Worksheet 2.3: Series Resistance Calculations

PhysicsSheets

Specification: GCSE Physics (AQA 4.2.2 / Edexcel SP10)

Core Equation (Series Resistance): $R_{\text{total}} = R_1 + R_2 + \dots$

Variables & Units:

R_{total} = Total resistance (_____, Ohms)

R_1, R_2 = Individual resistances (_____, Ohms)

Related Equations: $V = I \times R$ | $P = I \times V$ | $P = I^2 \times R$ | $P = \dfrac{V^2}{R}$

Section A: Formula Recall & Unit Conversions

1. The formula for total resistance in a series circuit is $R_{\text{total}} = R_1 + R_2$.

a) Rearrange the formula to make R_1 the subject.

b) Rearrange the formula to make R_2 the subject.

2. Complete the following unit conversions. Show your working where appropriate.

a) $2.5\,\text{k}\Omega =$ _____ Ω

b) $0.015\,\text{M}\Omega =$ _____ Ω

c) $470\,\Omega =$ _____ $\text{k}\Omega$

d) $120000\,\Omega =$ _____ $\text{M}\Omega$

e) $50\,\text{mA} =$ _____ A

f) $0.25\,\text{A} =$ _____ mA

Section B: Series Resistance Calculations

For all questions in this section, assume the resistors are connected in series. Show all your working.

1. A circuit contains two resistors, $R_1 = 15\,\Omega$ and $R_2 = 25\,\Omega$.

a) Calculate the total resistance of the circuit.

b) If a third resistor, $R_3 = 10\,\Omega$, is added in series, what is the new total resistance?

2. A series circuit has a total resistance of $120\,\Omega$. One of the resistors, R_A, has a resistance of $75\,\Omega$.

a) Calculate the resistance of the other resistor, R_B.

b) If the circuit is connected to a 6.0 V power supply, calculate the current flowing through R_A.

Section C: Application & Multi-step Problems

Figure 1 shows a simple series circuit containing a cell, a fixed resistor (R_F), and a thermistor (R_T).

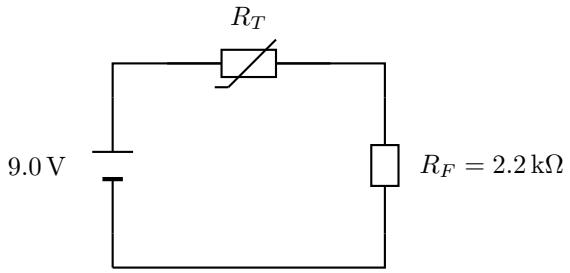

Figure 1: Thermistor Sensing Circuit

1. At a specific temperature, the thermistor (R_T) has a resistance of 1.8 kΩ. The fixed resistor (R_F) has a resistance of 2.2 kΩ.

a) Calculate the total resistance of the circuit in Ohms.

b) Calculate the current flowing through the circuit. Give your answer in milliamperes (mA) to an appropriate number of significant figures.

2. The circuit is used as a temperature sensor. The resistance of an NTC thermistor decreases as temperature increases.

a) Explain how an increase in temperature affects the total resistance of the circuit and the current flowing through it.

b) Calculate the power dissipated by the fixed resistor (R_F) when the current flowing through the circuit is 2.5 mA. Give your answer in milliwatts (mW).