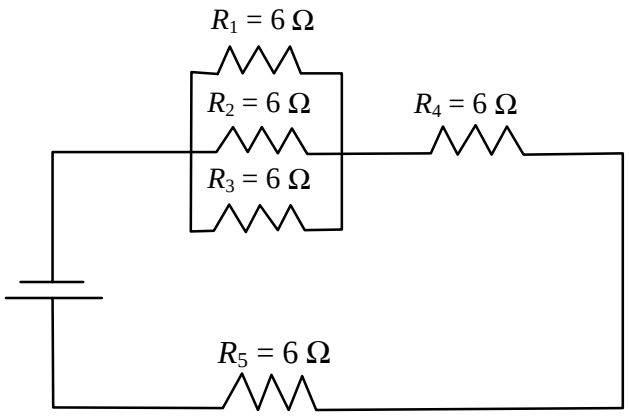
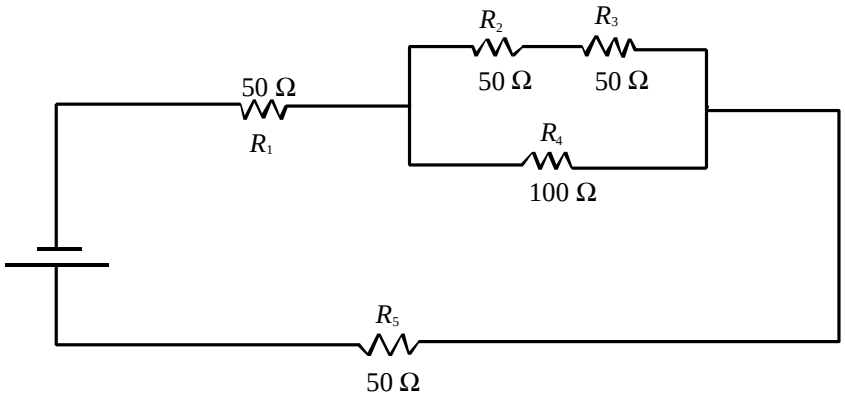
Combination Circuits: for 430 eyes only

1 Determine the equivalent resistance (R_{eq}) of the following circuit.



(1/Rp) = 1/6+1/6+1/6
Rp = 6/3 = 2 Ω.
Rt = Rp + R_4 + R_5
= 2 + 6 + 6 = 14 Ω.

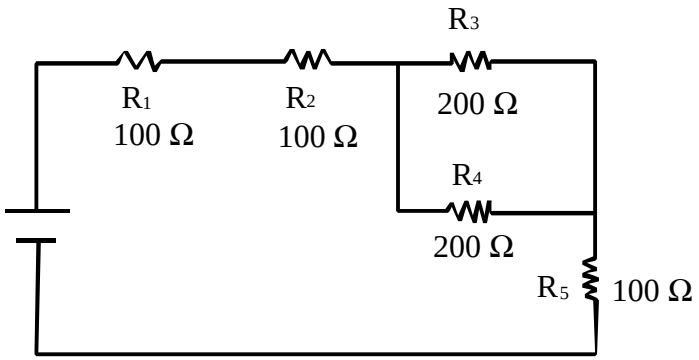
2 The following circuit consists of a power supply and five resistors (R_1, R_2, R_3, R_4 and R_5). Find R_t.



$$\frac{1}{Rp} = \frac{1}{R_2 + R_3} + \frac{1}{R_4}$$

1/Rp = (1/100) +(1/100)
Rp = 50 Ω.
Rt = R_1 + Rp + R_5 = 50 + 50 +50 = 150 Ω.

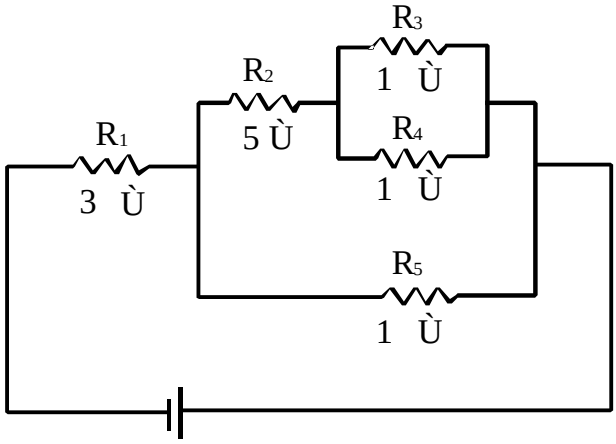
3 The following circuit consists of a power supply and five resistors (R_1, R_2, R_3, R_4 and R_5). What is the equivalent resistance of the entire circuit (R_{eq})?



(1/Rp) = (1/200) + (1/200)
Rp = 100 Ω.

Rt = R_1 + R_2 + Rp + R_5 = 100 + 100 +100 + 100 = 400 Ω.

4 The following electric circuit consists of a power source and five resistors (R_1, R_2, R_3, R_4 and R_5).



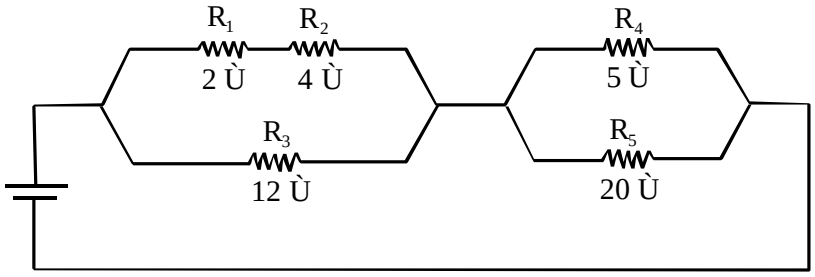
What is the equivalent resistance, R_{eq}, of this circuit?

$(1/R_{ptop}) = R_2 + (R_3^{-1} + R_4^{-1})^{-1} = 5 + (1^{-1} + 1^{-1})^{-1}$
R_{ptop} = 5.5 Ω.

$(1/Rp) = 1/R_{ptop} + 1/R_5 = 1/5.5 + 1/1$
R_p = 0.85 Ω.

$R_t = R_1 + Rp = 3 + 0.85 = 3.85$ Ω.

5 The following circuit consists of five resistors (R_1, R_2, R_3, R_4 and R_5).



What is the voltage drop across R_5 if the total voltage is 20 V?

$$\frac{1}{Rpleft} = \frac{1}{2+4} + \frac{1}{12}$$

R_{pleft} = 4 Ω.

$1/R_{pright}$ = 1/5+1/20

Rpright = 4 Ω.

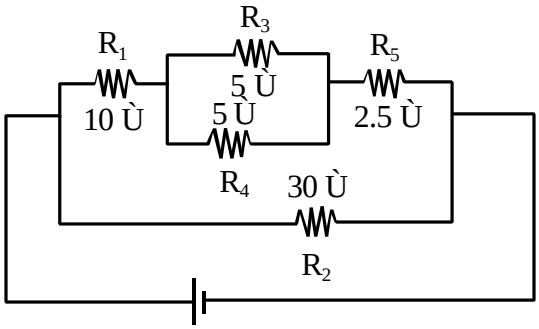
Since the resistances are equal each will experience a voltage drop of 20 V/2 = 10 V.

Otherwise, you'd have to do this:

$V_t = IR_t$
20 = I (4 +4)
I = 2.5 V

$V_{pright} = V_5 = IR_{pright}$
= 2.5(4) = 10 V.

6 The following electric circuit consists of a power source and five resistors (R_1, R_2, R_3, R_4 and R_5).



What current flows through R_4 if the total voltage is 32 V?

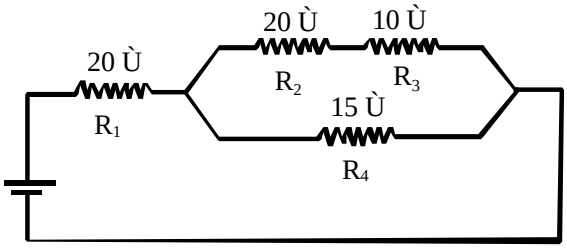
1/R = 1/5 + 1/5
R = 2.5 Ω. (for little parallel part)

$$\frac{1}{Rp} = \frac{1}{R_1 + R + R_5} + \frac{1}{R_2} = \frac{1}{15} + \frac{1}{30}$$

Rp = 30/30= 10 Ω.

$I_{top} = V/R_{top}$ =32/15 = 2.133 A, but then it splits within the little parallel part, so I4 = 2.133/2 = 1.07A.

7 A series-parallel electric circuit is illustrated on the right.

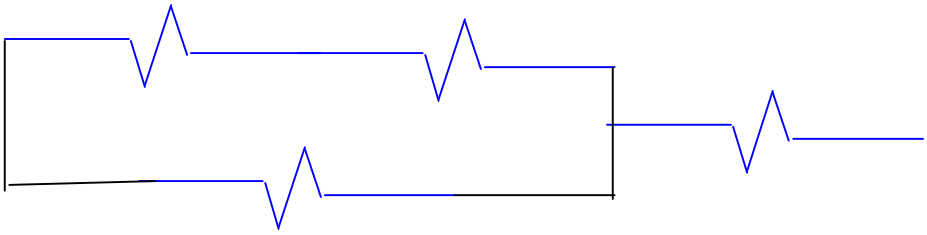


What current flows through R_2 if V_t = 100 V?

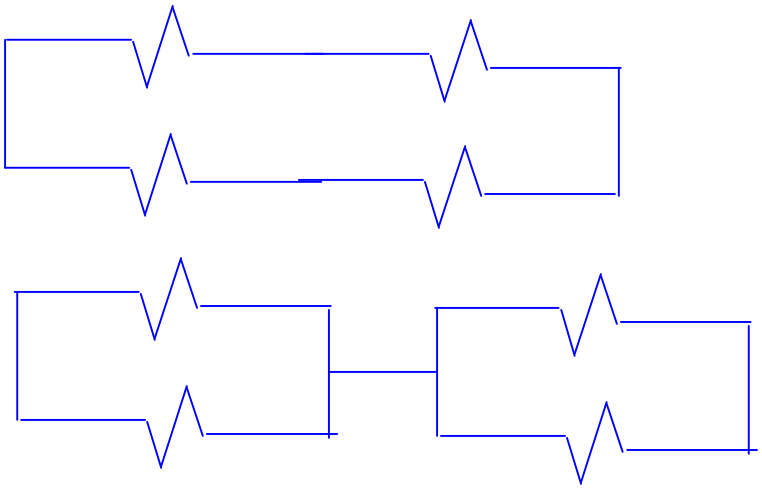
$1/R_p = 1/(20+10) + 1/15$
R_p = 10 Ω.
$R_t = R_p + R_1$ = 10 + 20 = 30 Ω.

$V = I_t R_t$
$100 = I_t (30)$
It = 3.33A. But the parallel part has a resistance of 10 Ω. Its voltage drop =
V= IR = 3.33(10) = 33.3 V. So the top part of the parallel branch will receive 33.3V/30 Ω = 1.11 A. (why divide by 30 Ω? It's the resistance for the top part of the parallel branch)

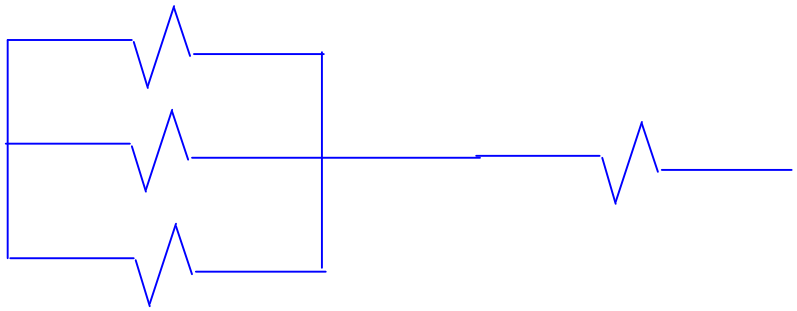
8 How do you connect four 1.00 Ω resistors so that the total resistance is 1.67 Ω?



9 Find TWO ways of connecting four 2.0 Ω resistors so that their total resistance is 2.0 Ω .



10 Three different resistors (A, B and C) have an identical voltages of 3.0 V. The fourth resistor has a potential difference of 4.0 V. Draw a circuit that would be consistent with the above measurements, and then find the total voltage.



$V_t = V_p + V_4 = 3 + 4 = 7$ V