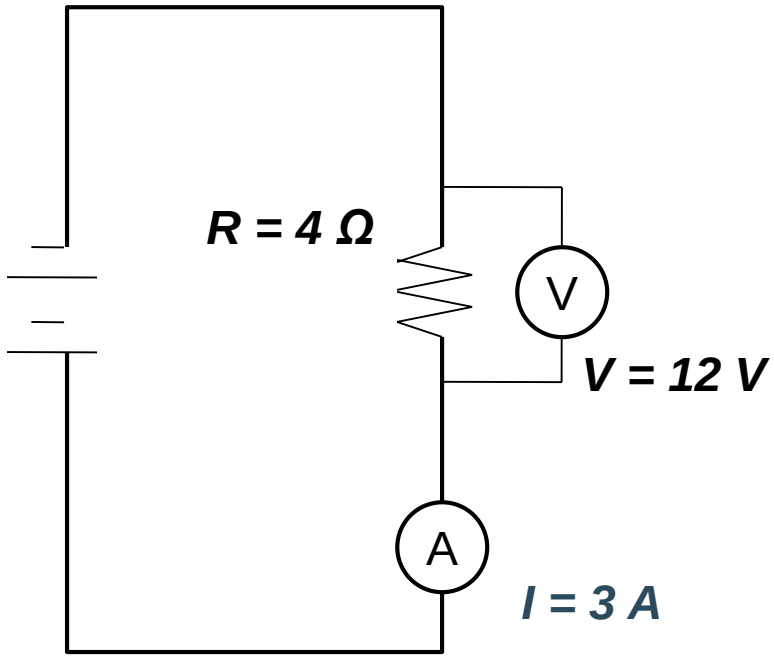
Series and Parallel Circuits

Section 11.5

- Three important quantities of an electrical load:
  - Potential difference (V)
  - Current (I)
  - Resistance (R)

- Related using Ohm's Law:
  V = IR



Loads can be added (in series or in parallel).

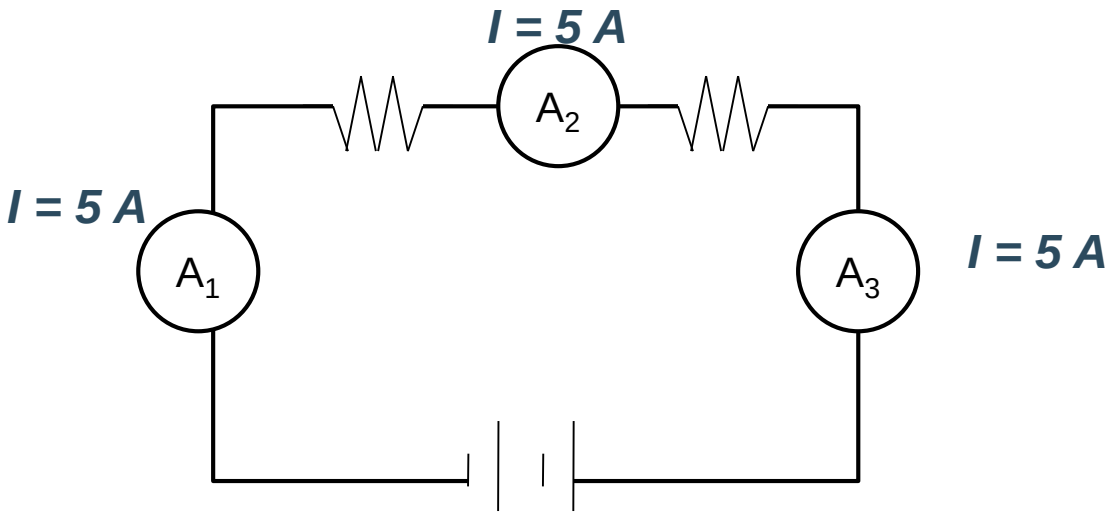
Adding loads can change these quantities.

Loads in Series

Current

- Since there is only one path for electrons, the current is **same at every point** in the circuit

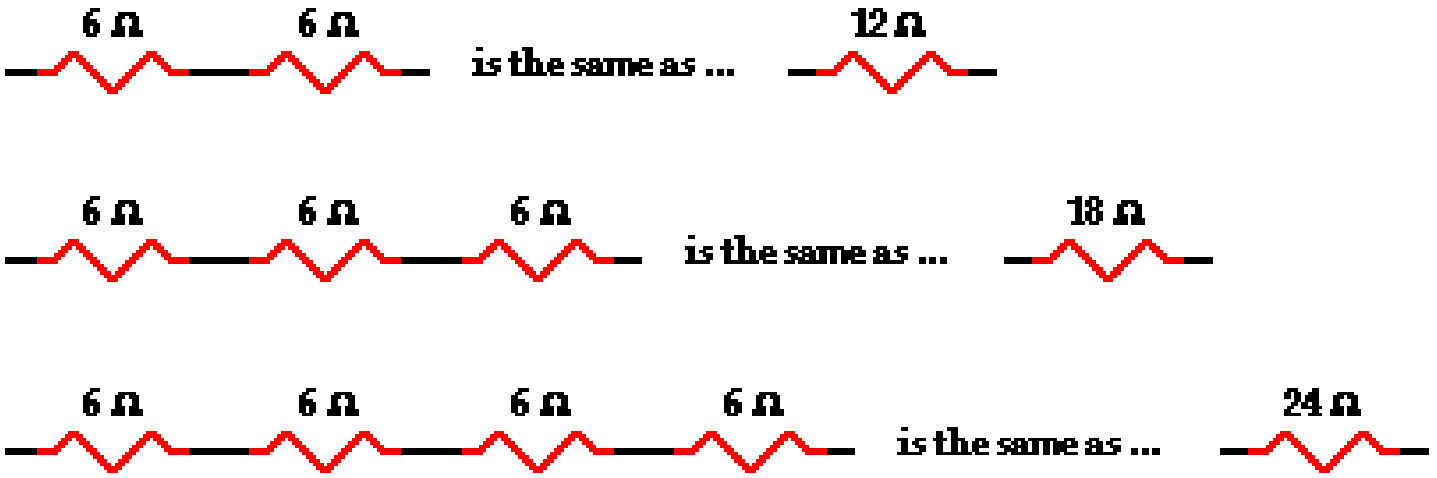
$$I_T = I_1 = I_2 = I_3$$

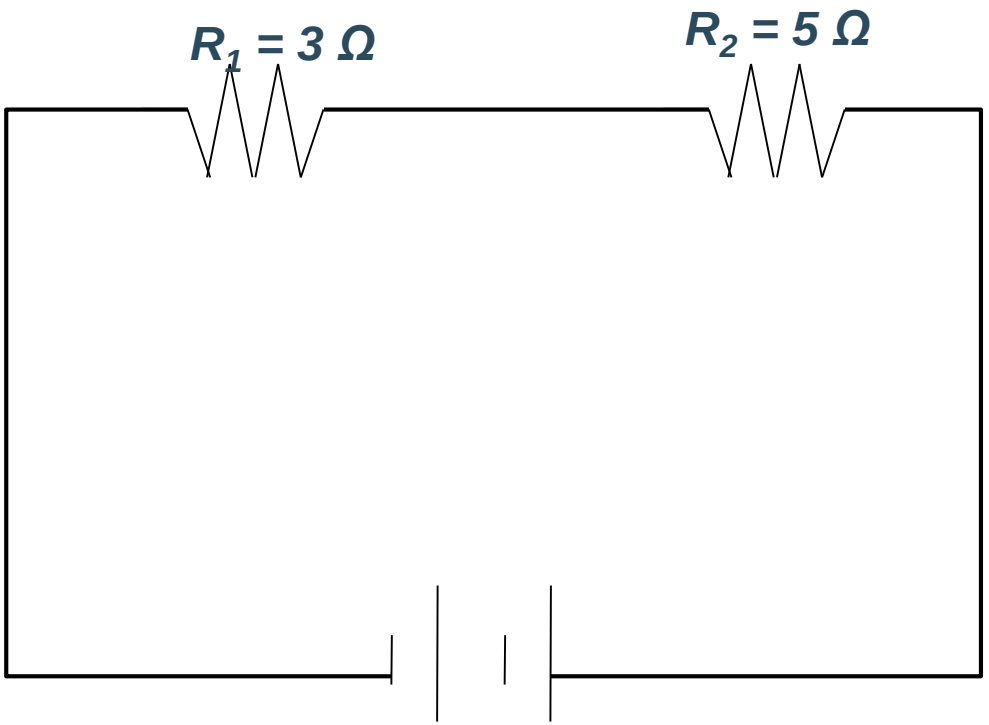


Resistance

- The **total resistance of the circuit (R_T)** is equal to the sum of the resistances of each individual load.

$$R_T = R_1 + R_2 + R_3...$$





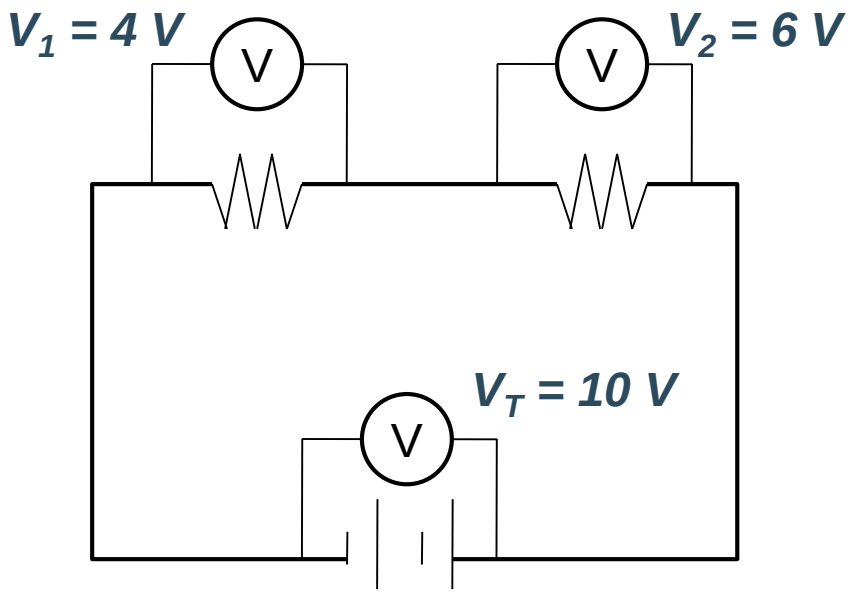
What is the total resistance in the circuit?

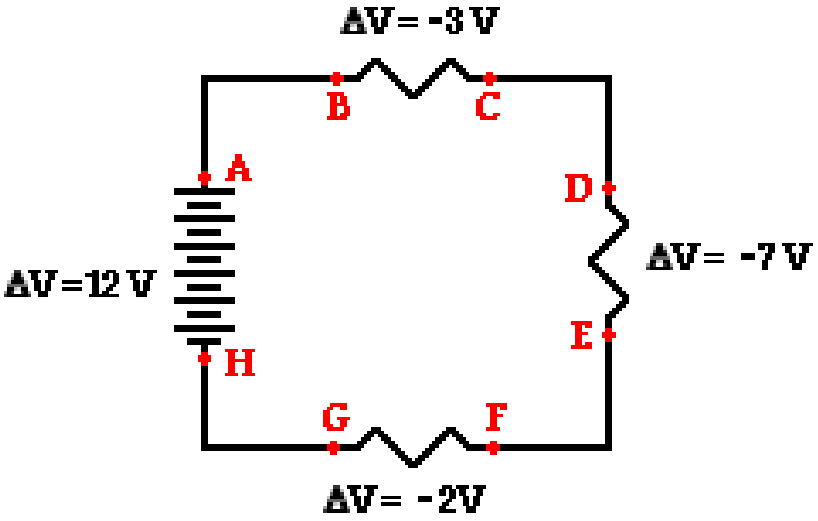
$R_T = 8\ \Omega$

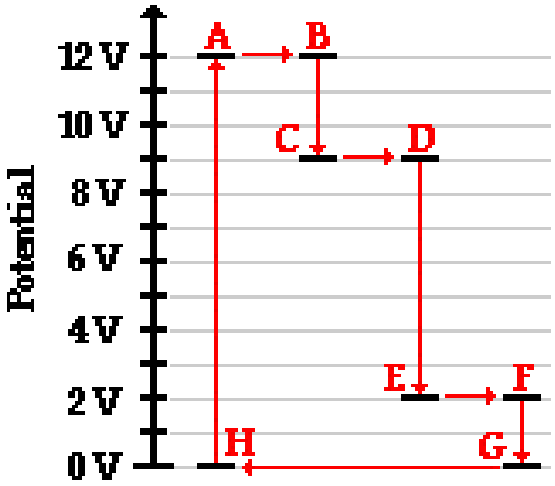
Voltage

- The voltage of the battery is equal to the sum of the voltages of each load:

$$V_T \text{ (battery voltage)} = V_1 + V_2 + V_3...$$







- The overall drop in potential energy is set by the cell/battery.
- When multiple loads are present, the energy is lost in a series of smaller steps.
- The actual potential drop at each load depends on the resistance of the load.

Find the unknown potential difference

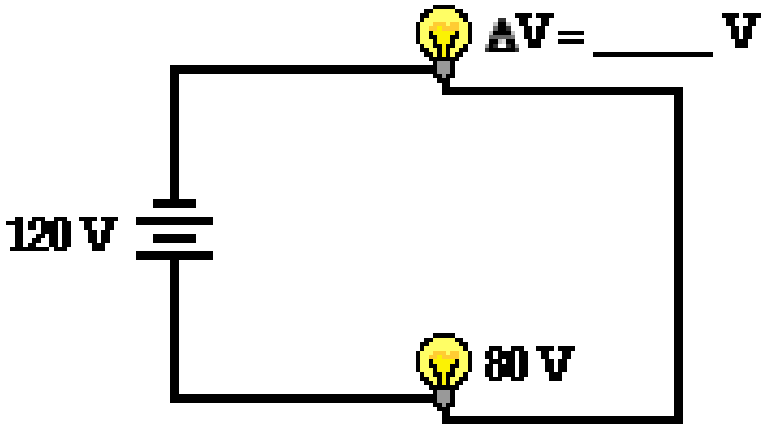


Diagram A

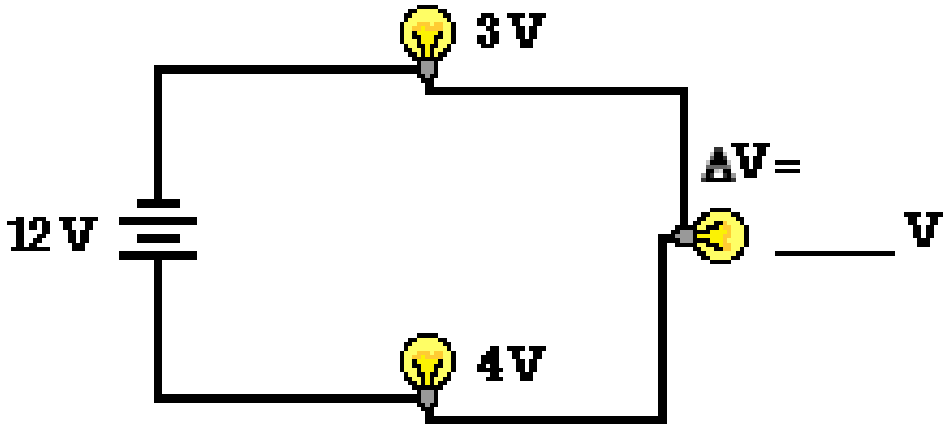


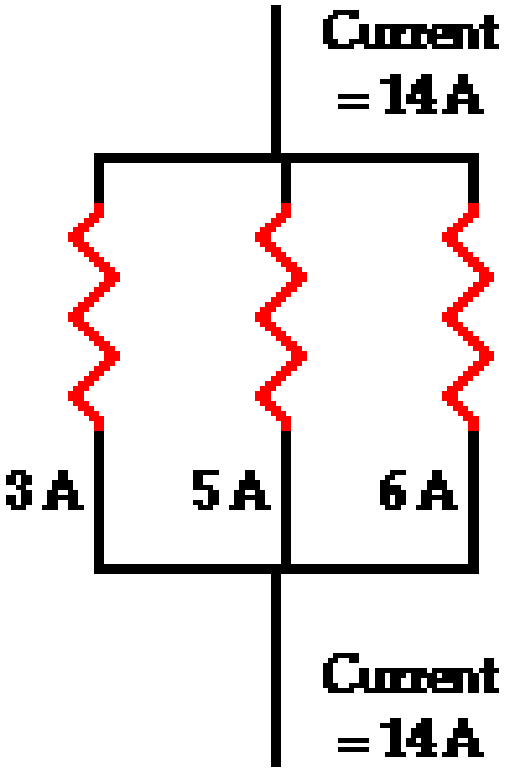
Diagram B

Loads in Parallel

Current

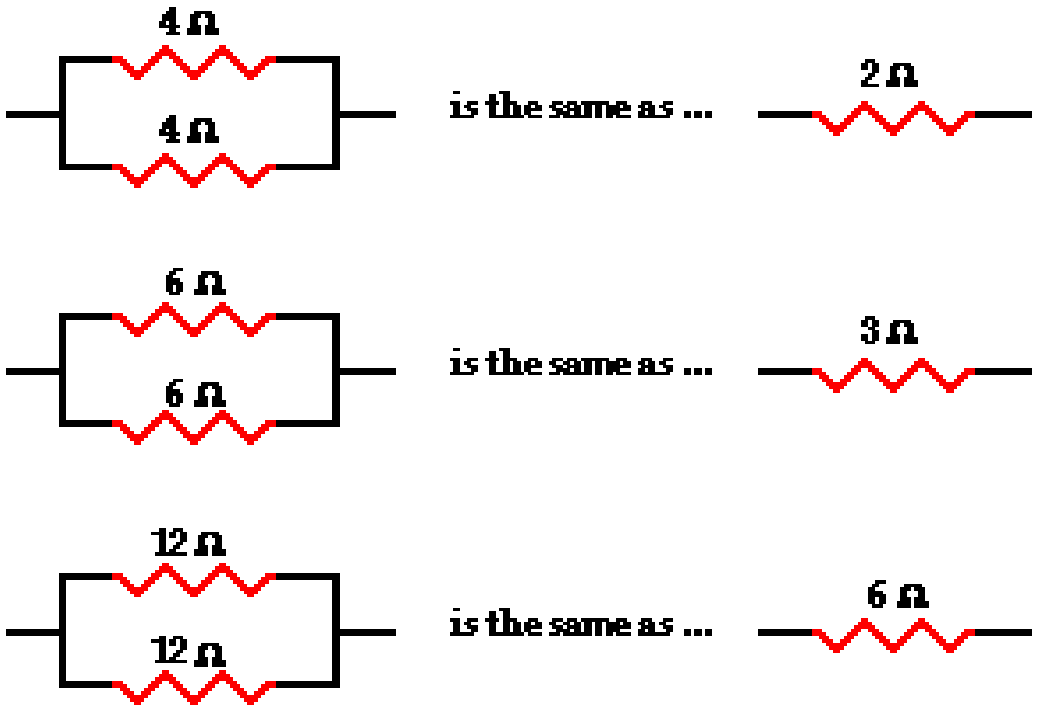
- Multiple paths: the **current gets split** every time it encounters a parallel connection

$$I_T = I_1 + I_2 + I_3 \ldots$$



Resistance

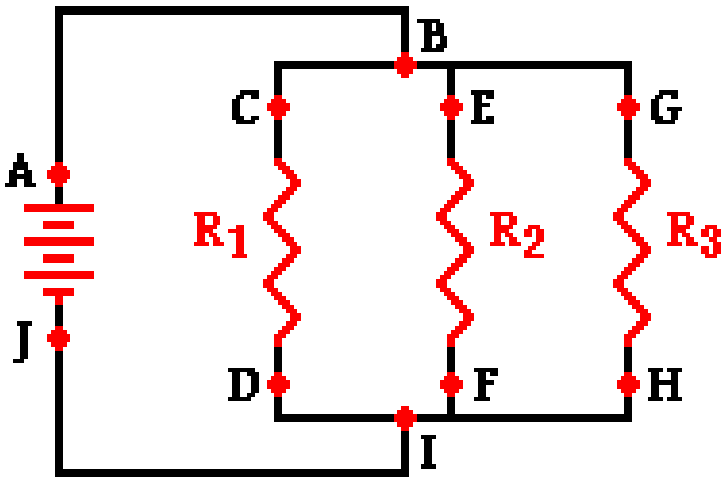
- The total resistance of the circuit actually **decreases**, since less current is flowing through each individual load.
  - *You don't have to do any calculations on this one!*

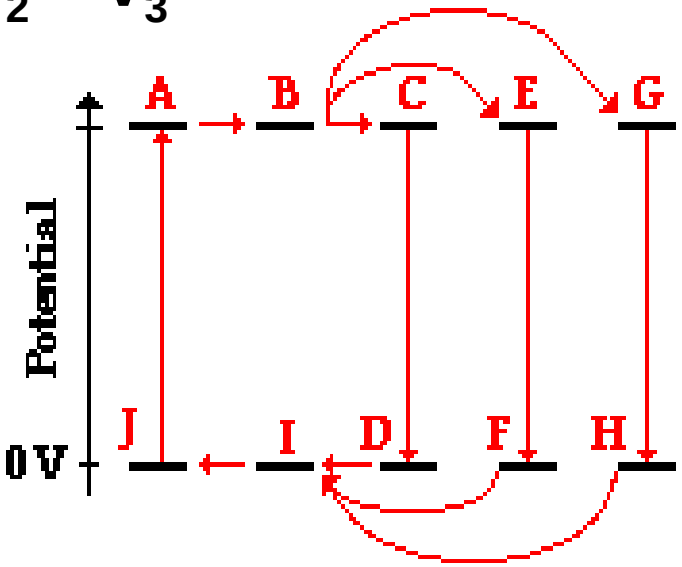


Voltage

- The **voltage** drop across each individual resistor still equals the voltage drop across the battery.

$$V_T = V_1 = V_2 = V_3$$





Applying Ohm's Law

Ohm's Law can still be used for circuits with multiple loads:

- for an **individual load**, the resistance, current, and voltage of only that load would be used

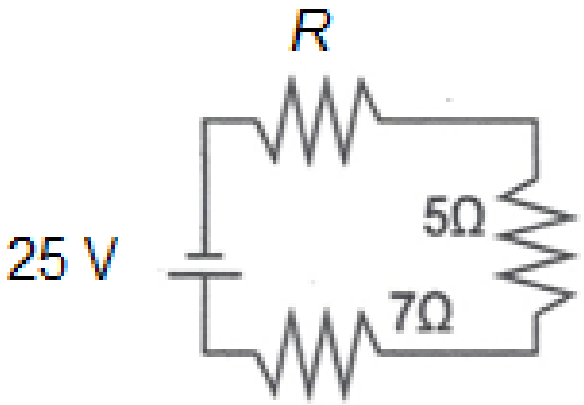
- for the **total circuit**, the total resistance, current, and voltage must be considered

Example 1

For the circuit pictured,

a) The total resistance is 18 Ω. What is the individual resistance at resistor *R*?

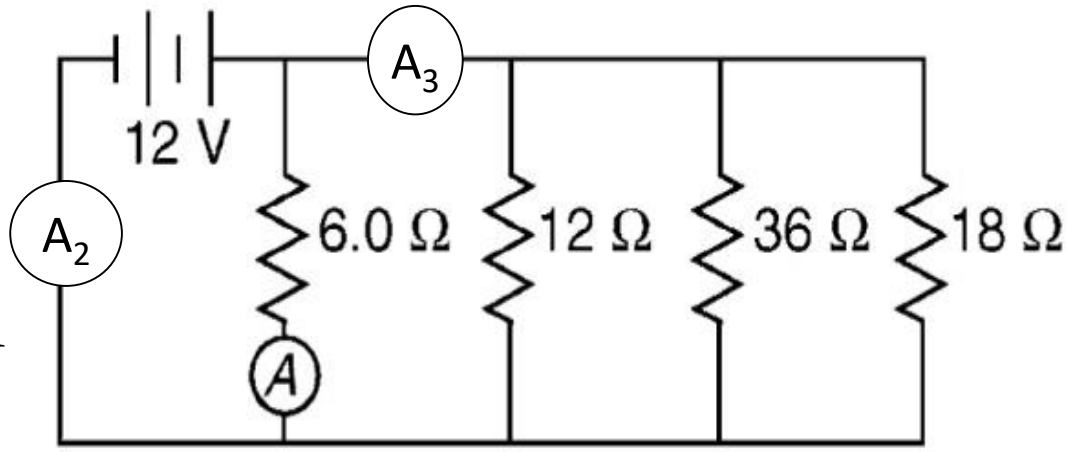
b) Use Ohm's Law to calculate the current in the circuit.



Example 2

a) Calculate the current at ammeter *A*.

b) The current measured at A_2 is 36 A.
Determine the current measured by ammeter A_3.



I = 36 A