1. A student wants to determine the extension per unit load for a spring. Here is their method.

Step 1 Attach a spring to the clamp stand by hanging it from a clamp so that it hangs freely over the side of the bench. Use a G-clamp to fix the clamp stand to the bench.

Step 2 Attach a mass hanger to the bottom of the spring with a pin positioned as shown in the diagram.

Step 3 Use a clamp to hold a metre rule vertically so that it is close to, but not touching, the spring. The pin should line up with the ruler. You will use this to measure the extension of the spring.

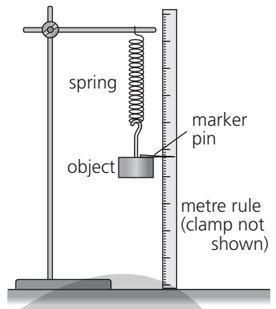
Step 4 Record the measurement on the ruler that the pin points to with only the mass hanger attached. Record the force as 0 N.

Step 5 Place a 1.0 N weight (100 g mass) on the mass hanger so that the spring extends. Record the measurement on the ruler that the pin now points to.

Step 6 Add another 1.0 N (100 g) mass on the mass hanger and again record the position on the ruler that the pin points to.

Step 7 Add more 1.0 N weights until a total weight of 6.0 N is hanging from the spring.

Step 8 Calculate the extension for each 100 g mass by taking the initial ruler measurement (Step 4) away from the ruler measurement at each step. Record the results in a table.



a. State the dependent variable in this experiment.

..... [1]

b. Write the equation that links mass and weight.

..... [1]

c. A student hangs a 200 g mass from a spring. Calculate the force acting on the spring. Give the unit with your answer.

(Use g = 10 N/kg)

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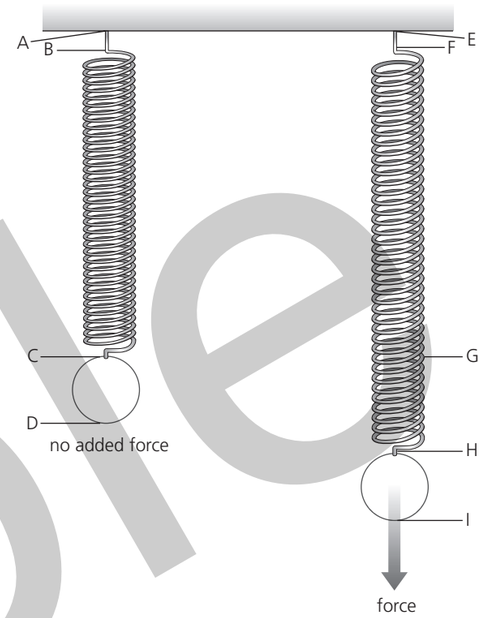
..... [2]

d. Look at the diagram below.



i. Give the letters which represent the initial length of the spring.

..... [1]

ii. Give the letters which represent the extension of the spring when loaded.

..... [1]

e. Complete the table by calculating the extension for each applied force. [1]

Force/N	Length of spring/cm	Extension of spring/cm
0	9	
1	13	
2	15	
3	17	
4	19	
5	21	
6	23	

f. Use the data in the table in part **e** to draw a graph of extension (*y*-axis) against force (*x*-axis).

[4]

g. Describe the relationship between force and extension for the spring. Give a reason for your answer.

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..... [2]

h. Predict and explain what would happen to the shape of the graph if more weights were added.

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..... [3]

i. Calculate the percentage change in the length of a spring with a 6 N force attached compared with an unstretched spring.

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..... [3]

j. Explain how to determine the spring constant from a graph of extension against force.

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..... [1]

k. Use your graph to calculate the spring constant, *k*, for the spring. Give the unit with your answer.

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..... [3]

l. Goggles are an essential piece of safety equipment in this practical. Give a reason why.

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..... [1]

m. Describe the function of the 'pointer' in this experiment.

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..... [1]

n. Explain why the student measured the length of the spring and calculated the extension after the experiment.

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..... [1]

o. In this experiment it is important to measure the length of the spring accurately. Define the term accurate.

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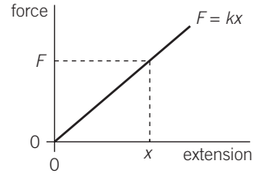
..... [1]

2. A student carries out the experiment described in question 1and draws a graph of their results.



Describe how the student could use their graph to determine the mass of an object.

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..... [4]