STRETCHING OF SPRINGS

1 A student investigates the stretching of a spring.

The apparatus is shown in Fig. 1.1.

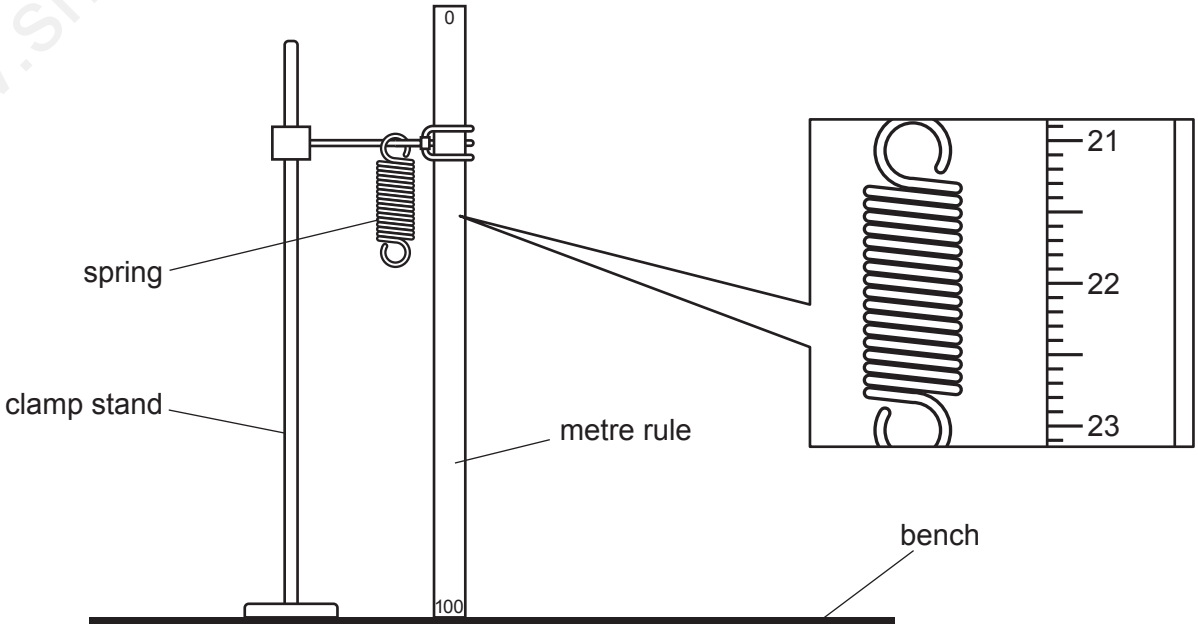


Fig. 1.1

(a) (i) On Fig. 1.1, take two readings from the metre rule to determine the unstretched length l_0 of the coiled part of the spring.

reading 1 ..... cm

reading 2 ..... cm

l_0 = ... cm
[3]

(ii) Draw a diagram to show clearly how you would use a set square to obtain an accurate reading from the metre rule.

[1]

(b) The student suspends a load of P = 1.0 N from the spring.

He records the new length l_1 of the coiled part of the spring.

l_1 = ... 2.2 ..... cm

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

e_1 = ... cm

Calculate a value for the spring constant k of the spring using the equation

$$k = \frac{P}{e_1}.$$

Include the unit.

k = ...

[2]

(c) The student suspends a load of P = 5.0 N from the spring.

He records the new length l_5 of the coiled part of the spring.

l_5 = ... 6.3 ..... cm

Calculate the extension e_5 using the equation $e_5 = (l_5 - l_0)$.

e_5 = ... cm

Calculate a second value for the spring constant k of the spring using the equation

$$k = \frac{P}{e_5}.$$

Give your answer to two significant figures.

k = ...

[2]

(d) State whether your two values of the spring constant k can be considered equal within the limits of experimental accuracy.

Explain your answer by referring to your results.

statement .....

explanation .....

.....

.....

[1]

(e) A student improves the experiment by taking additional sets of readings.

(i) Suggest the additional apparatus that the student uses.

.....

..... [1]

(ii) Suggest how the student uses the additional results.

.....

..... [1]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
1(a)(i)	21.3 (cm)	1
	22.8 (cm) (or the other way round)	1
	l_0 = 1.5 (cm)	1
1(a)(ii)	set square method clearly shown	1
1(b)	correct calculation of k; P divided by candidate's e_1 quoted to 2 or more significant figures	1
	N / cm	1
1(c)	e_5 = 4.8 (cm)	1
	k given to 2 significant figures	1
1(d)	statement to match results and explanation to match statement	1
1(e)(i)	additional load(s)	1
1(e)(ii)	plot a graph OR take an average	1

2 A student investigates the stretching of a spring.

Fig. 1.1 shows the set-up.

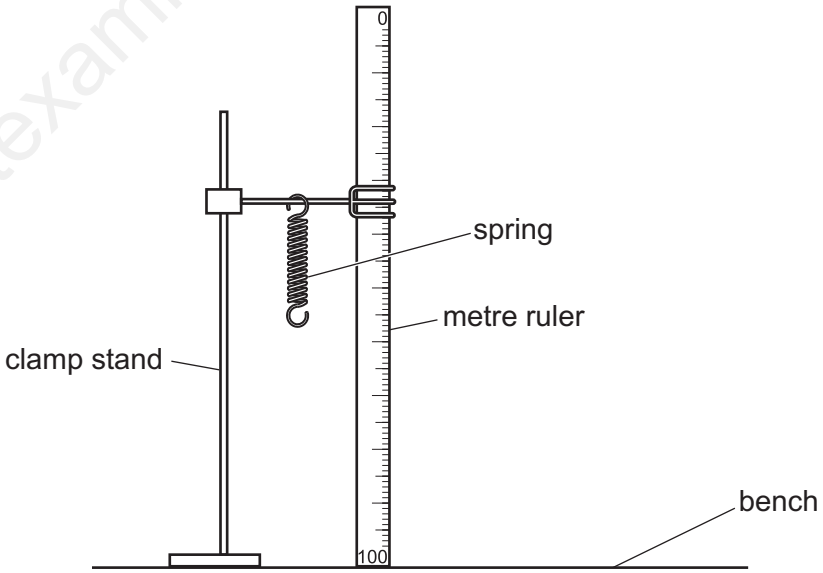


Fig. 1.1

(a) The value l_0 is the length of the spring when the load *L* is 0.0 N.

The student measures the length l_0 of the spring. She records l_0 = 16 mm in Table 1.1.

Draw a diagram of the spring to show clearly the length l_0 of the spring.

[1]

(b) The student suspends a load *L* = 0.20 N from the spring. She records the new length l of the spring in Table 1.1.

She repeats the procedure using loads *L* = 0.40 N, 0.60 N, 0.80 N and 1.00 N. The readings are shown in Table 1.1.

(i) Calculate the extension *e* of the spring for each load using the equation $e = (l - l_0)$.

Record the values of *e* in Table 1.1.

[2]

(ii) Complete the column headings in Table 1.1.

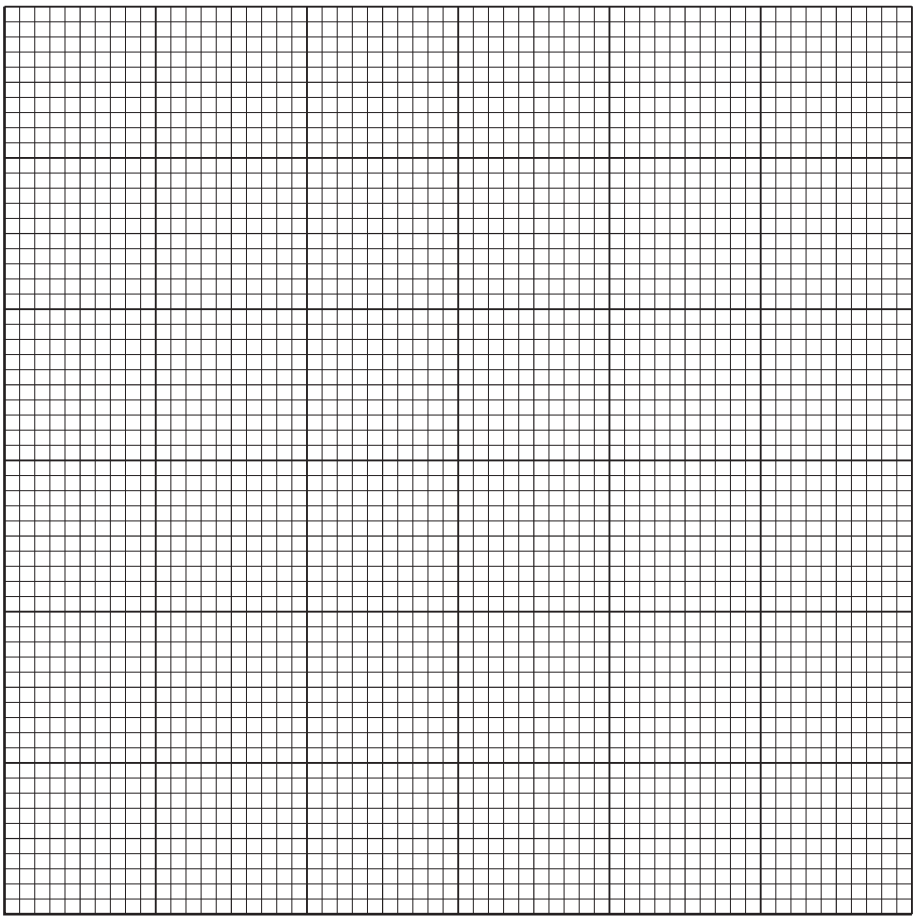
Table 1.1

L /	*l*/	*e* /
0.00	16	0
0.20	18	
0.40	21	
0.60	23	
0.80	24	
1.00	26	

[1]

(c) Plot a graph of *L* (*y*-axis) against *e* (*x*-axis).

Draw the best-fit line.



[4]

(d) Use the graph to determine e_A, the extension produced by a load of 0.50 N. Show clearly on the graph how you obtained the necessary information.

e_A = ... [3]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
(a)	diagram clearly showing the distance l_0 marked	1
(b)(i)	second *e* value: 2	1
	remaining *e* values: 5, 7, 8, 10	1
(b)(ii)	N, mm, mm cao	1
(c)	graph: • axes correctly labelled with quantity and unit and the right way round	1
	• suitable scales filling ≥ ½ the grid between the extreme plotted points	1
	• six plots correct to ½ small square – origin must be included	1
	• good line judgement, thin, continuous line	1
(d)	correct method shown clearly on graph	1
	candidate's value read correctly to ½ small square	1
	5.2 ± 0.2 (mm)	1

3 A student investigates the stretching of a spring.

Fig. 1.1 shows the apparatus.

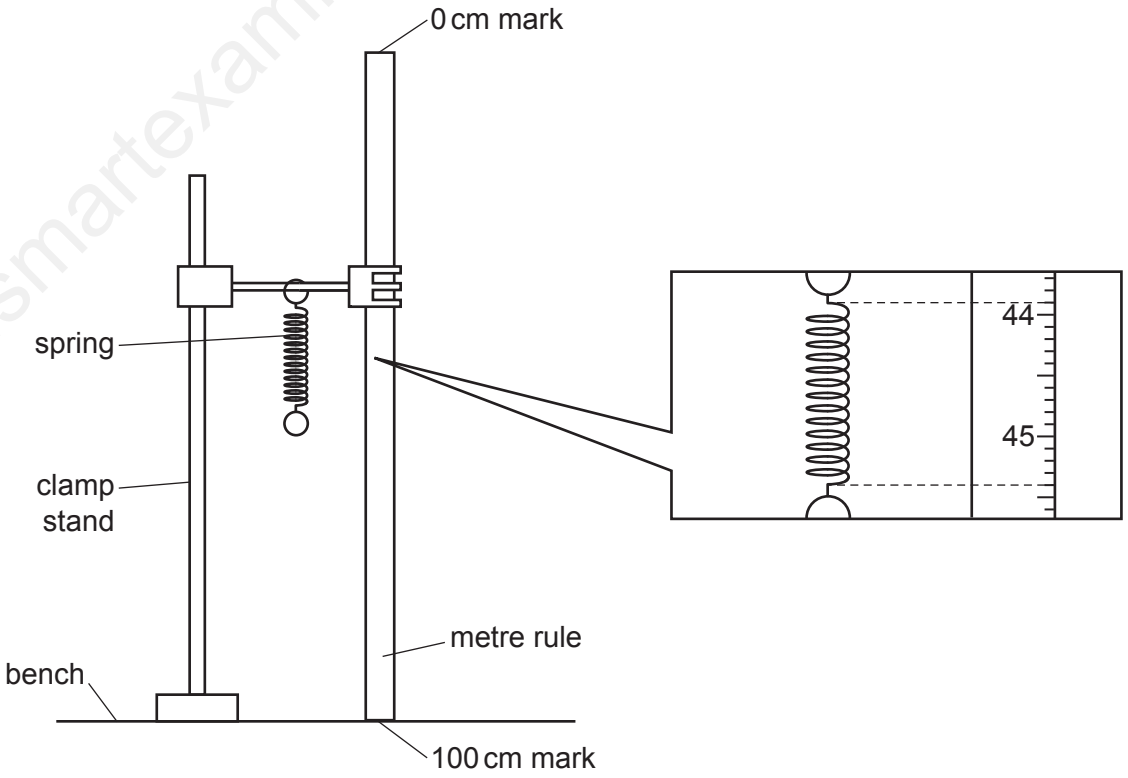


Fig. 1.1

(a) The metre rule is clamped in position near to the spring.

(i) Write down the scale readings in mm from the metre rule at the top and bottom of the spring, as shown in Fig. 1.1.

top reading = ... mm

bottom reading = ... mm
[2]

(ii) Using the two readings, calculate the length l_0 of the spring in mm. Record l_0 in Table 1.1. The value l_0 is the length of the spring when the load L = 0.00 N. [1]

(b) The student suspends a load L = 0.20 N from the spring. He records the new length l of the spring in Table 1.1.

(i) Use the equation $e = (l - l_0)$ to calculate the extension e of the spring. Record the value of e in Table 1.1. [1]

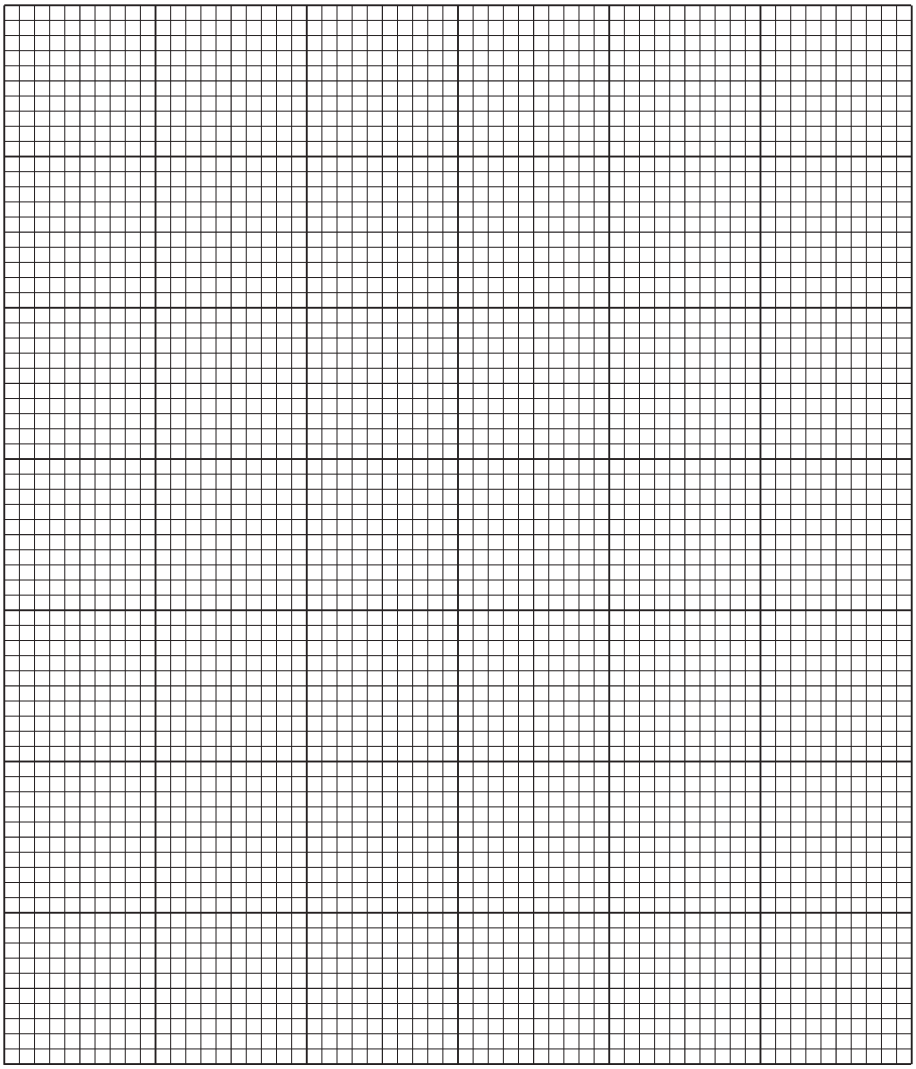
(ii) Complete the extension column heading in Table 1.1. [1]

(c) The student repeats the procedure using loads L = 0.40 N, L = 0.60 N, L = 0.80 N and L = 1.00 N. He records the readings and results in Table 1.1.

Table 1.1

L / N	l / mm	e /
0.00		0
0.20	17	
0.40	20	5
0.60	23	8
0.80	25	10
1.00	28	13

Plot a graph of e / mm (y-axis) against L / N (x-axis).



[4]

(d) Fig. 1.2 shows the unstretched spring and the spring with a load. On Fig. 1.2, show clearly the distances l_0, l and e.

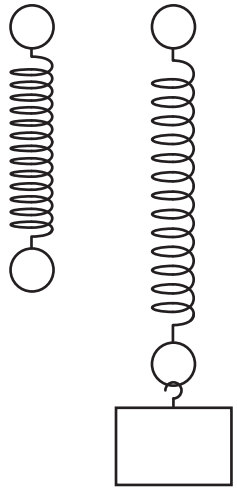


Fig. 1.2

[2]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
(a)(i)	439 / 43.9	1
	454 / 45.4 and both answers with correct unit	1
(a)(ii)	l_0 = top - bottom	1
(b)(i)	439 / 43.9	1
(b)(ii)	454 / 45.4 and both answers with correct unit	1
(c)	Graph: Axes correctly labelled with quantity and unit and right way round	1
	Suitable scales	1
	All SIX plots (including 0, 0) correct to ½ small square	1
	Good line judgement, thin, continuous line	1
(d)	l and l_0 clear and correct	1
	e clear and correct	1