202: Principles of electrical science  
**Handout 5: Resistors in parallel**

**Learning outcome**

The learner will:

1. Understand the relationship between resistance, resistivity, voltage, current and power.

**Assessment criteria**

The learner can:

4.5 calculate the values of current, voltage and resistance in parallel and series D.C. circuits.

**Resistors in parallel**

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| In order to find the total resistance of any parallel circuit, we must add the reciprocal (of all the resistances together.  The formula for calculating the total resistance of resistors connected in parallel is given below. | parallel 01.png |

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| **Example 1**  Calculate the total resistance of a parallel circuit if: . | | | parallel 01.png |
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| Find the lowest common denominator, which is 36: | | |  |
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| Inverting both sides of the equation will give us Rt: | | | |
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The total resistance of the circuit will determine the amount of current that will flow in that circuit.

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| **Example 2**  Calculate the total resistance of a parallel circuit if | | | parallel 01.png |
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| Find the lowest common denominator, which is 90: | | |  |
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| Inverting both sides of the equation will give us Rt: | | | |
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It can be seen that in all parallel circuits the total resistance of the circuit is **always less than** the smallest resistance in that circuit.

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| **Two resistors in parallel**  When there are only two resistors in parallel, the equivalent total resistance of the combination may be found by using the **product over sum** method, as shown below.   * The **product** of two numbers is the **multiplication** of the two numbers. * The **sum** of two numbers is the **addition** of the two numbers. | parallel 02.png |

**Example 3**

Calculate the total resistance of two resistors connected in parallel if R1 = 6Ω and R2 = 4Ω.

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This method only works for two resistors in parallel.

If all the resistors in parallel are of the same value, then all that has to be done, in order to calculate the total resistance of the circuit, is to take any one resistor and divide its value by the number of resistors that are in the parallel combination.

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| Kirchoff’s Current law  The sum of the currents arriving at a point must equal the sum of the currents leaving that point. | current 01.png |

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In any parallel branch/circuit, the voltage will always be the same across each individual resistor, but the current may be different depending on the value of the resistor.

Since the voltage is constant, it makes it easy to calculate the current flowing through each individual resistor.

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| **Example 4** | current 02.png |

If we calculate the total resistance of the parallel network:

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and then calculate the total current using Ohm’s law:

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|  |  | – Kirchhoff’s law is proved. |

The sum of the currents through the resistors is the same as the current drawn from the supply; therefore, the solution is correct according to Kirchhoff’s Current law.

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| current 03.png |