Series resistance. If resistor *R1* is in series with resistor *R2*, this combination behaves like one resistor with a value equal to *R1+R2*. See Figure 3.6. This means if replace the two series resistors in a circuit with one resistor at *R= R1+R2*, the behavior will be the same. The *V* equals *V1+V2*. By KCL, the currents through the two resistors are the same. These two facts can be used to derive the **voltage divider rule**

*V2 = I*R2 = (V/R)*R2 = V*R2/(R1+R2)*

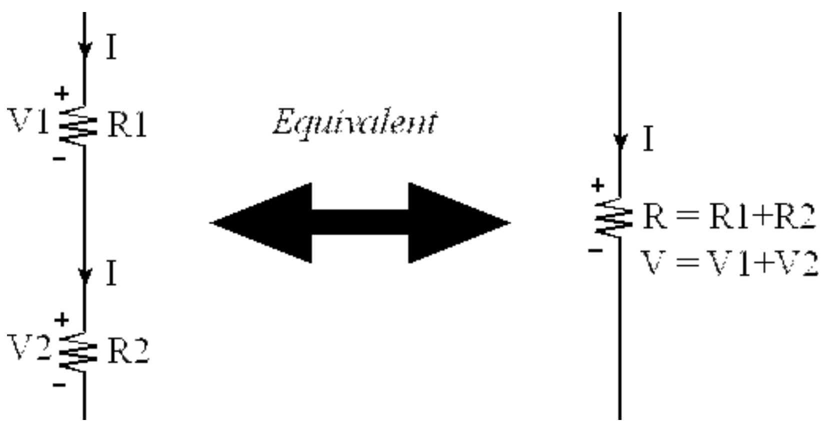

Figure 3.6. The series combination of two resistors, R1 R2, is equivalent to one resistor at R1+R2.

CHECKPOINT 3.10

Using Figure 3.6, assume I is 1mA, R1 is 2kΩ and R2 is 3kΩ, what is V?

Hide Answer

Total resistance is 2kΩ +3kΩ = 5kΩ. Ohm's Law V=I*R = 0.001A*5000Ω = 5V.

CHECKPOINT 3.11

Using Figure 3.6, assume V is 10V, R1 is 2kΩ and R2 is 3kΩ, what is V2?

Hide Answer

Total resistance is 2kΩ+3kΩ=5kΩ. I is 10V/5kΩ=2mA. V_2 =I*R_2 = 0.002A*3000Ω = 6V.

Parallel resistance. If resistor *R1* is in parallel with resistor *R2*, this combination behaves like one resistor with a value equal to

$$R = \frac{R1 * R2}{R1 + R2} = \frac{1}{1/_{R1} + 1/_{R2}}$$

See Figure 3.7. This means we can replace the two parallel resistors in a circuit with one resistor at *R= R1*R2/(R1+R2)*. The voltages across *R1* and *R2* will be the same because of KVL. Due to KCL, *I=I1+I2*. These facts can be used to derive the **current divider rule**

*I1 = V/R1= (I*R)/R1 = I*(R1*R2/(R1+R2))/R1 = I*R2/(R1+R2)*

*I2 = V/R2= (I*R)/R2 = I*(R1*R2/(R1+R2))/R2 = I*R1/(R1+R2)*

I = I1+I2

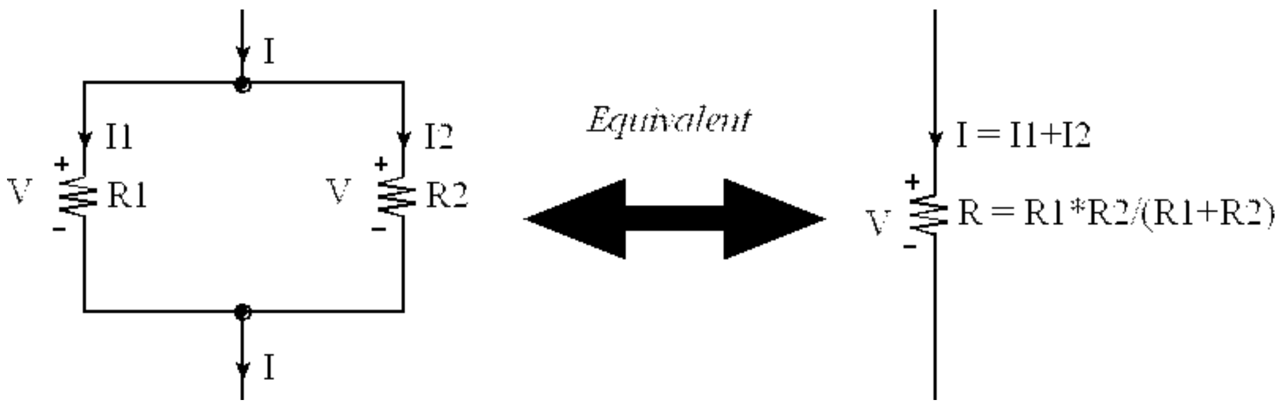

*Figure 3.7. The parallel combination of two resistors, R1 R2, is equivalent to one resistor at R1*R2/(R1+R2).*

CHECKPOINT 3.12

Using Figure 3.7, assume I is 1mA, R1 is 2kΩ and R2 is 4kΩ, what is V?

Hide Answer

Total resistance is 2000*4000/(2000+4000)=1333Ω. V =I*R = 0.001A*1333Ω = 1.333V.

CHECKPOINT 3.13

Using Figure 3.7, assume V is 10V, R1 is 2kΩ and R2 is 4kΩ, what is I2?

Hide Answer

Ohm's Law $I_2=V/R_2$ = 10V/4000Ω = 2.5mA

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