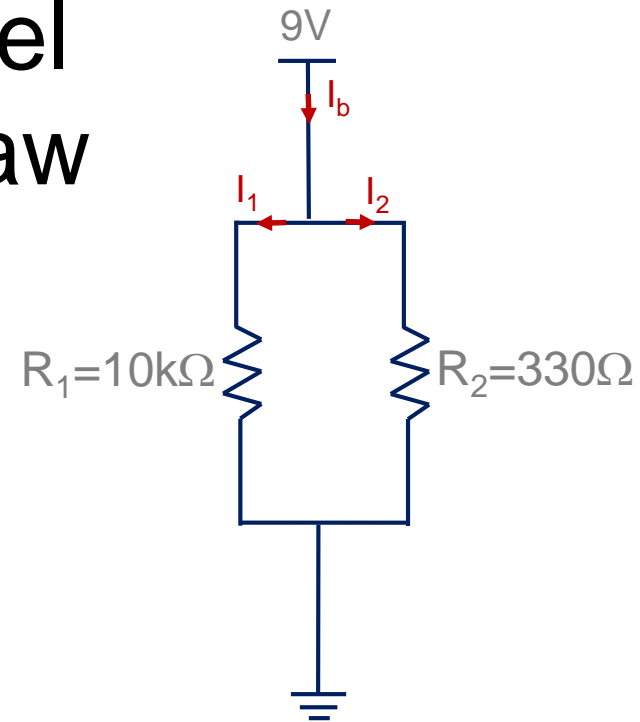




Photo: Library of Congress

**Gustav Kirchhoff** (1824 – 1887) was a German physicist who made fundamental contributions to the understanding of electrical circuits and to the science of emission spectroscopy. He showed that when elements were heated to incandescence, they produce a characteristic signature allowing them to be identified. He wrote the laws for closed electric circuits in 1845 when he was a 21 year-old student.