Resistor Combinations

Solving Problems by Thought rather than by Algebra

Once you know the formulas for resistors in series and parallel, it's terribly easy to
a) think that they are the only way of solving Resistor problems, and
b) to make mistakes and not realise you've done so.

There are certain combinations of resistors which you should be able to just look at and say 'ah, they're obviously going to have a total resistance of …'. Completing the tables below should help you on the way to being able to do so.

Resistors used	**Connected in …**	**Draw the circuit:**	**Total Resistance**
R and R	Series		
R and R	Parallel		
R, R and R	Series		
R, R and R	Parallel		
R, R, R and R	Series		
R, R, R and R	Parallel		

Combination	R_{tot} **= ?**
1Ω in parallel with 1000Ω	
10Ω in parallel with 1000Ω	
100Ω in parallel with 1000Ω	
1Ω in parallel with 1MΩ	
10Ω in parallel with 1MΩ	
100Ω in parallel with 1MΩ	

Now summarise what you've found as a general pattern for resistors R_1 and R_2 in parallel where $R_1 >> R_2$:

How to become a Resistor Jedi

Building on the skills you've developed over the page, you can now work out roughly what the total resistance of any number of resistors in parallel will be, before you do a calculation to check, if necessary. This can often save time or help you spot silly mistakes by doing rough estimates before you use the formula.

For example:

- If you have two 10Ω resistors in parallel, you know that the total resistance will be 5Ω. If you have four 10Ω resistors in parallel, you know that the total resistance will be 2.5Ω, and so on.
- If you have a 10Ω and a 100Ω resistor in parallel, you know that total resistance will be a bit less than 10Ω, because adding the 100Ω resistor just gives the current a slightly easier setup than the 10Ω by itself. *R_{tot} is actually about 9.1 Ω*
- If you have a 10 Ω and a 1000Ω resistor in parallel, you know that total resistance will still be a bit less than 10Ω, but it will be closer to 10Ω than in the previous example because the resistors are more unequal, so it becomes more similar to just a 10Ω Resistor on its own. *R_{tot} is actually about 9.9 Ω*
- If you've got more than two resistors in parallel, the total resistance will just be a bit less than the resistance of the smallest resistor. The more different the resistances are, the closer R_{tot} will be to the resistance of the smallest resistor.

Now try these (*<u>don't</u> use the formula until you've made a sensible guess!*):

Combination	R_{tot} = ? *(rough guess and explanation)*	R_{tot} = ? (*use the formula*)
50Ω in parallel with 1000Ω		
50Ω in parallel with 10kΩ		
50kΩ in parallel with 10Ω		
50kΩ in parallel with 200Ω		
50kΩ in parallel with 10kΩ and 200Ω		
50Ω, 1000Ω and 10kΩ, all in parallel		

Now you've honed this skill, amaze and astound your chums by looking over their shoulder whilst they're plugging away using the formula for their homework and tell them roughly what the answer will be long before they can calculate it. Or challenge people to estimate R_{tot} for a given combination and see who gets closest. Fun for all the family.