3 A student investigated the stretching of a spring.

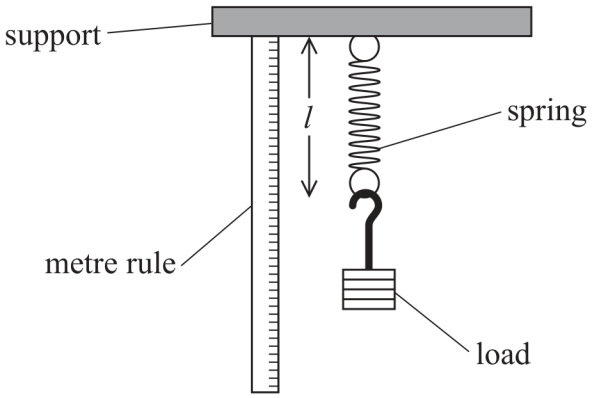
(a) The student used a metre rule to measure the unstretched length l_0 of the spring.

(i) The value of l_0 was 5.2 cm.

Explain why a metre rule is an appropriate instrument for this measurement.

(2)

(ii) The student added a load to the spring and measured the stretched length l of the spring, as shown.



Describe **two** techniques the student should use to make this measurement as accurate as possible.

(2)

(b) The student determined the weight W of different loads, and the corresponding values of l. He recorded the results in the following table.

W/N	l/cm
0	5.20
0.2	7.9
0.39	12
0.59	13.4
0.78	16.0

(i) Criticise the recording of these results.

(1)

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(ii) The student plotted the graph shown opposite.

Explain which value he should check.

(2)

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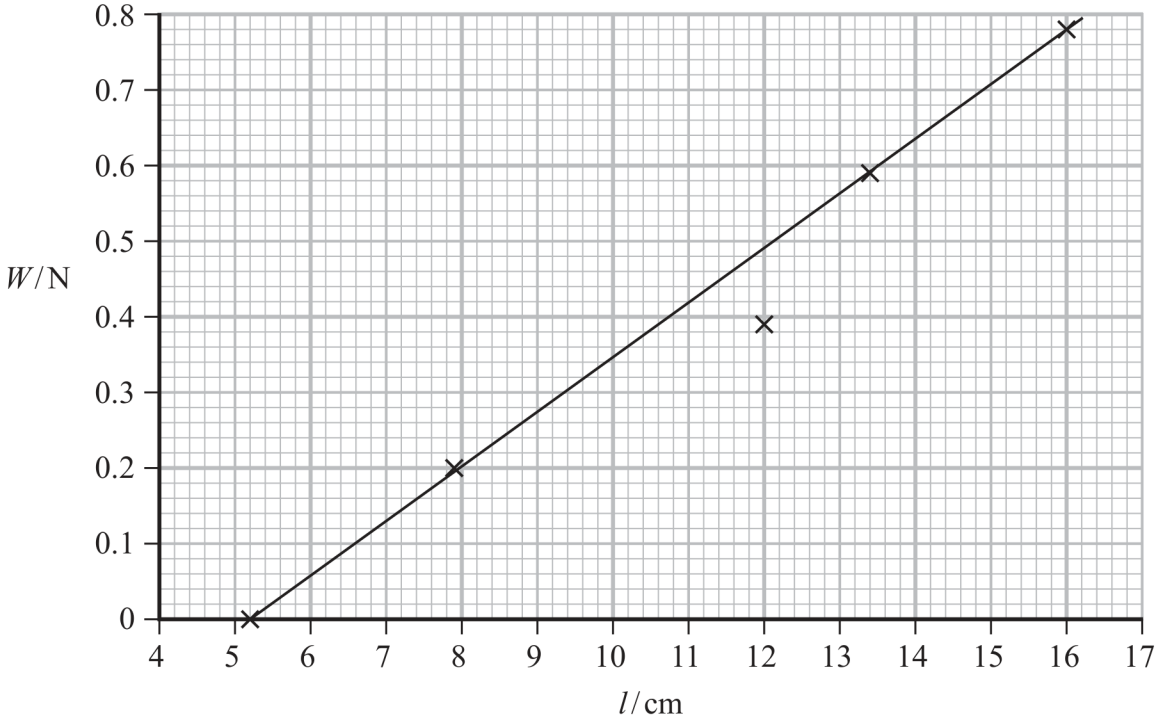
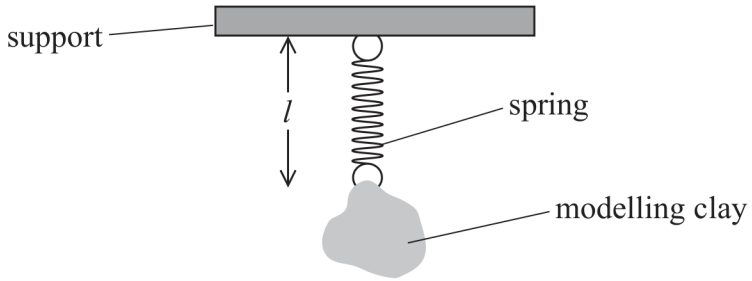


(iii) The student replaced the load with a small piece of modelling clay, as shown.



He measured l to be 8.4 cm.

Determine the weight W of the piece of modelling clay.

(1)

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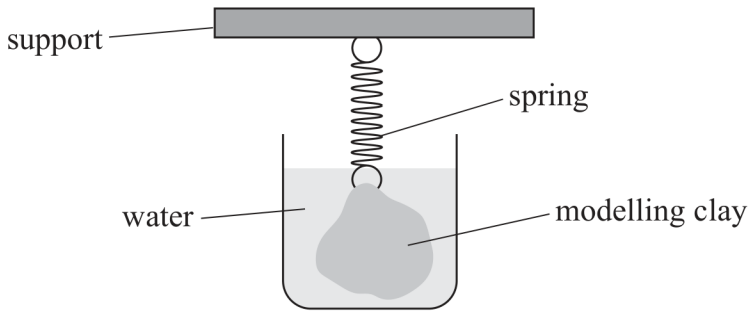
W = ...

(c) The student added more modelling clay to the spring and determined the weight W_1. Then he submerged the clay in a beaker of water and determined the new force F on the spring.



The density of the modelling clay can be determined from the ratio

$$\frac{\text{density of modelling clay}}{\text{density of water}} = \frac{W_1}{W_1 - F}$$

(i) Determine the density of the modelling clay.

$W_1 = 0.65\,\text{N}$
$F = 0.27\,\text{N}$
density of water = $1000\,\text{kg}\,\text{m}^{-3}$

(2)

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Density of modelling clay = ...

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(ii) The student estimated the percentage uncertainty in his calculated value of the density of modelling clay to be 4%.

The density of polymer clay is $1760\,kg\,m^{-3}$.

Deduce whether the modelling clay could be made from polymer clay.

(2)

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(Total for Question 3 = 12 marks)