Self-Training Activity 1:

Series Circuit Analysis and Fault Simulation

This activity is designed to help students solidify their theoretical understanding, practical application, and troubleshooting skills related to **Series Circuit Connections**.

1. Pre-Activity Theoretical Calculation (Analysis)

You will analyze a three-resistor series circuit.

Component	Value	Unit
Source Voltage (Vs)	12	V
Resistor 1 (R_1)	100	Ω
Resistor 2 (R_2)	200	Ω
Resistor 3 (R_3)	300	Ω

Tasks (Show all working using the series circuit formulas):

1. Calculate the **Total Equivalent Resistance** (RT):

    $R_T = R_1 + R_2 + R_3$

2. Calculate the **Total Circuit Current** (IT) using Ohm's Law:

    $I_T = R_T {}_{VT}$

3. Calculate the **Voltage Drop** across each resistor (V_1, V_2, V_3):

    $V_n = I_T \times R_n$

4. **Verification:** Verify Kirchhoff's Voltage Law (KVL): Is $V_T = V_1 + V_2 + V_3$?

Quantity	Calculated Value	Unit
R_T		Ω
I_T		A
V_1		V
V_2		V
V_3		V

2. Virtual/Simulated Measurement (Application)

Use a circuit simulation software (e.g., **PhET Circuit Construction Kit or CiruitLab**) to build and measure the circuit.

Tasks:

1. **Construct** the series circuit using a 12V source and the three specified resistors (100Ω, 200Ω, 300Ω).
2. Use a virtual **Ammeter** to measure the current at *three different points* (I_1, I_2, I_3).
3. Use a virtual **Voltmeter** to measure the voltage drop across each resistor (V_1, V_2, V_3).

Quantity	Measured Value	Unit	Comparison to Calculated Value
I_1		A	
I_2		A	
I_3		A	
V_1		V	
V_2		V	
V_3		V	

Reflection: State the fundamental property of current in a series circuit based on your measurements of I_1, I_2, and I_3. Why is the sum of your measured voltages ($V_1+V_2+V_3$) equal to the source voltage?

---

3. Fault Simulation and Troubleshooting (Problem Solving)

Restore the original circuit before simulating each fault. Record your measurements and draw a conclusion about the fault type and location.

Fault 1: Open Circuit Simulation

1. Simulate an **Open Circuit** by disconnecting or removing R_2 (breaking the path).
2. Measure the **Total Circuit Current** (IFault 1).
3. Measure the **Voltage** across the break/gap where R_2 was (Vgap).

Fault 2: Short Circuit Simulation

1. Restore the original circuit.
2. Simulate a **Short Circuit** by placing a zero-resistance wire in **parallel** with R_3.
3. Measure the **Total Circuit Current** (IFault 2).
4. Measure the **Voltage Drop** across the shorted component (V_3, short).

Fault Type	Measured I_T	Measured V across the Fault Component/Gap	Analysis (How Resistance and Current Changed)
Open Circuit			
Short Circuit			

Conclusion: Troubleshooting a series circuit relies on knowing that:

- An **open circuit** causes the current to **(value)**, and the entire source voltage is measured across the **(location/type)**.
- A **short circuit** causes the total resistance to **(increase/decrease)**, resulting in a large increase in the **(quantity)**, while the voltage across the shorted component drops to **(value)**.

Result (hint)

Result:

Quantity	Calculated Value	Unit
RT	600	Ω
IT	0.02	A
V1	2	V
V2	4	V
V3	6	V