Hooke's Law

Question Paper 2

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	General Physics
Sub-Topic	Hooke's Law
Paper Type	Alternative to Practical
Booklet	Question Paper 2

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

1 An IGCSE class is carrying out this experiment to determine the mass of a metal block.

Fig. 1.1 shows a spring drawn full size.

Fig. 1.2, also full size, shows the spring with a load of 100 g suspended from it.

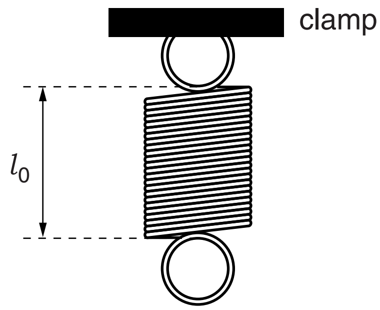

Fig. 1.1

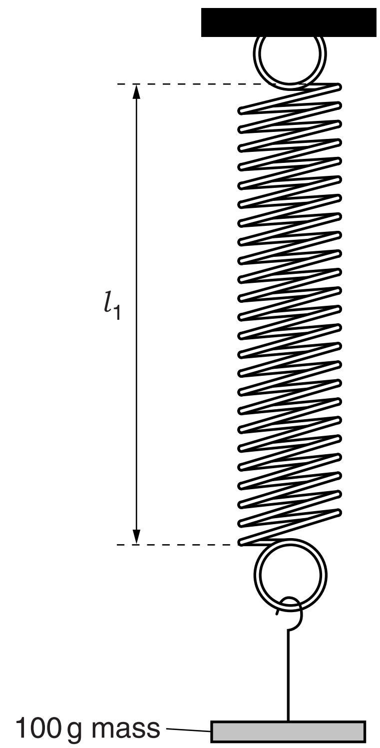

Fig. 1.2

(a) **(i)** On Fig. 1.1, measure the length l_0, in cm, of the spring without any load.

l_0 = ... cm

(ii) On Fig. 1.2 measure the stretched length l_1, in cm.

l_1 = ... cm [1]

(iii) Calculate the extension e_1 of the spring using the equation $e_1 = (l_1 - l_0)$.

e_1 = ... [1]

(iv) Determine a value for k using the equation $k = \frac{m}{e_1}$, where m = 100 g.

k = ... unit ....[2]

(b) The apparatus is then set up as shown in Fig. 1.3.
The rule is at a small angle to the bench.

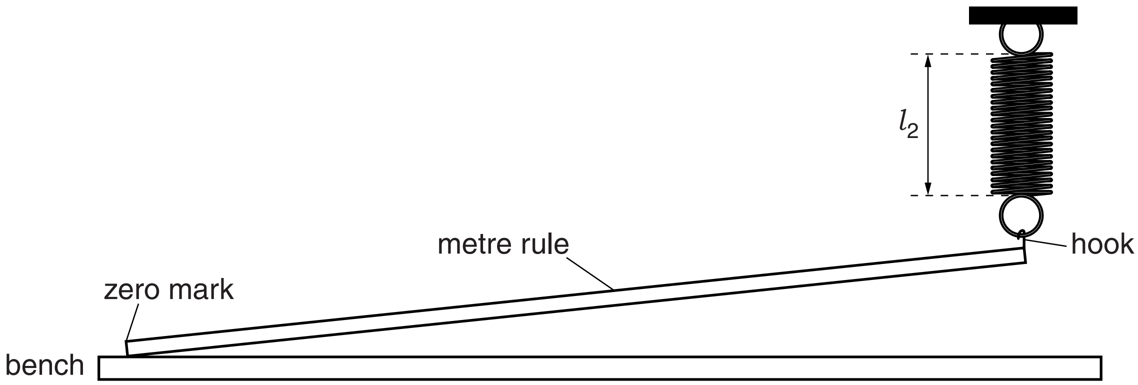

Fig. 1.3

A student measures the length of the stretched spring and obtains the result

l_2 = ...4.4 cm........

(i) He then places a metal block **X** with its centre at the 40.0 cm mark on the rule.

Explain briefly how the student can make sure that the block is in the correct position. You may wish to use a diagram.

....

....

.... [1]

(ii) The student measures the new length l_3 of the spring and records it as

l_3 = ...7.5 cm........

Determine the change in the extension e_2 due to block **X**, using the equation $e_2 = (l_3 - l_2)$.

e_2 = ...

(iii) Calculate the mass M of block **X** using your answers to **(a)(iv)** and **(b)(ii)** and the equation $M = k\left(\frac{e_2}{0.40}\right)$.

M = ... [2]

(c) Suggest two practical causes of inaccuracy in this experiment.

1. ....

....

2. ....

....
[2]

[Total: 9]

2 **(a)** An IGCSE student is investigating the relationship between the extension of a metal wire of unstretched length 3.000 m, and the load hung on the wire. He has a set of 10 N weights.

Consider the readings that the student should take and write appropriate column headings, with units, in Table 5.1.

Table 5.1

0	3.000	0
20	3.001	0.001
40	3.002	0.002
60	3.003	0.003
80	3.010	0.010

[2]

(b) The student decides to repeat the experiment using a wire made of a different metal in order to study how the extension may be affected by the metal from which the wire is made. To make a fair comparison, other variables must be kept constant. Suggest two variables that the student should keep constant.

1. ....

2. ....[2]

[Total: 4]

3 The IGCSE class is investigating springs.

A student measures the length l_0 of a spring and then uses a stand and clamp to suspend the spring vertically. He hangs a weight *W* on the spring and measures the new length l. He calculates the extension *e* of the spring. He repeats the procedure using a range of weights.

Table 5.1 shows some readings obtained by the student. The unstretched length l_0 of the spring is 16 mm.

Table 5.1

W / N		
0	16	0
0.10	17	
0.20	19	
0.30	21	
0.40	23	
0.50	27	
0.60	33	

(a) Complete the column headings in Table 5.1. [1]

(b) Complete the third column in the table by calculating the extension *e* of the spring. [1]

(c) State whether the results support the suggestion that the extension is directly proportional to the load. Justify your answer by reference to the results.

statement ....

justification ....

....

....[2]

(d) Draw a diagram of the apparatus including the spring, clamp, a weight hanging on the spring and a ruler positioned to measure the length of the spring.

[2]

[Total: 6]

4 An IGCSE student is investigating the stretching of springs.

Fig. 1.1 shows the apparatus used for the first part of the experiment.

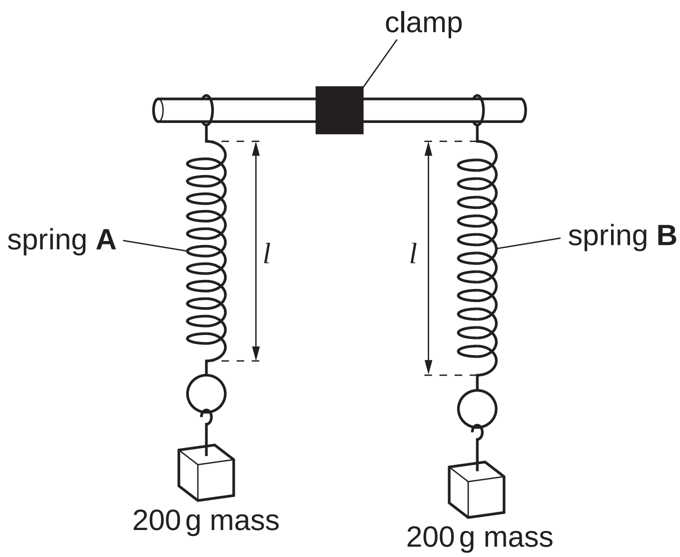

Fig. 1.1

The unstretched length l_A of spring **A** is 15 mm.

The unstretched length l_B of spring **B** is 16 mm.

(a) The student hangs a 200 g mass on each spring, as shown in Fig. 1.1.

(i) On Fig. 1.1 measure the new length *l* of spring **A**.

l = ... mm

(ii) Calculate the extension e_A of the spring using the equation $e_A = (l - l_A)$.

e_A = ... mm

(iii) On Fig. 1.1 measure the new length *l* of spring **B**.

l = ... mm

(iv) Calculate the extension e_B of the spring using the equation $e_B = (l - l_B)$.

e_B = ... mm
[2]

(b) The student then sets up the apparatus as shown in Fig. 1.2.

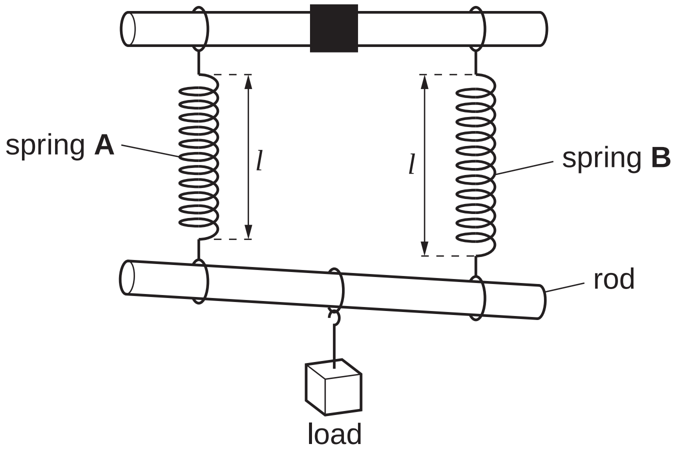

Fig. 1.2

(i) On Fig. 1.2 measure the new length of each of the springs.

spring **A**: l = ... mm

spring **B**: l = ... mm

(ii) Calculate the extension of each spring using the appropriate equation from part **(a)**.

spring **A**: e = ... mm

spring **B**: e = ... mm

(iii) Calculate the average of these two extensions e_{av}. Show your working.

e_{av} = ...mm
[3]

(c) It is suggested that $(e_A + e_B)/4 = e_{av}$.

State whether your results support this theory and justify your answer with reference to the results.

Statement ....

Justification ....

.... [2]

(d) Describe briefly one precaution that you would take to obtain accurate length measurements.

....

....

.... [1]

5 The IGCSE class is investigating the stretching of springs.

Each student is able to use a selection of different springs, a set of slotted masses to hang on the end of a spring, a metre rule, and any other common laboratory apparatus that may be useful.

A student decides to investigate the effect of the type of metal from which the spring is made on the extension produced by loading the spring.

(a) Suggest three possible variables that should be kept constant in this investigation. (Do not include variables that are likely to have very little effect on the length of a spring in this context.)

1. ....

2. ....

3. .... [3]

(b) In the investigation, the original length l_0 of a spring is measured and then the new length l when a load is attached. Fig. 5.1 shows an unloaded spring and the same spring with a load attached. On Fig. 5.1, show clearly the original length l_0 and the new length l.

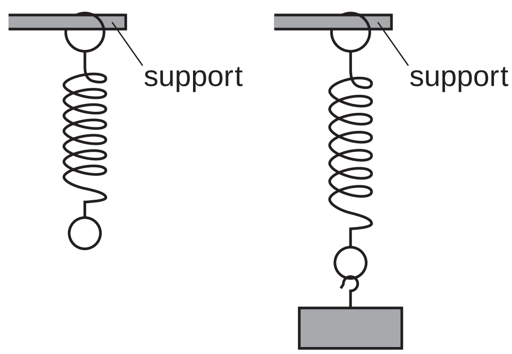

Fig. 5.1

[1]

(c) It is not possible to position a metre rule immediately next to the spring. Describe briefly how you would overcome this problem when measuring the length l. You may draw a diagram.

....

.... [1]

[Total: 5]

6 An IGCSE student is determining the density of the metal from which a load is made.

The apparatus is shown in Fig. 1.1.

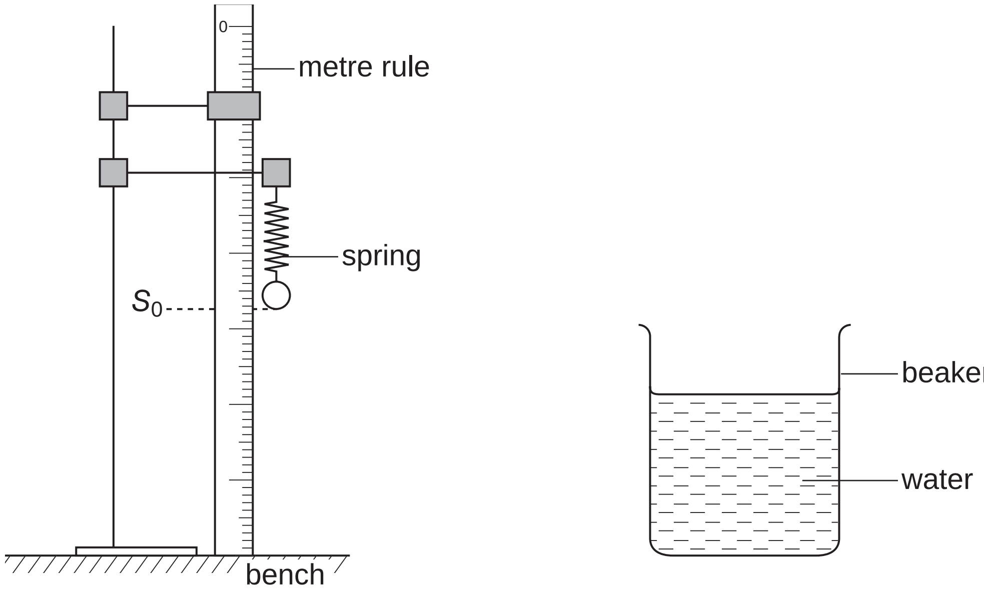

Fig. 1.1

(a) The student records the scale reading S_0 on the metre rule at the bottom of the spring, as shown in Fig. 1.1.

$S_0 = 37.4$ cm

Describe briefly how the student can avoid a parallax error when taking the scale reading.

....

....[1]

(b) He then hangs the load on the spring as shown in Fig. 1.2. He records the new scale reading S_1.

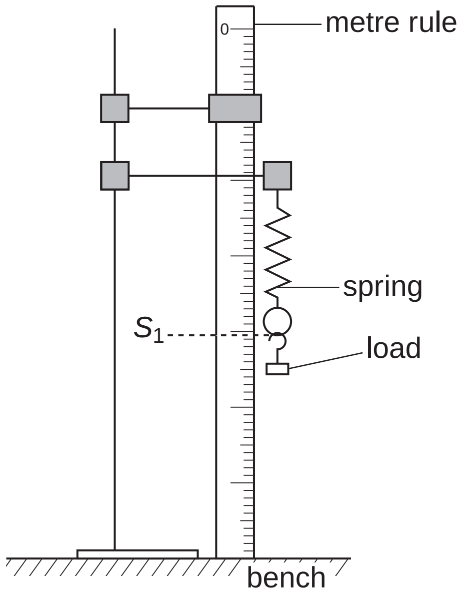

Fig. 1.2

$S_1 = 40.5\,\text{cm}$

(i) Calculate the extension e_1 of the spring using the equation

$$e_1 = (S_1 - S_0).$$

e_1 = ...

The student carefully raises the beaker under the load until it is completely under water. The load does not touch the sides or base of the beaker. He records the new scale reading S_2.

$S_2 = 39.8\,\text{cm}$

(ii) Calculate the extension e_2 of the spring using the equation $e_2 = (S_2 - S_0)$.

e_2 = ...

[2]

(c) Calculate the density ρ of the material of the load using the equation

$$\rho = \frac{e_1}{(e_1 - e_2)} \times k$$

where $k = 1.00\,\text{g/cm}^3$.

ρ = ... [3]

(d) A second load, made from the same material and with the same mass, is too long to be completely submerged in the water.

Suggest whether

(i) the value obtained for e_2 would be greater, smaller or the same as that obtained in part **(b) (ii)**,

....

(ii) the value obtained for ρ would be greater, smaller or the same as that obtained in part **(c)**.

....
[2]

[Total: 8]

7 The IGCSE class is determining the mass of a metre rule using two methods.

Method 1.

Fig. 1.1 shows the apparatus used.

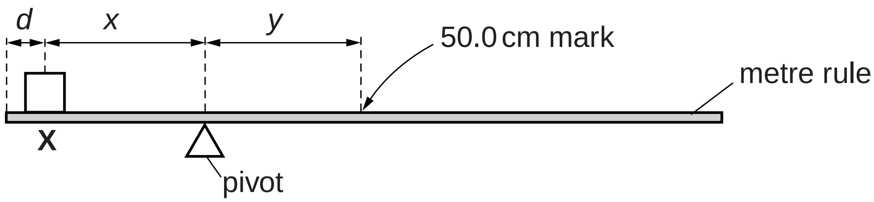

Fig. 1.1

A student places a 100 g mass **X** on the rule so that its centre is at a distance d = 5.0 cm from the zero end of the rule, as shown in Fig. 1.1. He adjusts the position of the rule so that it is as near as possible to being balanced.

He measures the distance x from the centre of the mass **X** to the pivot and the distance y from the pivot to the 50.0 cm mark on the rule.

He repeats the procedure using d = 10.0 cm.

The readings are shown in Table 1.1.

Table 1.1

d / cm	x / cm	y / cm
5.0	23.7	21.1
10.0	21.0	18.5

(a) **(i)** Using the values of x and y in the first row of the table, calculate the mass M of the rule using the equation

$$M = \frac{100x}{y}.$$

M = ...

(ii) Repeat step **(a)(i)** using the values of x and y in the second row of the table.

M = ...
[2]

(iii) Calculate the average value of M.

average value of M = ... [1]

Method 2.

(b) The student measures the mass *M* of the rule, using a spring balance as shown in Fig. 1.2.

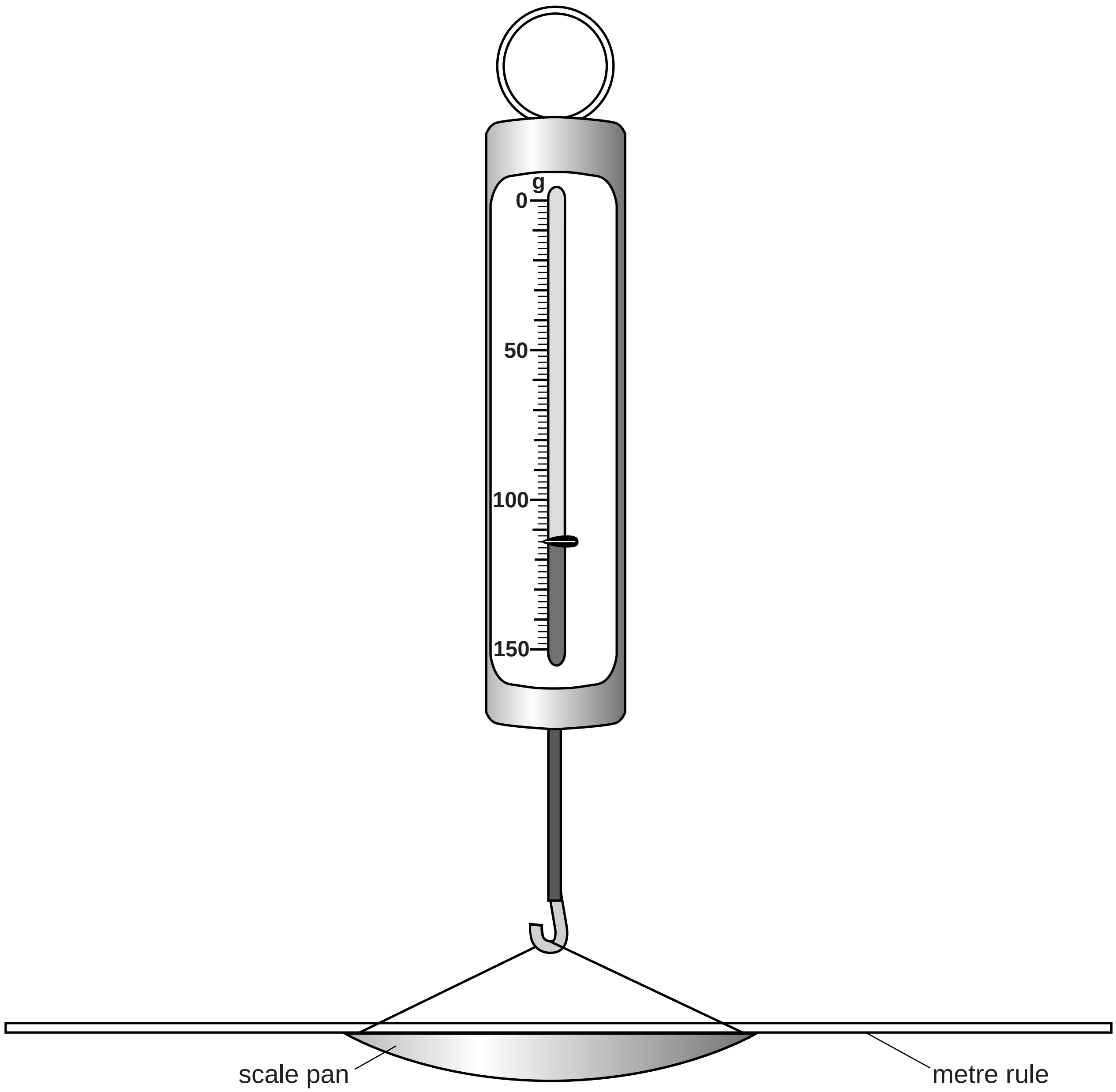

Fig. 1.2

Write down the reading shown in Fig. 1.2.

M = ... [1]

(c) The student expects that the values of the mass *M* obtained by the two methods will be exactly the same.

Suggest two practical reasons why, in spite of following the instructions with care, the values may differ. Assume that the balance used in Method 2 is accurate.

1. ....

....

2. ....

....
[2]

(d) Explain briefly how you would judge the position of the centre of the mass **X** when it is on the rule in Method 1. You may draw a diagram.

....

....

....[1]

[Total: 7]