Physics Coursework

Investigating how the length of a wire affects its resistance

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I have decided for my coursework that I will investigate how length affects the resistance of a wire.

Background information on resistance

In 1826, George Ohm discovered that:

> The current flowing in a metal is proportional to the Potential difference across it providing the temperature remains constant.

He then developed a formula: -

Resistance (R) = Voltage (V) ÷ Current (I)

Resistance is a measure of how easily the electrons can move through a metal. Therefore a low resistance means that the electrons can move more easily.

Aim

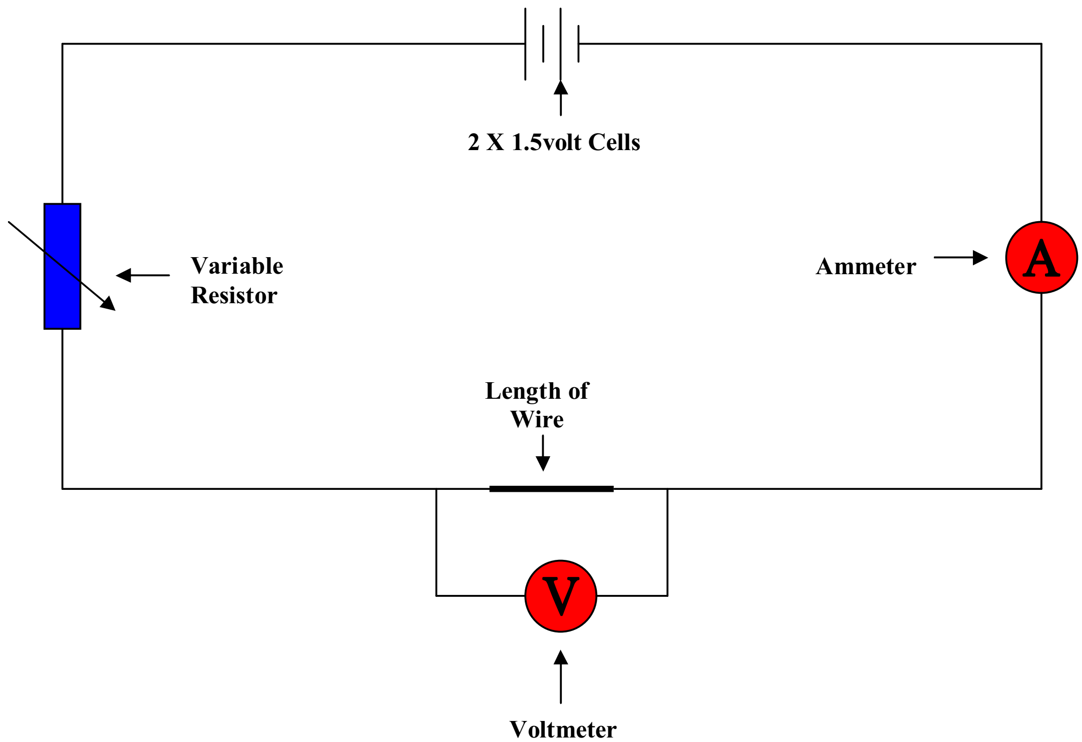
In my investigation I shall try to see if the length of a piece of wire affects its resistance.

Prediction

I predict that the length of wire will affect its resistance. I am making this prediction because all metal s contain electrons in their outer shell. The larger the surface area of the piece of wire, the more positive ions there are present within the wire. The more positive ions there are contained in the wire, that the more chance the negative ions will collide with them and the electrons will be slowed down and some f its energy will be picked up by the ions. If this happens often enough then the current will be reduced and the metal will get hotter. This heat will cause the resistance to increase. An increased resistance means that the current is reduced. I will also find the gradient of the graph 10CM, which represents Resistance. I will use the formula Y2-

Y1÷X2-X1 to find the gradient.

Apparatus



The wire will be made of: Nichrome
The Voltmeter will be set at: 20V
The Ammeter will be set at: 10 A

Method

I shall take five different lengths of wire: 10CM, 20CM, 30CM, 40CM and 50CM.For each piece of wire I will take five different readings of voltage against current get the resistance of each reading and then get the average resistance of each of the five lengths.

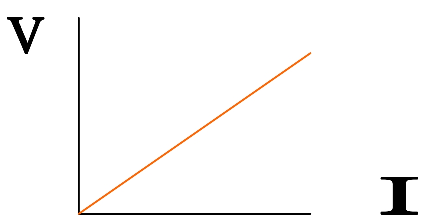
RESULTS

For each length of wire I will use a table like this: -

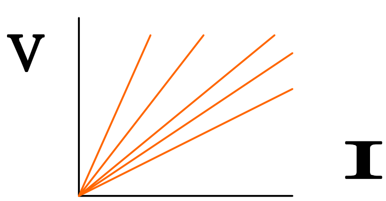
Setting	Voltage (V)	Current (A)	Resistance (Ω)
1			
2			
3			
4			
5			

I will then get the average resistance by adding all five resistances up and diving by 5.

I will then draw 5 separate graphs for each length showing voltage against current.



Then I will incorporate all 5 lengths into one graph to show the changing trends.



Finally my last graph will include length against average resistance.

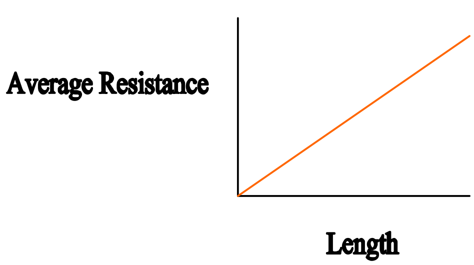


Table of Results

10 CM

Setting	Current (A)	Voltage (V)	Resistance (Ω)
1	0.6000	0.1500	0.2500
2	0.5000	0.1255	0.2510
3	0.4000	0.1015	0.2538
4	0.3000	0.0760	0.2533
5	0.2000	0.0510	0.2550

Average Resistance = 0.2526Ω

20 CM

Setting	Current (A)	Voltage (V)	Resistance (Ω)
1	0.4500	0.1500	0.3333
2	0.3500	0.1180	0.3371
3	0.2800	0.0920	0.3259
4	0.2000	0.0653	0.3265
5	0.1200	0.0400	0.3333

Average Resistance: 0.3312Ω

30 CM

Setting	Current (A)	Voltage (V)	Resistance (Ω)
1	0.3600	0.1500	0.4167
2	0.3200	0.1320	0.4125
3	0.2800	0.1160	0.4143
4	0.2400	0.1000	0.4167

5	0.0800	0.0347	0.4338

Average Resistance: 0.4188Ω

40CM

Setting	Current (A)	Voltage (V)	Resistance (Ω)
1	0.2800	0.1500	0.5357
2	0.2400	0.1273	0.5304
3	0.2000	0.1067	0.5335
4	0.1600	0.0853	0.5331
5	0.1200	0.0647	0.5392

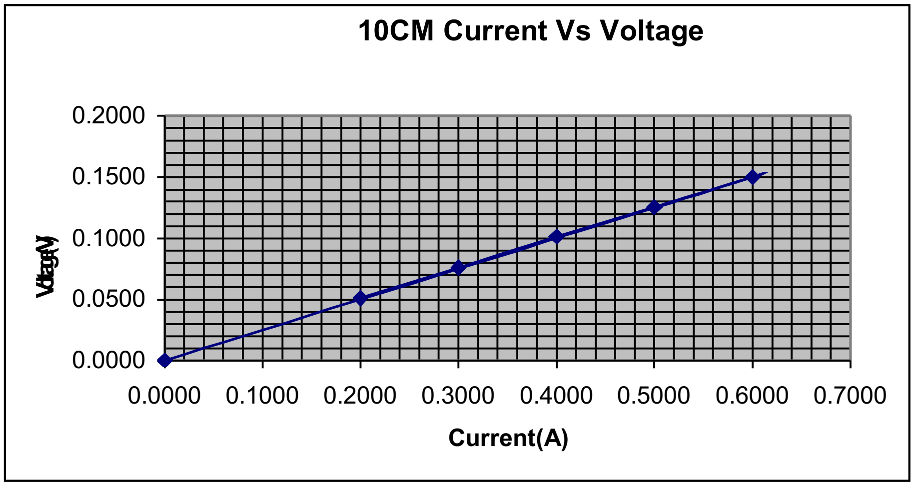
Average Resistance: 0.5344Ω

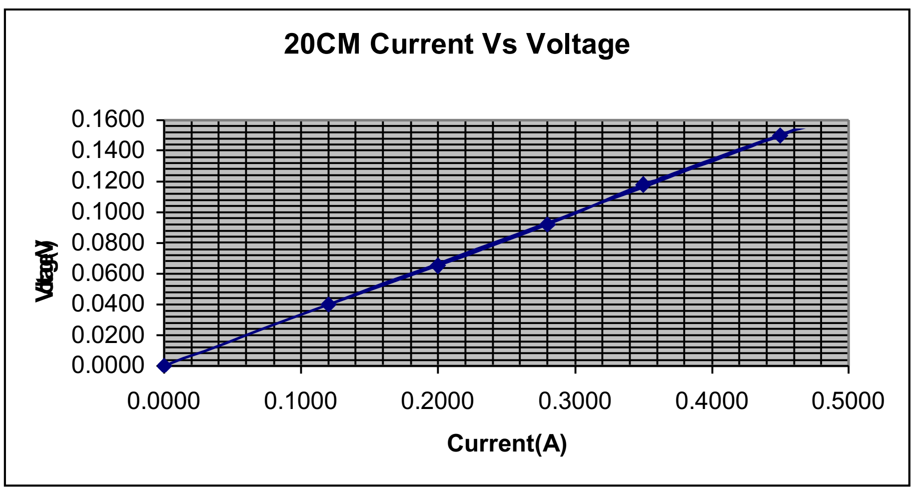
50 CM

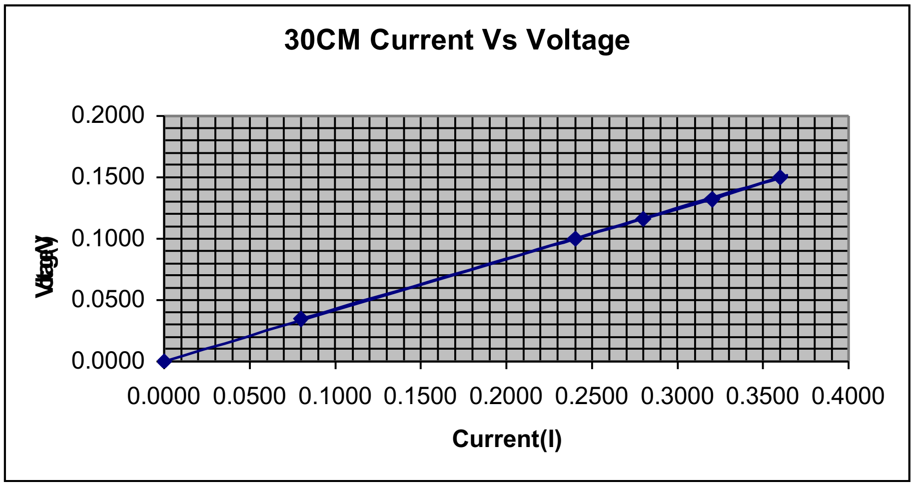
Setting	Current (A)	Voltage (V)	Resistance (Ω)
1	0.2000	0.1500	0.7500
2	0.1600	0.1200	0.7500
3	0.1200	0.0913	0.7608
4	0.0800	0.0607	0.7588
5	0.0425	0.0320	0.7529

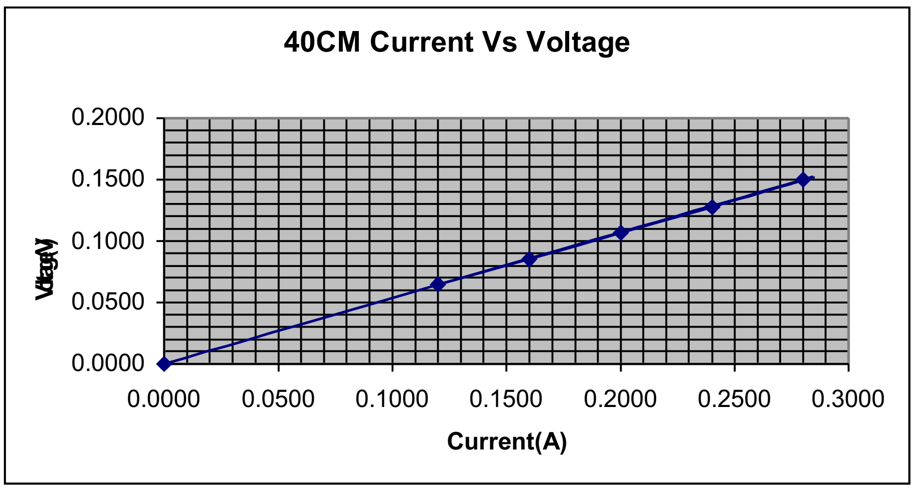
Average Resistance: 0.7545Ω

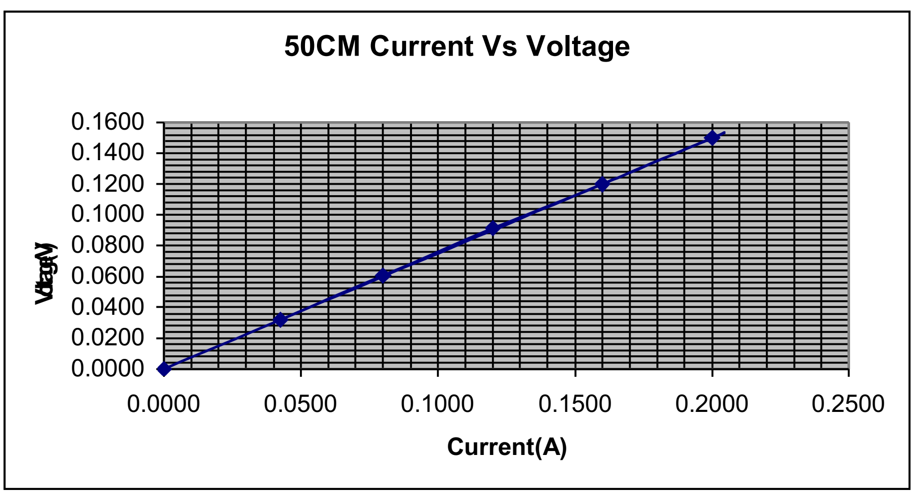
Graphs

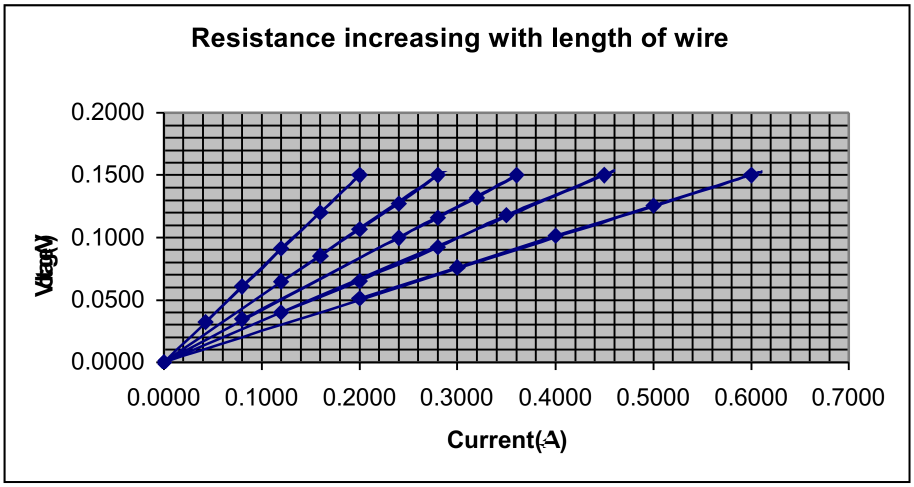

10CM Current Vs Voltage
0.2000
0.1500
0.1000
0.0500
0.0000
Voltage(V)
0.0000
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
Current(A)

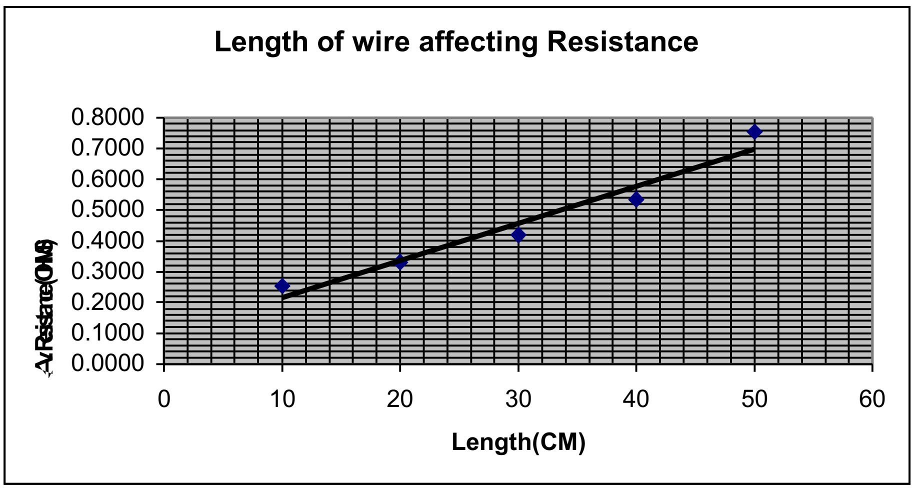

20CM Current Vs Voltage
0.1600
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
Voltage(V)
0.0000
0.1000
0.2000
0.3000
0.4000
0.5000
Current(A)


30CM Current Vs Voltage
Voltage(V)
0.0000
0.0500
0.1000
0.1500
0.2000
0.0000 0.0500 0.1000 0.1500 0.2000 0.2500 0.3000 0.3500 0.4000
Current(I)


40CM Current Vs Voltage
Voltage(V)
0.0000
0.0500
0.1000
0.1500
0.2000
0.0000 0.0500 0.1000 0.1500 0.2000 0.2500 0.3000
Current(A)


50CM Current Vs Voltage
Voltage(V)
0.0000
0.0200
0.0400
0.0600
0.0800
0.1000
0.1200
0.1400
0.1600
0.0000 0.0500 0.1000 0.1500 0.2000 0.2500
Current(A)





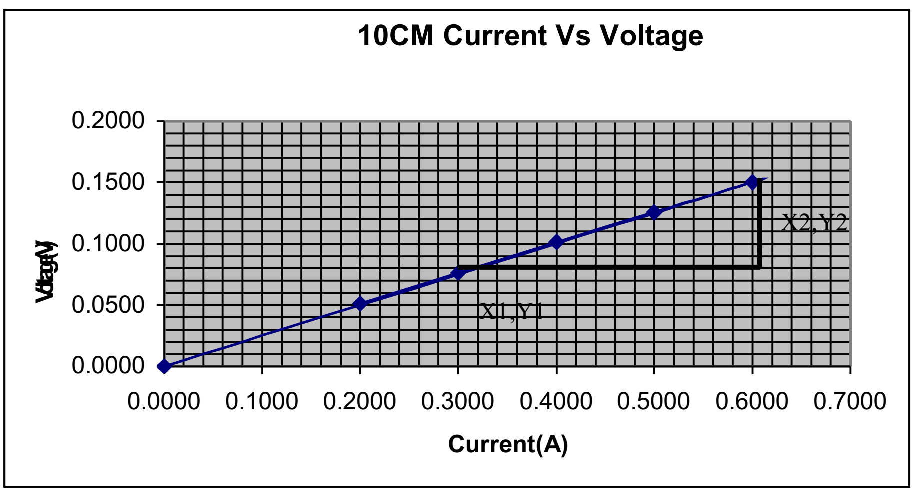
Evaluation and Conclusion

I predicted that length does affect resistance from my results, I can conclude that this is correct.

In each of my lengths of wire, the average resistance increased each time the length was increased, starting with 0.2526Ω at 10CM and rising to 0.7545Ω at 50CM. This proves that atoms are made up of a positively charged nucleus surrounded by negatively charged electrons, that collide with each other which slows down the electron and current is therefore dropped. The larger the surface area (length) the more electrons and ions there are present so therefore the longer the piece of wire, the more resistance.

In each of the graphs I drew, I got straight lines. This proves Ohm's law; the current flowing in a metal is proportional to the potential difference across it providing the temperature remains constant.

I plotted the graph of 10CM Voltage vs. Current. The straight line I got from this represents resistance. I will now use the formula y2-y1÷x2-x1 to get the resistance of the voltage-current graph. If I have gained accurate results the answer I get from this formula should match closely the result of the average resistance of a 10CM piece of nichrome wire.



X1= 0.3000, Y1= 0.0760, X2= 0.6000, Y2= 0.1500

Y2-Y1÷X2-X1

= 0.1500-0.0760÷0.6000-0.0760

=0.0740÷0.3000

= 0.2467Ω

My average resistance for 10Cm was 0.2526Ω. My answer for the resistance of the graph was 0.2467Ω. This shows that my graphs and tables are very accurate and that the straight line on the voltage-current graph represents resistance.

I feel that my results gained were reliable as all my results tallied. But at times the voltage and current readings on the voltmeter and ammeters flickered giving me at times, inaccurate results. If I were to repeat the experiment I would use much more up to date meters. I feel that some of my graphs did not turn out the way I would have liked them because I didn't take enough readings in the practical. If I had have taken more results them my graphs would have been much more accurate. I do though however feel that the evidence is sufficient to support my predictions as my results turned out to be accurate and they supported my predictions well.