DC CIRCUITS

- Kirchhoff's current law: The sum of all currents entering a node is equal to the sum of all currents leaving the node.
- Kirchhoff's voltage law: The directed sum of the electrical potential differences around a loop must be zero.

Ohm's Law

$$R = \frac{V}{I}$$

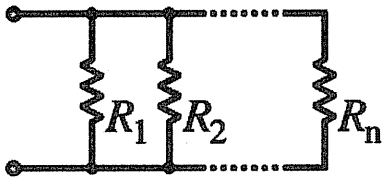
Power dissipation

The power dissipated by a resistor is the voltage across the resistor multiplied by the current through the resistor:

$$P = I^2R = I \cdot V = \frac{V^2}{R}$$

Series and parallel circuits

Resistors in a parallel configuration each have the same potential difference (voltage). To find their total equivalent resistance (R_{eq}):



$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

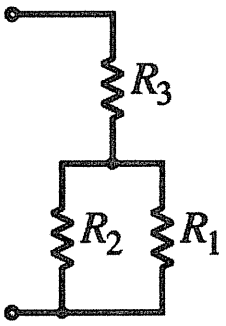
The parallel property can be represented in equations by two vertical lines "||" (as in geometry) to simplify equations. For two resistors,

$$R_{eq} = R_1 \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$$

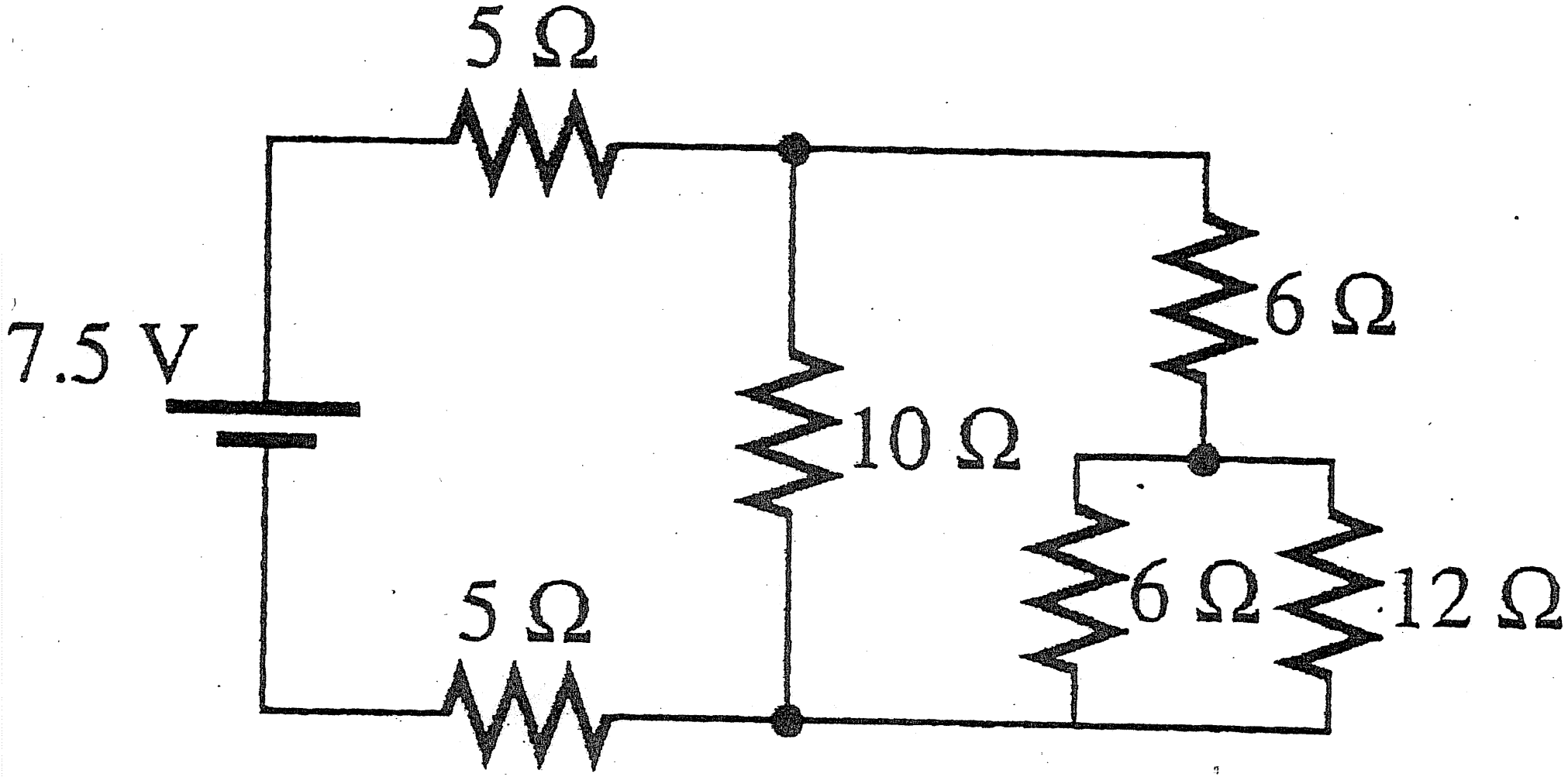
The current through resistors in series stays the same, but the voltage across each resistor can be different. The sum of the potential differences (voltage) is equal to the total voltage. To find their total resistance:

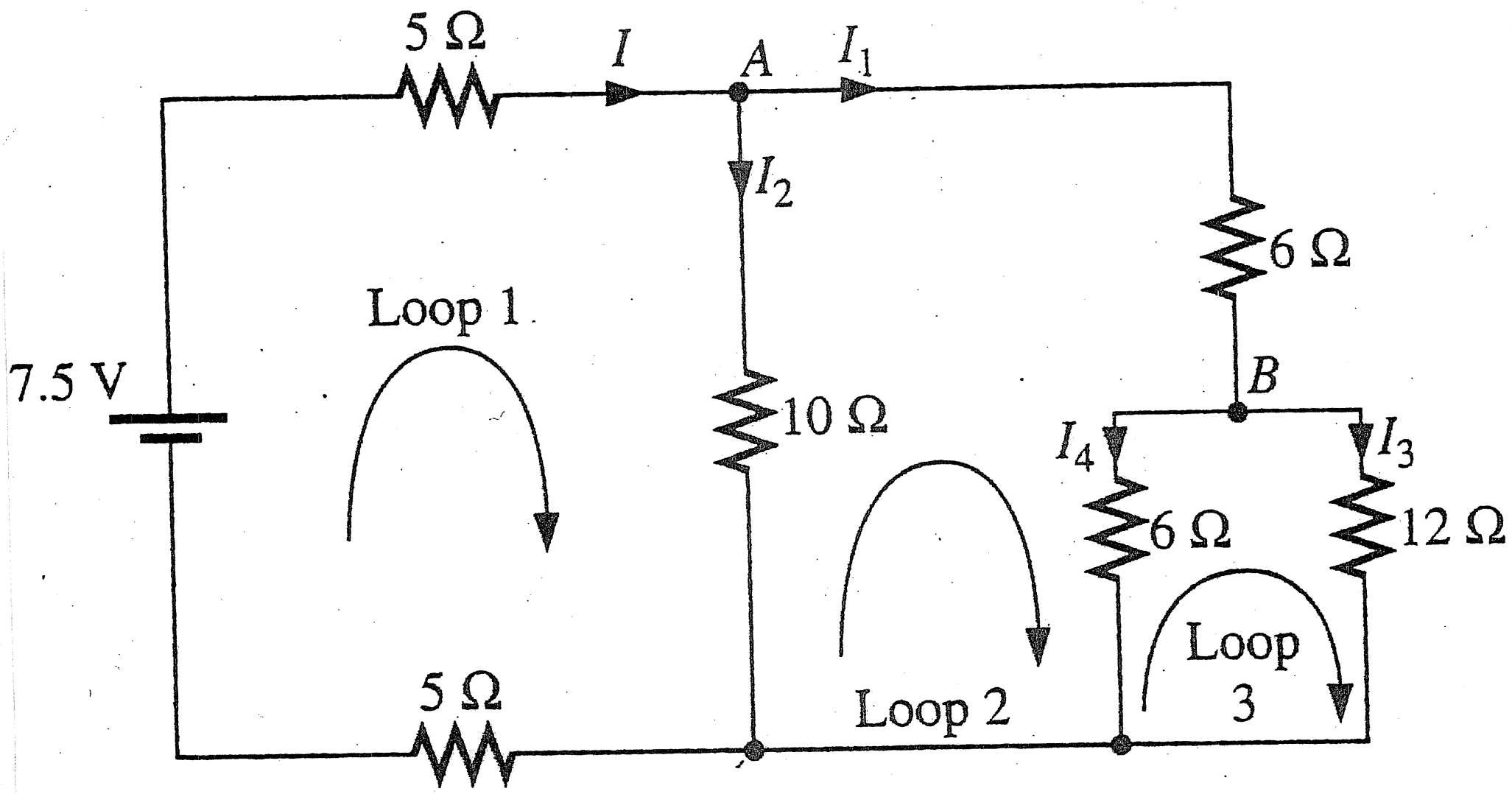
$$R_{eq} = R_1 + R_2 + \cdots + R_n$$

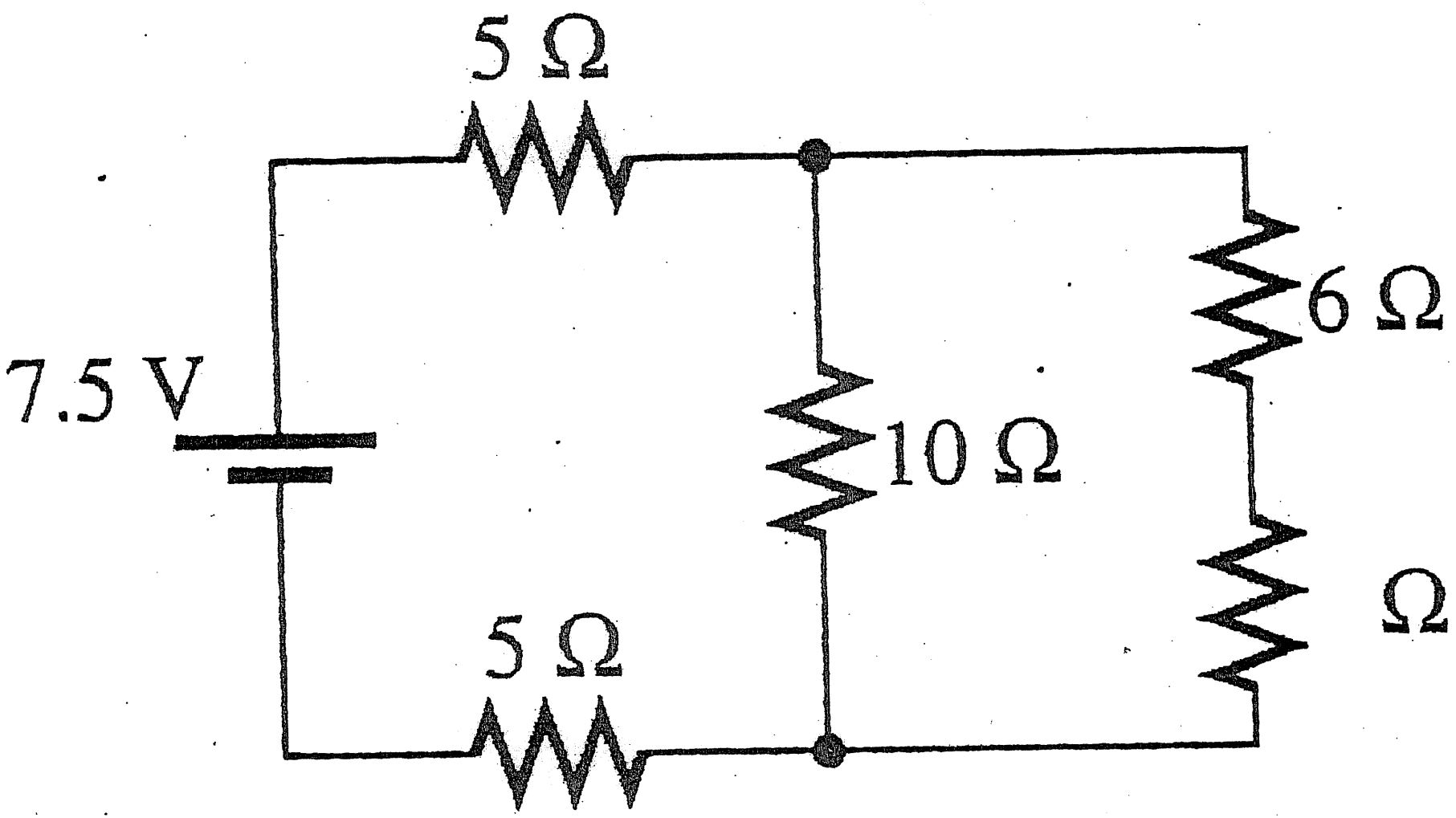
A resistor network that is a combination of parallel and series can sometimes be broken up into smaller parts that are either one or the other. For instance,

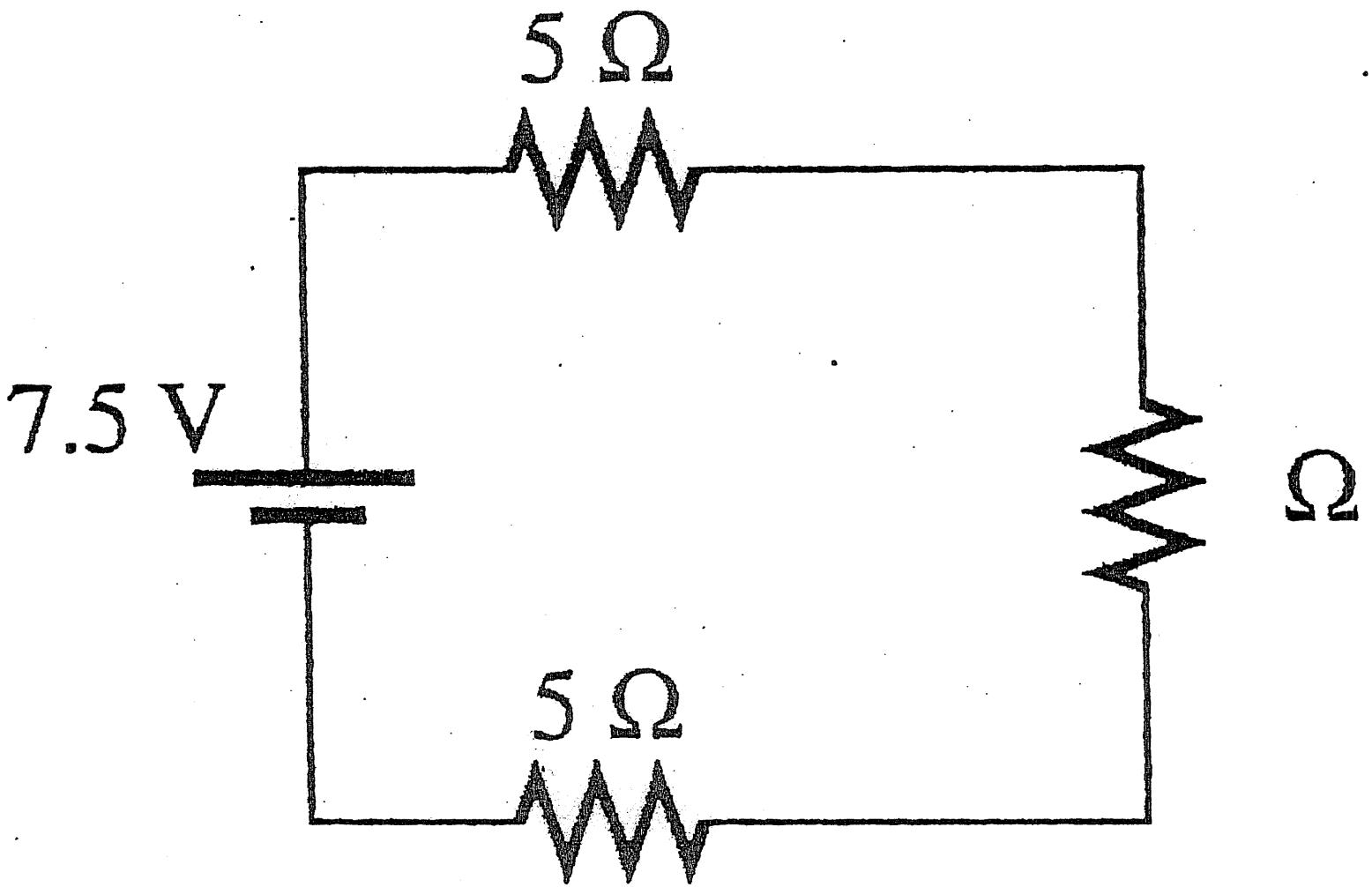


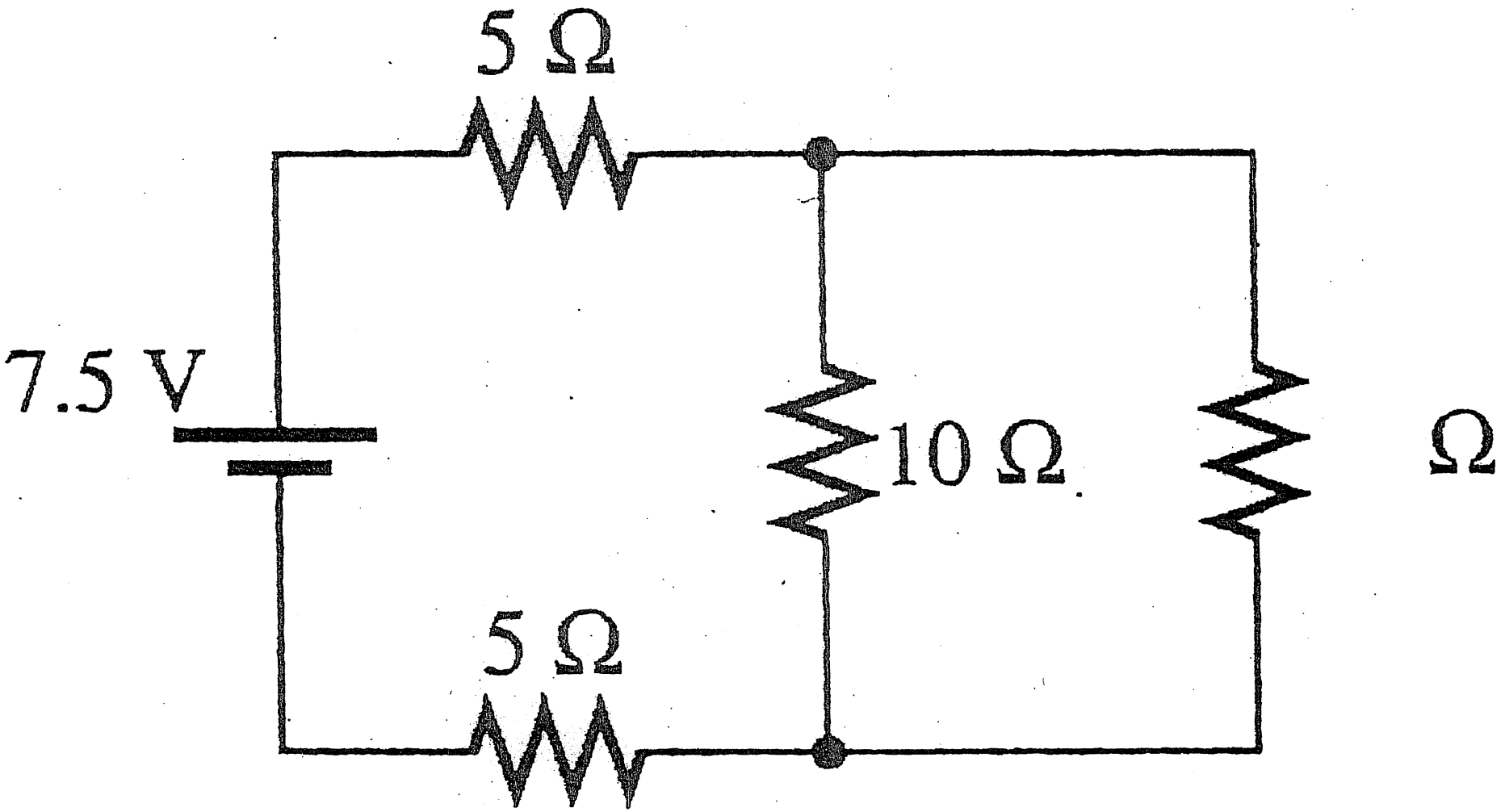
$$R_{eq} = (R_1 \| R_2) + R_3 = \frac{R_1 R_2}{R_1 + R_2} + R_3$$

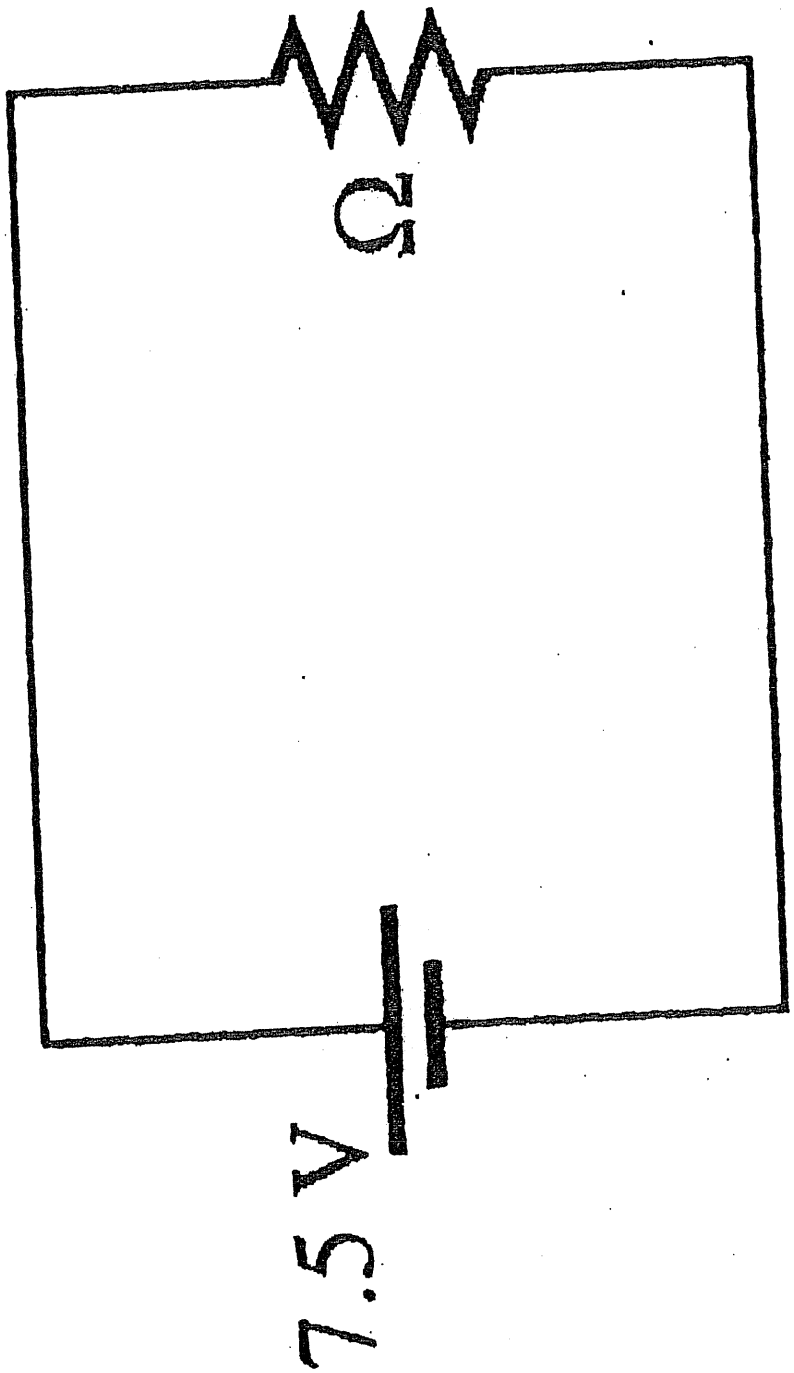

5 Ω
7.5 V
10 Ω
6 Ω
6 Ω
12 Ω
5 Ω

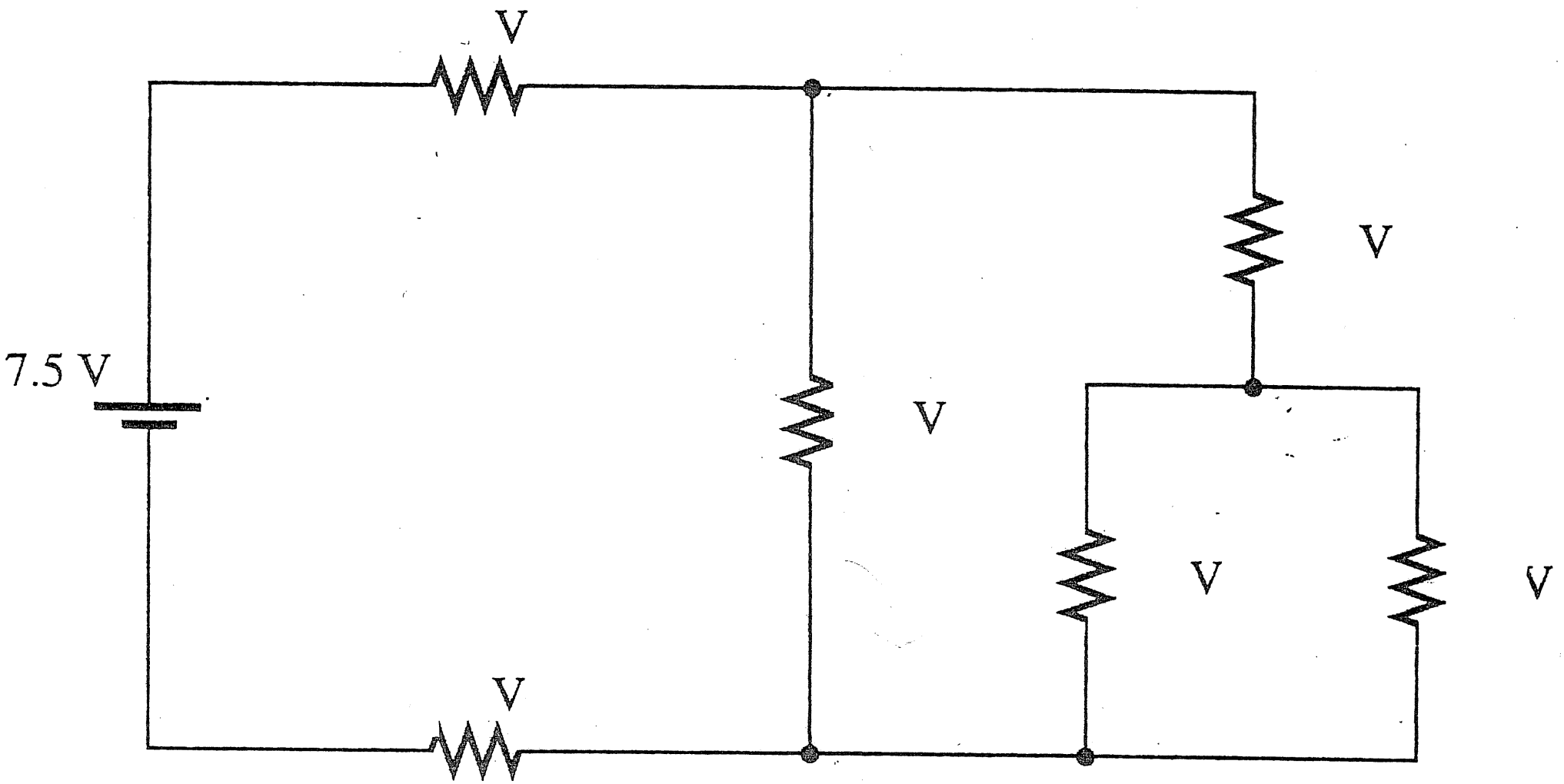

5 Ω
I
A
I_1
I_2
6 Ω
Loop 1
7.5 V
B
10 Ω
I_4
I_3
6 Ω
12 Ω
Loop 3
Loop 2
5 Ω


5 Ω
7.5 V
10 Ω
6 Ω
Ω
5 Ω


5 Ω
7.5 V
Ω
5 Ω


5 Ω
7.5 V
10 Ω
Ω
5 Ω


G
7.5 V


V
V
V
7.5 V
V
V
V
V