

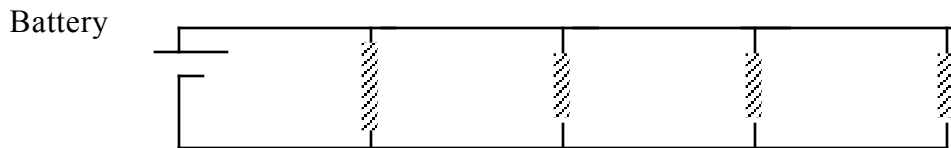
Eqiv circuits 1

Resistors are very much like water faucets in that they allow a controlled amount of electric current to flow in a certain direction and to a certain place. They allow you to break up the voltage (voltage divider) and they allow you to break up the current (current divider).

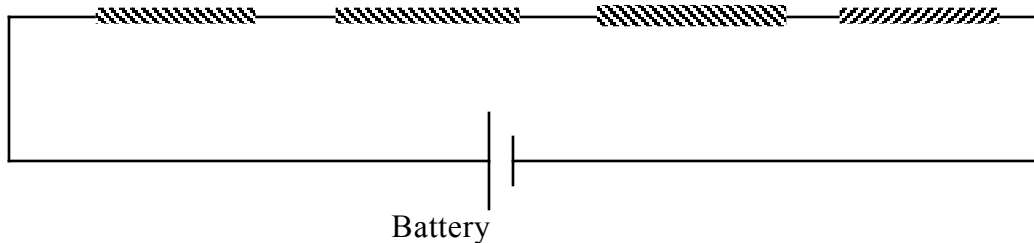
There are two basic arrays of resistors: **Parallel and Series**

Parallel: This is a current divider. The heads of two or more resistors are put together and the tails of two or more resistors are put together.

Series: This is a voltage divider. Two or more resistors are arranged head to tail.

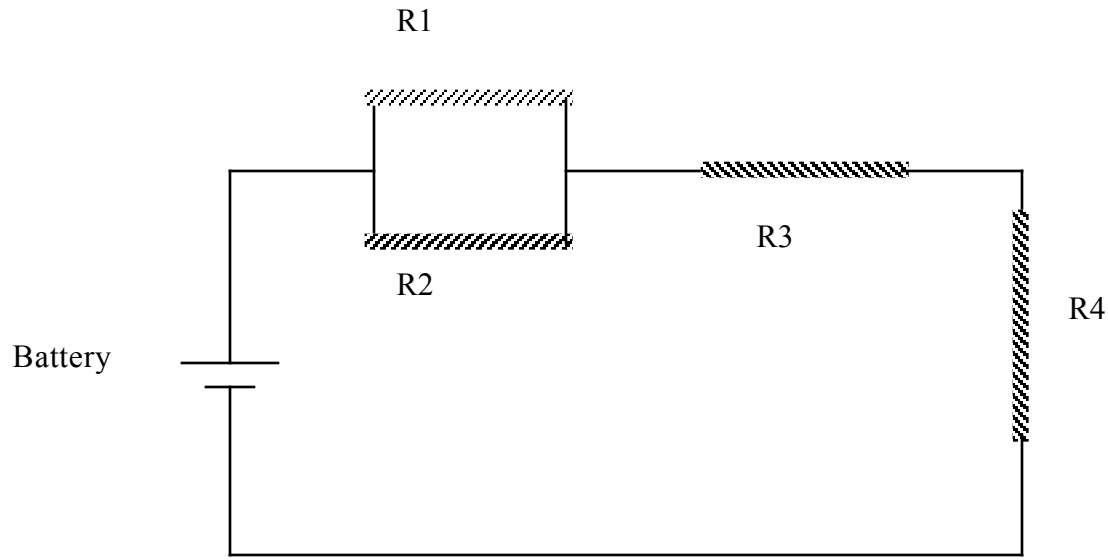


Parallel



Battery
Series

Most circuits are a combination of both series and parallel resistors.



- Notice that R1 and R2 are in parallel with each other (they will divide the current).
- R3 and R4 are in series with each other (they divide voltage)
- R1 and R2 act as a whole new resistor which we will call *R1, R2 equivalent* and this resistor is in series with R3 and R4

There are two formulas you need to find the **equivalent resistance** of a parallel or series resistor network.

Resistors in series: SIMPLY ADD THE RESISTOR VALUES

$$R_{equivalent} = R_1 + R_2 + R_3 + \dots$$

Resistors in parallel: add the reciprocals of the resistor values and then take the reciprocal of this sum (HUH???????)

$$\frac{1}{R_{(parallel)}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

The formula for parallel is a little tricky but it is very important that you learn it. It will take some practice but once you know how to do it on your calculator it is not that hard.

Reciprocal means 1 divided by the number. The reciprocal of 5 is $\frac{1}{5} = 0.2$

There is a key on your calculator that looks like this

$$X^{-1}$$

This will give you the reciprocal of any number.

- Press 5
- Press X⁻¹
- Press **Enter**
- You should see 0.2 or .2

Now let's find the equivalent resistance of the circuit I drew above and let's give the resistors actual values

$$R_1 = 100\Omega \quad R_2 = 50\Omega \quad R_3 = 150 \quad R_4 = 220\Omega$$

Since R1 and R2 are in parallel we must use the parallel formula to get their equivalent resistance

$$\frac{1}{R_{e(parallel)}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

or for this case

$$\frac{1}{R_e} = \frac{1}{100} + \frac{1}{50} = 0.03$$

To do this on your calculator

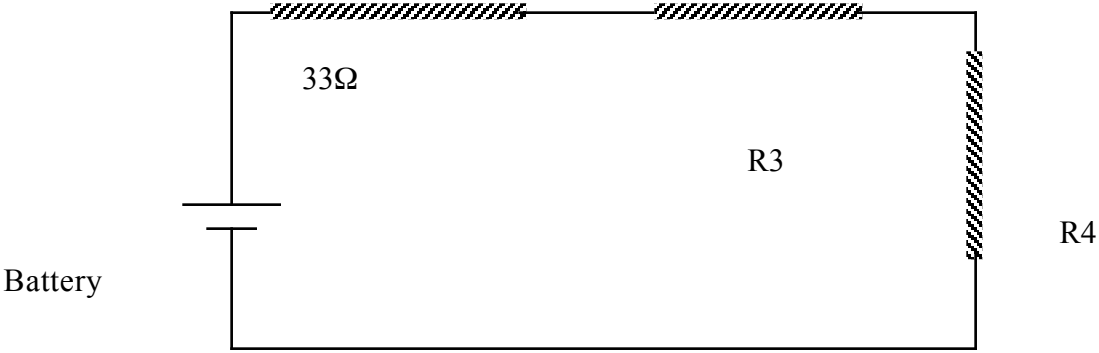
- press 100
- press X⁻¹
- press +
- press 50
- press X⁻¹
- press **enter**

This gives you the **reciprocal of the answer that you want**. To get the actual R_e you must press the X⁻¹ key again.

- The answer you get will be 33Ω (round to the nearest Ω)

RULE: Anytime you have resistors in parallel, the **equivalent resistance** is always less than the resistance of the smallest value resistor .

Okay - Now you have the R_e of R1 and R2. But this is in series with R3 and R4. The battery “sees” the following resistor circuit

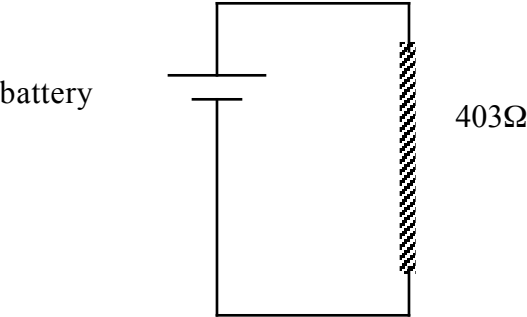


Since $R3 = 150\Omega$ and $R4 = 220$ we have 33, a 150, and a 220 Ω resistors in series. Since they are in series we use the series formula

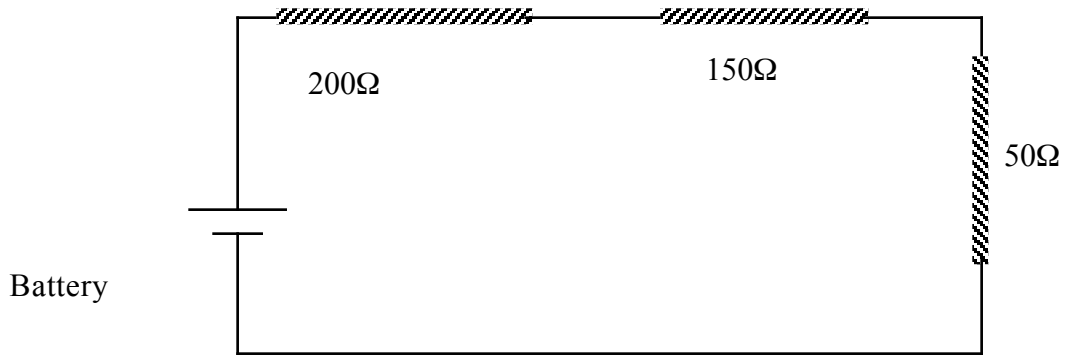
$$R_{equivalent} = R_1 + R_2 + R_3 + \dots \text{ to get}$$

$$R_e = 33 + 150 + 220 = 403\Omega$$

The battery “sees” one resistor of 403 Ω .

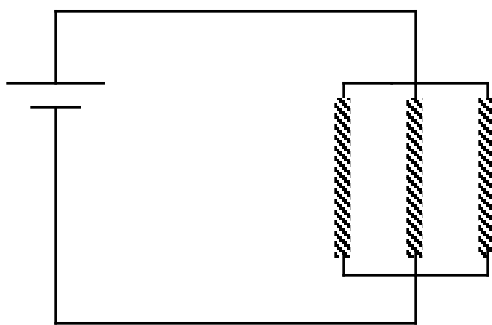


Find the equivalent resistance of the following resistor network



$R_e =$ _____

Find the equivalent resistance of the following resistor network

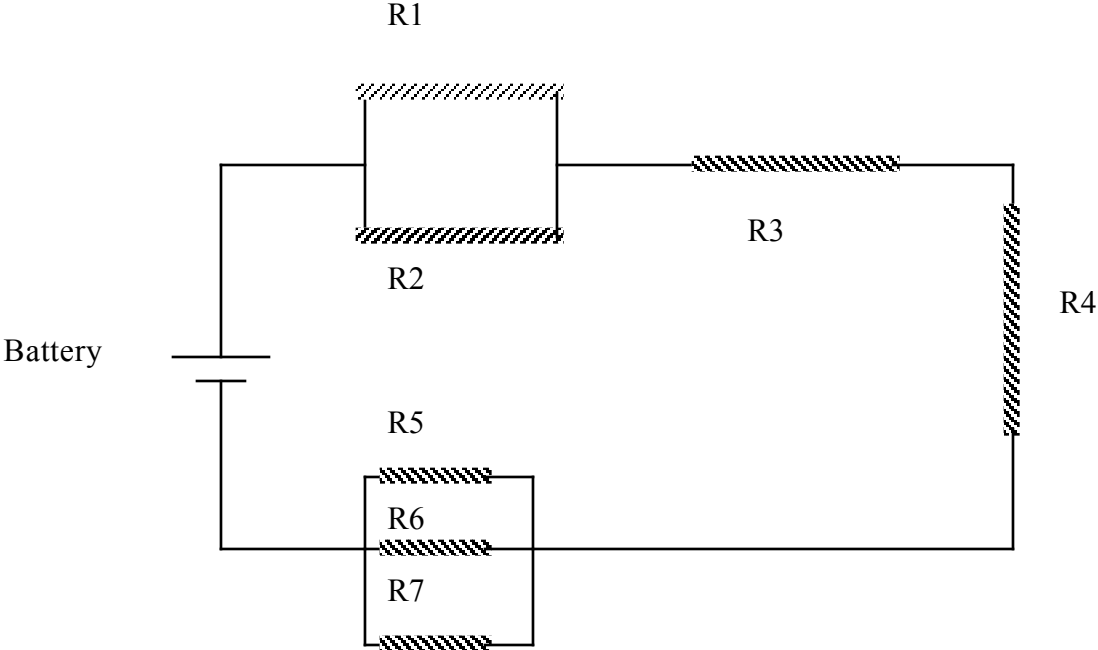


All three resistors are equal to 150Ω

$R_e =$ _____

What do you notice about the equivalent resistance and the value of each resistor when you have three of the same resistors in parallel?

Find the equivalent resistance of the following resistor network



$R_1 = 100\Omega$ $R_2 = 150\Omega$ $R_3 = 220\Omega$ $R_4 = 1000\Omega$ $R_5 = R_6 = R_7 = 300\Omega$

$R_e (R_5, R_6, \text{ AND } R_7) = \underline{\hspace{4cm}}$

$R_e (R_1, R_2) = \underline{\hspace{4cm}}$

$R_e (\text{Entire Circuit}) = \underline{\hspace{4cm}}$