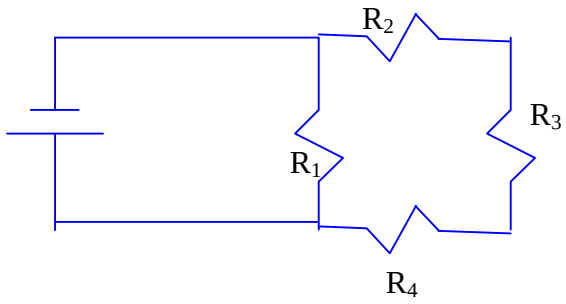
Combination Circuits
Think Tank

1. Four *identical* resistors are connected to each other in some unknown way. The following voltages are measured:

   $V_t = 12$ V
   $V_1 = 12$ V
   $V_2 = 4$ V
   $V_3 = 4$ V
   $V_4 = 4$ V

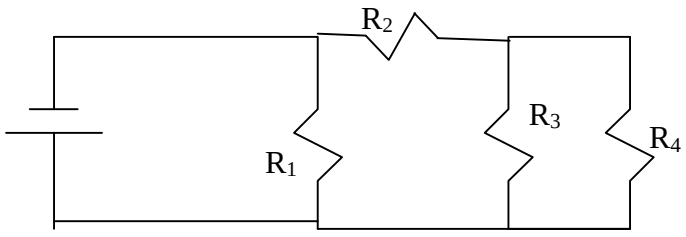
   Draw a circuit consistent with these results.

   Solution:



   R_2, R_3 and R_4 are in series. Being identical resistors, they have the same voltage, so since $V_2 + V_3 + V_4 = V_t$
   $3V_2 = 12$
   $V_2 = 12/3 = 4$ V
   The trio of resistors is parallel to R_1, so their combined voltage of 12 V equals that of R_1.

2. Four identical resistors are connected as shown in the diagram below:



   If the total voltage is 12V, find the voltage across each resistor.

   Solution:

R_1 experiences the total voltage. $V_1 = 12V$.
R_4 and R_3 are parallel to each other, and since they're identical, their combined resistance is half of any individual resistance such as R_2. Since voltage is directly proportional to resistance, $V_2 = 2V_3$.
Also since R_2 is in series with the combined parallel branch consisting of R_3 and R_4, and since R_1 is in parallel with the rest,

$V_2 + V_3 = V_1$. Substituting:
$2V_3 + V_3 = 12$
$V_3 = 4$ V. (and $V_4 = 4$ V.)
$V_2 = 2(4) = 8$ V