To investigate the factors of affecting the resistance of a wire essay sample

Aim: To investigate the factors of affecting the resistance of a wire.

In this experiment I will be using a metal nichrome wire to show the resistance when the length and width is changed.

Variables

Variables that I am going to keep the same. Variables that I am going to change.

Width- 0. 36mm2

Material- Nichrome wire

Voltage- 2V

Temperature- Room Temperature

Length- 10cm, 20 cm, 30cm, 40cm, 50cm

Material- Nichrome

Length- 50cm

Voltage- 2V

Temperature- Room Temperature

Width- 0. 36mm2, 0. 32mm2, 0. 24mm2, 0. 16mm2, 0. 12mm2, 0. 08mm2

In this experiment I am going to use the nichrome wire as a conductor and I will be measuring the resistance by using an ammeter and a voltmeter because electricity can pass through the nichrome wire and the voltmeter

will give me the volts produced and the ammeter will give me the amps produce, therefore these readings can be used to find the resistance.

The resistance of a conductor is defined by the equation: R= V

I

Resistance = Potential difference (Voltage)(V)

Current (amps)

Therefore I will be using this formula to give me the resistance, where the voltage divided by the current will equal the resistance.

Metals conduct electricity because the atoms in them do not hold on to their electrons very well, and so creating free electrons, carrying a negative charge to jump along the line of atoms in a wire. Resistance is caused when these electrons flowing towards the positive terminal have to ‘ jumps’ atoms. So if we double the length of a wire, the number of atoms in the wire doubles, so the number of jumps double, so twice the amount of energy is required: There are twice as many jumps if the wire is twice as long. The thinner the wire is the less channels of electrons in the wire for current to flow, so the energy is not spread out as much, so the resistance will be higher: We see that if the area of the wire doubles, so does the number of possible routes for the current to flow down, therefore the energy is twice as spread out, so resistance might halve.

Resistance occurs when the electrons travelling along the wire collide with the atoms of the wire. These collisions slow down the flow of electrons

causing resistance. Resistance is a measure of how hard it is to move the electrons through the wire.

The factors of resistance are;

1. Temperature: If the wire is heated up the atoms in the wire will start to vibrate because of their increase in energy. This causes more collisions between the electrons and the atoms, as the atoms are moving into the path of the electrons. This increase in collisions means that there will be an increase in resistance.

2. Material: The type of material will affect the amount of free electrons that are able to flow through the wire. The number of electrons depends on the amount of electrons in the outer energy shell of the atoms, so if there are more or larger atoms then there must be more electrons available. If the material has a high number of atoms there will be high number of electrons causing a lower resistance because of the increase in the number of electrons. Also if the atoms in the material are closely packed then the electrons will have more frequent collisions and the resistance will increase.

3. Wire length: If the length of the wire is increased then the resistance will also increase as the electrons will have a longer distance to travel and so more collisions will occur. Due to this the length increase should be proportional to the resistance increase.

4. Wire width: If the wires width is increased the resistance will decrease. This is because of the increase in the space for the electrons to travel

through. Due to this increased space between the atoms there should be less collisions.

Out of the 4 factors I am going to investigate 2, which are width and length and I have chosen these two because I think the investigation will be the most easiest to carry out, where I will only be using almost the same apparatus and circuit, where I will only have to change the width and length of the Nichrome wire, but also I believe that the length and width has a major effect towards the resistance, where the width of the wire will effect the electrons to travel through the wire without bumping into atoms depending on the space and the length may change the resistance whether the longer the distance the further energy and longer route to take for the electrons.

Prediction

I predict that if the length increases then the resistance will also increase in proportion to the length. I think this because the longer the wire the more atoms and so the more likely the electrons are going to collide with the atoms. So if the length is doubled the resistance should also double. This is because if the length is doubled the number of atoms will also double resulting in twice the number of collisions slowing the electrons down and increasing the resistance. For example reaching London from France is easier then from reaching it towards USA. I also predict the bigger the width the less the resistance in proportion to the size. I think this because when increasing the width of the wire will allow the electrons to flow through the wire quicker because of more space being available for the electrons and so

the chance of bumping into an atom is less. For example going through a busy street is more harder then walking through not so busy street, where I wont be bumped into as much.

Fair test

To keep my experiment a fair test I will do the following;

– When measuring the resistance of the wire through length, I will use the same fabric (nichrome wire) and keep the width the same.

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– When carrying out the experiment I will use the same amount of volts going into the experiment, which will be 2 volts.

Safety

To keep my experiment safe for others and myself around me I will carry out the following;

– Always put the voltage on 2 so that the wire doesn’t melt

– Don’t leave the electricity on for long period of time, so that the wire doesn’t heat up and cause it to melt

– When turning the circuit on after working out the resistance, I will let the wire cool down before touching it, so I don’t get burnt.

– I will also keep a safe environment to work in, where bags and especially water isn’t around the experiment in case of accidents or electricity shock.

Method

1. I will firstly collect the apparatus needed ton carry out this experiment, which are; nichrome wire, stopwatch, power pack, crocodile clip, ammeter, voltmeter, circuit board and a ruler. I will the set it out in a complete circuit with the voltmeter running parallel without no gaps and keeping the power off, as shown in the diagram.

2. When investigating the length of the wire, I will firstly measuring the length of the wire with a ruler, so that my results are accurate and therefore the measurements should go by 10cm, 20cm, 30cm, 40cm and 50cm, but I will keep the width the same at 0. 36mm2.

3. Then I will place the Nichrome wire into circuit, starting with 10cm, where I will connect the crocodile clips into the circuit from the power pack and ammeter and then the voltmeter will be connected parallel in the circuit by also using a crocodile clip.

4. I will then on the power pack, allowing the electricity to flow through the circuit, where I will then be able to collect the volts from the voltmeter and the amps in the ammeter. Which will be noted down quickly.

5. I will move the crocodile clip an extra 10cm apart, which will therefore increase the length of the nichrome wire being used in the circuit.

This method will then be repeated, but when it comes towards changing the nichrome wire, instead of increasing the length, I will just keep the length the same at 50cm but I will change the width of each wire to 0. 36mm2, 0. 32mm2, 0. 24mm2, 0. 16mm2, 0. 12mm2 and 0. 08mm2.

By looking at my graphs, I can see that in the graph showing the resistance of the thickness of a wire, a line gradually curving up to the right hand side from the bottom left, which means there is a gradual increase in resistance from the width of 0. 36mm2 to 0. 08mm2, where the thinner the wire the more resistance and by looking at the results table I can also see a trend, where as each width increased the resistance in a proportion of about 2 ohm's. When looking at the graph to show the resistance of different lengths, I can see that there is also a curve going up towards the top right hand side from the bottom left side, which shows increase in resistance as the length of the wire increase from 10cm to 50cm and by looking at the results table I can also see a trend, where the resistance is increasing proportionally because of the extra length of the wire.

From collecting these evidence, I have proven my predictions ' that if the length increases then the resistance will also increase' and ' the bigger the width the less the resistance'. This is simply because the bigger the width of the wire the more space for the electrons to flow through without bumping into atoms and therefore producing less resistance, whereas if the wire was thinner the electrons would be confined in a small space where they will more likely bump into atoms and if the length of the wire is increased the distance for the electrons to travel will be longer and difficult if it had to travel to 50cm then a short distance of 10 cm, where the resistance should

be smaller and as shown by evidence I have shown that this theory is true and that length and width are a factor of resistance, where the wider the wire the less the resistance and the shorter the wire the less resistance, but the thinner the wire the more the resistance and the longer the wire the more the resistance.

Evaluation

My experiment worked very well without any major problems and without any anonymous readings. My plan was adequate and had been successful to produce a suitable result, where the experiment was easy to carry out and easy to follow the method.

My results were accurate, where most of the results were almost the same, which was good enough to plot into a graph that showed that my prediction was correct, which was done by following the method, where I have kept it a fair test and collect the results from the amps and volts carefully and accurately. To make my results more reliable I have repeated my experiment 3 times and from this I have made an average that I have plotted. In my experiment there seem to be no odd results.

My plan was able to get some evidence to prove my prediction, but to prove it to a full 100% to make sure that I am correct, I could have repeated the experiment again to get more averages and more results where I could of compared it with and also during the experiment I was short of clip wires, which instead I had to use crocodile clips for, which could of effected the results, so if I had to do the experiment again, I would get the right apparatus.

As my plan being concise and safe to work on, other people can use my method to construct the same experiment to try and prove my prediction from any mistakes or faults.

My second and third results were mostly similar to the first set of results for both width and length, but there were some readings off by a couple of ohm’s, which could have been accounted from misreading, although I believe I have enough results to prove my prediction but it can be repeated for more reliability.