**Connecting springs in series and parallel**

**Introduction**

In this experiment you will be using combinations of springs to contribute to your understanding of the Young modulus as the property of a material.

You are expected to be familiar with the concept of the application of a force leading to the extension of an elastic material in tension and the further concepts of stress and strain.

There is an opportunity for evaluation of potential uncertainties in readings and the combination of individual uncertainties into the uncertainty of the final result.

**Aim**

* To determine relationships for combinations of springs in series and parallel
* To use these relationships to contribute to a measurement of the property of a material independent of its shape.

**Intended class time**

* 60 to 90 minutes

**Equipment**

* spring x 6
* 100g masses on holder
* metre rule
* stand
* boss and clamp
* additional stand upright x2
* 1 kg mass
* safety goggles to EN166F

**Health and Safety**

Safety goggles or spectacles (as provided by the centre) must be worn at all times due to the risk of the tensioned wire snapping and causing damage to the eyes.

Your teacher will have determined a maximum load to be applied to the springs to reduce the risk of breaking.

**Procedure**

1. **Connecting springs in series**

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1. Measure the original length, *L*, of a spring.
2. Load the spring with 100g and determine the extension, *x*.
3. Connect two springs in series and measure the new extension.
4. Continue up to 5 springs.
5. Plot a graph of the number of springs, N, along the x-axis, against extension on the y-axis.
6. Use this graph to calculate the strain given by (x/NL).

**B. Connecting springs in parallel**

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1. Set up the apparatus with two springs.
2. Add a load of 1kg to the lower rod (shown in red).
3. Determine the extension which this produces.
4. Compare this extension with that for one spring in A above.
5. Estimate the anticipated extension of one spring with a 1 kg mass.
6. Increase the number of springs to 3 and record the new extension.
7. Repeat this up to a maximum of six springs.
8. Note the relationship observed between the number of springs and extension.
9. Plot an appropriate graph to demonstrate this relationship.

**Extension Opportunities**

Young modulus = *(F/A)/(x/L)* spring constant *k=F/x*

Which of these constants relates solely to the material and is independent of shape, and which is a function of the shape of the object?

Explain how these two experiments support your conclusion.

**Recording**

As evidence for the Practical Endorsement you should have the data collected from your group in a clear and logical format. All work should be clearly dated.

In addition, in preparation for the assessment of practical work in the written examinations and to help develop your understanding of physics, you should have used the data collected to plot graphs and to make estimates of values as detailed.