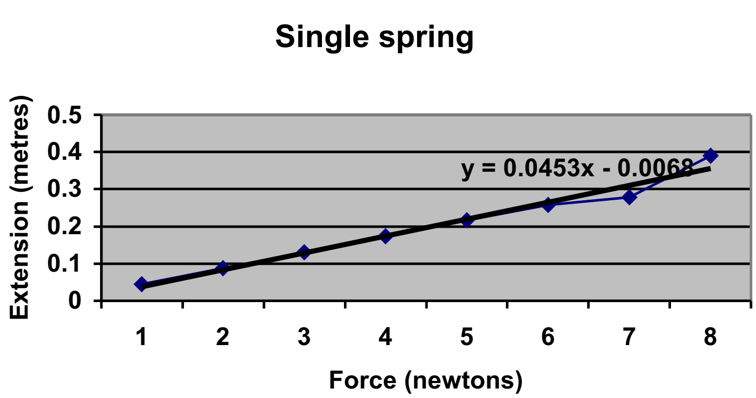
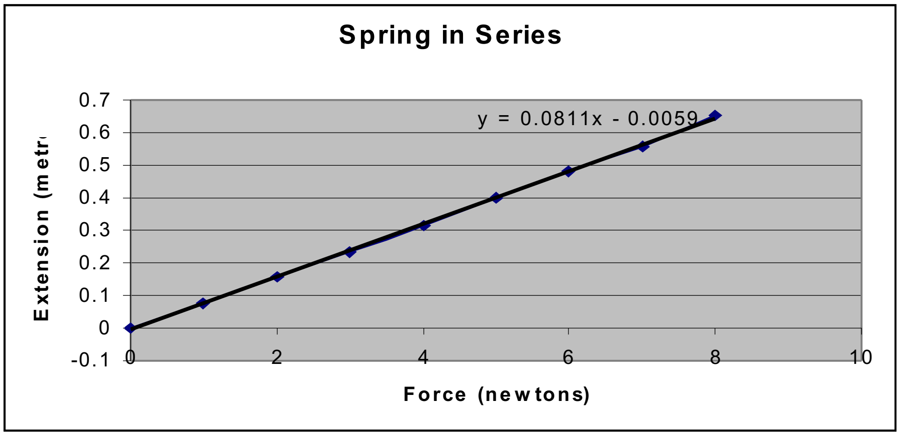
Analysis

The results that I have collected have proved very conclusive. From the graphs that have been plotted I have been able to deduce that when a spring is added to the spring in series then the extension increases proportionally, as is proved below:

Force (N)	Single spring (m)	Spring in series (m)
0	0.000	0.000
1	0.044	0.086
2	0.087	0.157
3	0.130	0.234
4	0.173	1.312
5	0.216	0.399
6	0.258	0.481
7	0.278	0.553
8	0.336	0.652

When the load 1N is added to the springs in series the extension is 0.086 m, however when the load is added to the spring on it's own the extension is only 0.044 m.
This proves that the equation k = f / x is true. This is because when the load is kept the same but the spring stiffness is doubled then the extension is also doubled.
To work out the spring constant I will need to use the equation:
K = Force or Load / gradient
The spring stiffness is a measure as to how much the string is extended when a load is placed on it. This can be worked out using the equation:
K = F / X
Graph of my results:





The graph that has been plotted (spring stiffness against load) shows that the stiffness of the spring halves when there is single spring but when two are put in series then the stiffness is doubled. It can be seen clearly that the gradient of single spring is almost half of spring in series.

Gradient for single spring	Gradient for spring in series
y = 0.0453x – 0.0068	y = 0.0811x – 0.0059

Also, the graph that has been plotted (spring stiffness against load) shows that the stiffness of the spring halves when there is single spring but when two are put in series then the stiffness is doubled. However, when a single spring is added to two springs in series then the stiffness decreases by a quarter. I have also noticed that the spring stiffness remains the same regardless of the load that is being put onto it. This seems to be a defining characteristic of the springs. The only time that the spring stiffness alters noticeably is when the first load is added. This can be attributed to the fact that the springs need to be stretched before hand. This is because they do not stretch, as they should originally, it requires energy to begin stretching away from the coil.
From the graph I have also noticed that the springs in series have a spring stiffness almost exactly two times greater than the springs on its own. This is because the single springs have a lower spring stiffness than when they are in series, I believe that this is because there is a larger number of coils working together to hold the force when the springs are in series. The results gained from the experiment are the ones that I expected. The differences between the actual results and the calculated times can be attributed to errors by people or inaccuracies in the equipment.

Evaluation

The investigation is now completed along with the experiments and now I will evaluate the quality of my results and also comment on the method. I believe that my results were reliable for the reason that I measured each extension of the springs three times from which I was able to gain an average, unlike my preliminary work. By repeating the measurement three times I reduced the amount of error in the experiment.
Additionally, my experiment was carried out using a fair procedure. This is because my method did not have any implication on the input variables other than the force applied to the springs. This is because I used the same type of springs of same length and stiffness throughout the experiment as well as the rest of the equipment. Therefore the variables apart from the force did not have a great affect on the extension of the springs, which was good because I only wanted to look at the affects of changing force applied to the springs on the extension.

Furthermore, as I stated that as the force applied on the springs is increased the extension of the spring would also increase. Therefore, my results also show that the spring also obeyed by Hooke's Law. This is clearer from the graphs that I have drawn which shows that the extension of the spring is directly proportional to the force applied. I also said that the spring constant of the single spring would be half that of the springs in series. This prediction also turned out to be true showing that I had calculated the gradient of the graphs correctly as well as used it correctly to find the spring constant.
Apparently, to drawing the graphs I found that out of eight points on the graph almost all of them fitted into the line of best for the graph of springs in series but the last point is looked closely on my graph appears to be slightly away from the line of best fit. The single spring graph had two points that did not fit on the line of best fit. This means that I had a few anomalous results and that the experiment may not have been carried out fairly.

The anomalous results may have occurred due to the lack of accuracy. I may not have measured the extension of the springs with precision and may have also calculated the extension as well as the average extension of the spring incorrectly. Therefore, if I do such an experiment again I will have to make sure that all my concentration is on precise measurements in order to get fair results.However, to extend the experiment further I could look at how changing the force effects springs that are placed in parallel and find out how the springs constant of these springs changes.