

1.4 Hooke's law

Aim

To investigate Hooke's law for a spring.

Theory

Hooke's law states that:

$$F = kx$$

where F is the stretching force, x is the extension of the spring and k is the spring constant. The law should hold if the spring is not permanently stretched.

Variables

Complete Table 1.

Table 1

Manipulated (independent)	Fixed	Responding (dependent)

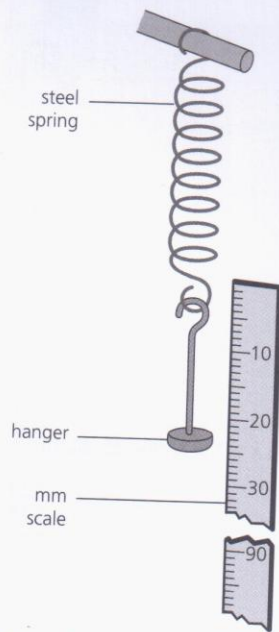
[1]

Apparatus

- retort stand
- spring
- hanger with 100 g weights
- ruler
- adhesive/sticky tape

Procedure

Set up the apparatus as shown in Figure 1.



Safety!

Take care with masses and think where the hanging masses would fall if the spring snapped.
Wear eye protection when instructed.

Figure 1

- 1 Fix the ruler vertically next to the spring so that it can be used as a scale.
- 2 Record the position of the bottom of the unweighted spring on the scale, l_s , and repeat your measurement.
- 3 Measure the length of the hanger, l_0 .
- 4 Hang an unweighted (100g) hanger on the spring and record the scale position of the bottom of the hanger.
- 5 Add a 100g mass to the hanger and again record the scale position of the bottom of the hanger.
- 6 Repeat step 5 with 200g, 300g, 400g and 500g masses on the hanger.
- 7 Plot a graph of the stretching force along the x-axis against the extension along the y-axis.
- 8 Calculate the gradient of the graph.

Method

Explain the method you used to measure the extension of the spring as accurately as possible.

[2]

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Results and calculations

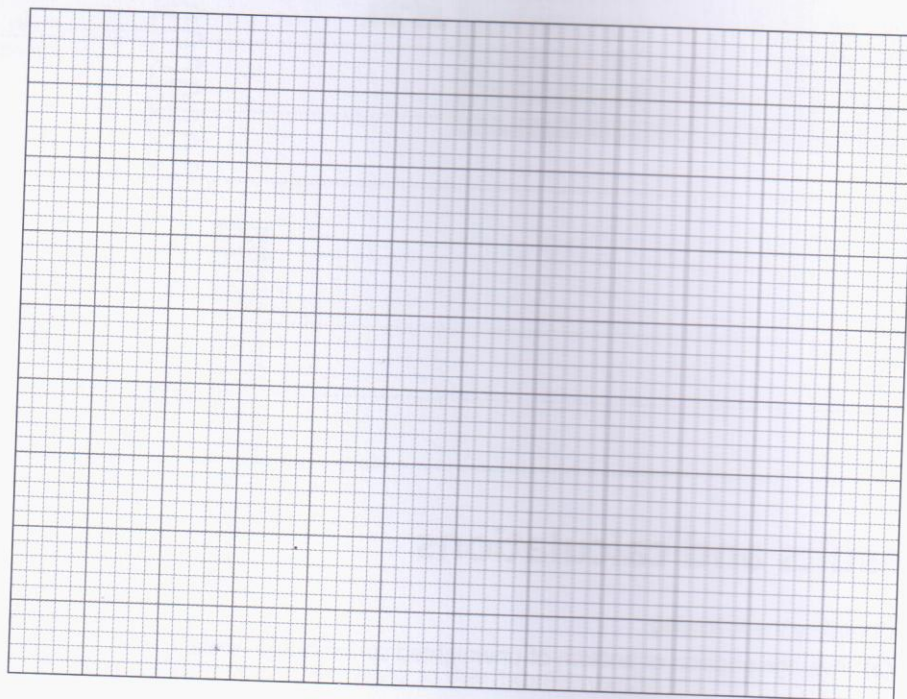
- 1 Complete the following.
- (a) Average position of bottom of unweighted spring on the scale, $l_s =$
 mm
- (b) Length of hanger, $l_o =$ mm
- 2 Complete Table 2. Take the force exerted by gravity on a mass of 100 g to be 1 N.
- Note:
 extension of spring = scale reading of bottom of hanger – ($l_o + l_s$)

Table 2

Mass/g	Stretching force/N	Scale reading/mm	Extension/mm

[6]

- 3 Plot a graph of the stretching force along the x -axis against the extension along the y -axis.



[4]

Summary of results

Gradient of graph =

[2]

Conclusions

State whether or not the extension is proportional to the stretching force on the spring. [1]

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What do your results suggest about the validity of Hooke's law? [1]

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Evaluation

Discuss how the experiment could be improved to give more reliable results. [2]

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Extension

Calculate the value of the spring constant, k .

$$k = \frac{1}{\text{gradient of graph}}$$

$$k = \dots\dots\dots \text{N/mm}$$

[1]