



PRACTICAL INVESTIGATION

PART 1

Current strength, potential difference & total resistance when resistors are connected in series

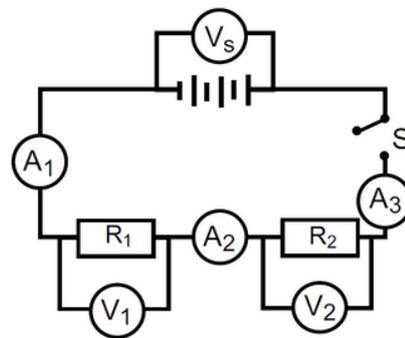
Materials

- three 1,5 V torch batteries
- two light bulbs or resistors
- connecting wires
- a switch
- a voltmeter
- an ammeter



NOTE

First use 2 identical resistors, and repeat with two different resistors.



NOTE

If you don't have the apparatus you can use **this** simulation instead.

Method

- 1 Use the materials listed to set up the circuit as shown in the circuit diagram above.
 - Resistors **R₁** and **R₂** are connected in series.
 - **A₁**, **A₂** and **A₃** are points along the circuit where an ammeter can be connected.
 - **V₁**, **V₂** and **V_s** are points along the circuit where a voltmeter can be connected
- 2 Start by connecting the ammeter at point **A₁** and the voltmeter at **V₁**. Close the switch (S) and note the ammeter (I) and voltmeter (V) readings. Add the data to the table below.
- 3 Open the switch and move the ammeter to point **A₂** and the voltmeter to point **V₂**. Close the switch (S) and note the ammeter (I) and voltmeter (V) readings.
- 4 Repeat STEP 3 for the final positions of the ammeter (**A₃**) and the voltmeter (**V_s**).

Observation and results

	Ammeter A₁	Ammeter A₂	Ammeter A₃	Volmeter V₁	Voltmeter V₂	Voltmeter V_s	Total Resistance
Trial 1							
Trial 2							

Answer the following questions as to formulate the observations made during the investigation and draw a final conclusion:

Questions

- 1 Write a short sentence to formulate an investigation question for the investigation.
- 2 How do the three ammeter readings compare. What conclusion can be drawn from the ammeter readings regarding the current strength through two or more resistors connected in series?
- 3 How do the three voltmeter readings compare. What conclusion can be drawn from the voltmeter readings across the battery and across resistors that are connected in series?
- 4 Calculate the resistance of each resistor and the total external resistance (R_{tot}).

Answers

- 1 How does the total current compare with the current through each resistor? **AND**
How does the total potential difference across the battery compare with the potential difference across each resistor?

2 $A_1 = A_2 = A_3$

The ammeter reading remains the same, regardless where it is connected in the circuit. / The current strength (I) is the same everywhere in a series circuit.

3 $V_s = V_1 + V_2$

The voltmeter reading on V_s (total potential difference) is equal to the sum of the voltmeter readings of V_1 and V_2 (across in series resistors) / The potential difference across the battery, i.e. across the entire circuit, is shared between the series resistors.

NOTE

*If $R_1 = R_2$, they have the same potential difference across them.
If $R_1 \neq R_2$, the larger resistor has the larger potential difference across it.*

- 4 The resistance values R_1 and R_2 of the resistors chosen, can be confirmed as follows:

$$R_1 = \frac{V_1}{I} \quad \text{and} \quad R_2 = \frac{V_2}{I}$$

The **total external resistance** is the sum of the resistance values of individual in series resistors.

$$R_{\text{tot}} = R_1 + R_2 \quad \text{OR} \quad R_{\text{tot}} = \frac{V_s}{I}$$

(Substitute the correct values and do the calculations)

Current strength, potential difference & total resistance when resistors are connected in parallel

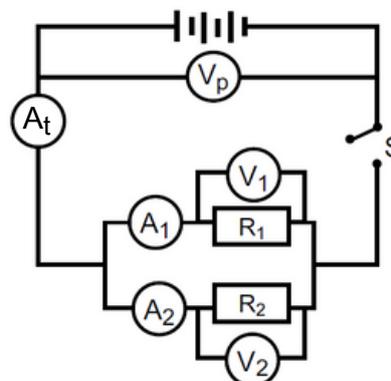
Materials

- three 1,5 V torch batteries
- two light bulbs or resistors
- connecting wires
- a switch
- a voltmeter
- an ammeter



NOTE

First use 2 identical resistors, and repeat with two different resistors.



NOTE

If you don't have the apparatus you can use **this** simulation instead.

Method

- 1 Use the materials listed to set up the circuit as shown in the circuit diagram above.
 - Resistors **R₁** and **R₂** are connected in parallel.
 - **A₁**, **A₂** and **A_t** are points along the circuit where an ammeter can be connected.
 - **V₁**, **V₂** and **V_p** are points along the circuit where a voltmeter can be connected
- 2 Start by connecting the ammeter at point **A₁** and the voltmeter at **V₁**. Close the switch (S) and note the ammeter (I) and voltmeter (V) readings. Add the data to the table below.
- 3 Open the switch and move the ammeter to point **A₂** and the voltmeter to point **V₂**. Close the switch (S) and note the ammeter (I) and voltmeter (V) readings.
- 4 Repeat STEP 3 for the final positions of the ammeter (**A_t**) and the voltmeter (**V_p**).

Observation and results

	Ammeter A₁	Ammeter A₂	Ammeter A_t	Voltmeter V₁	Voltmeter V₂	Voltmeter V_p	Total Resistance
Trial 1							
Trial 2							

Answer the following questions as to formulate the observations made during the investigation and draw a final conclusion:

Questions

- 1 Refer to the ammeter readings and write a conclusion regarding the current in a circuit with two or more resistors in parallel.
- 2 Refer to the voltmeter readings and write a conclusion regarding the potential difference across the battery / combination of resistors in parallel and across each parallel branch.
- 3 Calculate R_{tot} , the total (effective) resistance of the circuit.
- 4 Draw a final conclusion regarding the current through and the potential difference across resistors connected as follows in a circuit:
 - (a) in series
 - (b) in parallel

Answers

1 $A_t = A_1 + A_2$

The **ammeter reading** on A_t (total current) is **equal to the sum of the ammeter readings** of A_1 and A_2 (current through parallel resistors). / The total current is shared between the parallel branches.

NOTE

If $R_1 = R_2$, the total current is divided equally between the parallel branches.
If $R_1 \neq R_2$, the smaller portion of the current flows through the branch with the larger resistance.

2 $V_p = V_1 = V_2$

The **voltmeter reading** across the parallel combination of resistors (V_p) is the **same** as the reading across **each branch with 1 resistor**.

3 The **total (effective) resistance** of resistors in parallel can be calculated as follows:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \text{OR use Ohm's law: } R_{\text{tot}} = \frac{V_p}{I_t}$$

$$\therefore R_p = \left[\frac{1}{R_1} + \frac{1}{R_2} \right]^{-1}$$

(Substitute the correct values and do the calculations)

4 (a) The same current flows through all resistors connected in series, i.e. the current strength (I) is the same everywhere in the circuit.

The total potential difference is divided between the resistors (proportionally to their resistance values), i.e. series resistors are potential dividers.

(b) The same potential difference is measured across the battery / combination of parallel resistors and across each parallel branch.

The total current is divided between the resistors, i.e. parallel resistors are current dividers.

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Natural Sciences



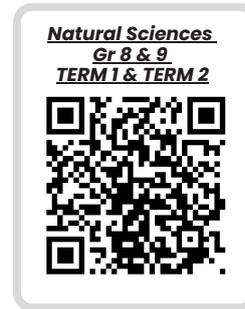
Physical Sciences

TAS ATP & LESSON PLANNERS

TERM	DATE	TOPIC	RESOURCES	STATUS
TERM 1	2021	Work, Energy & Power	Work, Energy & Power (Gr 8 & 9)	Completed
TERM 2	2021	Work, Energy & Power	Work, Energy & Power (Gr 8 & 9)	Completed
TERM 3	2021	Work, Energy & Power	Work, Energy & Power (Gr 8 & 9)	Completed
TERM 4	2021	Work, Energy & Power	Work, Energy & Power (Gr 8 & 9)	Completed

Compiled using the ATP's and our TAS class texts and study guides for FET and GET.

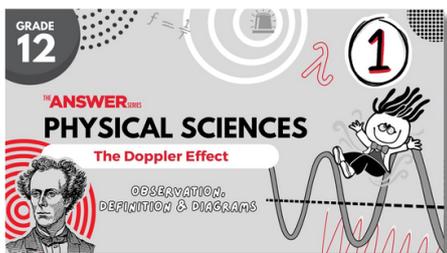
Includes TAS resources, resources from our Teacher WhatsApp Community as well as others on the web.



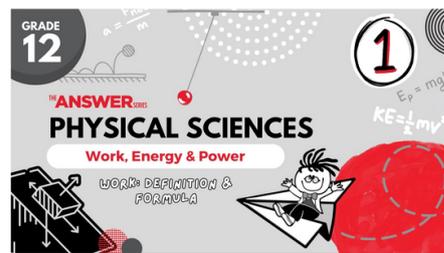
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