# Electrical Engineering

## Analysis of Series and Parallel Circuits

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### Given and Introduction:

This circuit consists of multiple components: resistors and voltage sources, with provided values of current and voltage across some elements. The task involves calculating the unknown values for voltage drops, resistances, and currents in the circuit.

- **Voltage of the battery:** 24 V
- **Voltage across B:** 12 V
- **Voltage across E:** 4.5 V
- **Current through A:** 4 A
- **Resistance of D:** 6 Ω
- **Current through C:** 0.75 A

### Step-by-Step Solution:

**Step 1: Voltage Drop Across A**

**Formula:** Ohm's Law, $V = I \times R$

**Given:**

- Current through A ($I_1$): 4 A
- Voltage of battery: 24 V
- Voltage across B: 12 V
- Voltage across E: 4.5 V

**Calculation:**

$$V_A = 24\ V - (12\ V + 4.5\ V)$$
$$V_A = 24\ V - 16.5\ V$$
$$V_A = 7.5\ V$$

**Explanation:** The voltage drop across A is the remaining voltage after accounting for the voltage drops across B and E in the circuit.

**Supporting Statement:** Calculating the voltage drop across A helps determine the individual potential differences at different points in the circuit.

**Voltage drop across A:** 7.5 V

**Step 2: Resistance of A**

**Given:**

- Voltage across A ($V_A$): 7.5 V
- Current through A ($I_1$): 4 A

**Formula:** Ohm's Law, $R = V / I$

**Calculation:**

$$R_A = 7.5\ V / 4\ A$$
$$R_A = 1.875\ \Omega$$

**Explanation:** Using Ohm's Law, the resistance is calculated by dividing the voltage across A by the current through A.

**Supporting Statement:** The resistance of a component provides insight into how much it opposes the current flow in the circuit.

**Resistance of A:** 1.875 Ω

**Step 3: Resistance of E**

**Given:**

- Voltage across E ($V_E$): 4.5 V
- The current through the entire circuit ($I_{total}$): 4 A

Since E is in series with the other components, the current through E is the same as the current through A.

**Formula:** Ohm's Law, $R = V / I$

**Calculation:**

$$R_E = 4.5\ V / 4\ A$$
$$R_E = 1.125\ \Omega$$

**Explanation:** The resistance of E is calculated using the same method as for A, considering the series connection in the circuit.

**Supporting Statement:** Evaluating the resistance of each component aids in understanding the distribution of resistance throughout the circuit.

**Resistance of E:** 1.125 Ω

**Step 4: Voltage Drop Across C**

**Given:**

- Current through C ($I_3$): 0.75 A

First, assume that the voltage drop across D is equal to the calculated voltage from B and E, verified from KVL (Kirchhoff's Voltage Law) around the loop including B, C, D.

**Formula:** $V = I \times R$

**Given:**

**Calculation:**

- $R_{\text{-}D}$ = 6 Ω
- $I_{\text{-}D}$ = 0.75 A

$$V_D = I_D \times R_D$$
$$V_D = 0.75\ A \times 6\ \Omega$$
$$V_D = 4.5\ V$$

Since the voltage drop across D and C must be the same in parallel:

$$V_C = V_D$$
$$V_C = 4.5\ V$$

**Explanation:** Voltage drop across parallel components is the same, hence taking the voltage drop across D.

**Supporting Statement:** Ensuring correct voltage drops in the parallel sections ensures proper analysis of the circuit.

**Voltage drop across C:** 4.5 V

**Step 5: Current through D**

**Given:**

- Resistance of D ($R_D$): 6 Ω
- Voltage drop across D is known from previous step: 4.5 V

**Formula:** $I = V / R$

**Calculation:**

$$I_D = 4.5\ V / 6\ \Omega$$
$$I_D = 0.75\ A$$

**Explanation:** Calculating the current through D using the voltage drop across it and its resistance.

**Supporting Statement:** Current through each component helps determine the flow of charge throughout the circuit.

**Current through D:** 0.75 A

**Step 6: Resistance of C**

**Given:**

- Voltage across C ($V_C$): 4.5 V
- Current through C ($I_C$): 0.75 A

**Formula:** Ohm's Law, $R = V / I$

**Calculation:**

$$R_C = 4.5\ V / 0.75\ A$$
$$R_C = 6\ \Omega$$

**Explanation:** The resistance of C is derived from its voltage drop and the current passing through it.

**Supporting Statement:** Determining resistance in the circuit confirms that Ohm's Law is applicable.

**Resistance of C:** 6 Ω

**Step 7: Current through B**

**Given:**

- Voltage across B ($V_B$): 12 V

The current through B ($I_B$) corresponds to the total current in the series circuit, which includes the battery and resistor B.

Knowing the elements in series,

The current through A which is $I_A = 4\ A$

**Therefore, Current through B is the same as current through A:**

$$I_B = 4\ A$$

**Explanation:** As the same current flows through series components, the total current remains consistent.

**Supporting Statement:** Confirming the current in series elements validates consistent current flow.

**Current through B:** 4 A

### Final Solution Summary

- Voltage drop across A: 7.5 V
- Resistance of A: 1.875 Ω
- Resistance of E: 1.125 Ω
- Voltage drop across C: 4.5 V
- Current through D: 0.75 A
- Resistance of C: 6 Ω
- Current through B: 4 A